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PREFACE

The ad'hoc FAO/ECE/FINNIDA meeting of experts on forest resource assessment was held, in accordance with the mandate of the Joint FAO/ECE Working Party on Forest Economics and Statistics and at the invitation of the Government of Finland, at the Kotka College of Forestry and Forest Industry from 26 to 30 October 1987. The papers delivered at the meeting are printed in this publication. They fall into the following three categories: Secretariat Papers, National Reports and Invited Papers. In addition, a report of the meeting including recommendations will be published separately.

Helsinki 15 December 1987

Aarne Nyyssönen

Director of the Finnish Forest Research Institute
Chairman of the meeting

Part I

SECRETARIAT PAPERS

منظمة الأغذية والزراعة للأمم المتحدة
联合国粮食及农业组织
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

September 1987

ECE/FAO/FINNIDA

Forest Resource Assessment Meeting

Objectives for International Resource Assessment

by
P. Wardle

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Accuracy and consistency of national data in international assessments

Introduction

Knowledge of forest resources is basic to consideration of policy for forests and fundamental to their management. The international assessment of forest resources has been foremost among the forestry concerns of FAO and ECE since their formation. The collection, analysis, interpretation and dissemination of information is a primary function in FAO's constitution. The broad aims underlying international assessments carried out by FAO and ECE may be summarised in the following three objectives.

The first objective of international work on forest resource assessment is to support national forest authorities in the development of an adequate information base for national policy makers, both in the forestry authority and at higher levels of government requiring information about the forest resource situation. The international assessment thus concentrates on the identification of essential topics, classification and definitionsand methodology of assessment and presentation.

Countries are interdependent on the optimum supply of their needs for forest products. Environmental subjects related to the state of forests such as oxygen and carbon dioxide balances know no national boundary. Sound national forest policy formulation must take account of the situation in other countries of the world. Few countries are able to assemble this essential international information. The international forest resource assessment has the second objective of making essential information available to all countries.

A third objective of international forest resource assessments is to provide basic information essential for international cooperation on the development of the forestry sector. It is essential to ensuring that sound information is available to the international community in securing awareness

of the forestry situation, and in mobilising the community to action as in the FAO Tropical Forestry Action Plan and in the policy formulation of national and international development agencies relating to the forestry sector.

Objectives and scope of previous international assessments

The objectives and scope of FAO and ECE assessments have evolved over the years, particular surveys reflecting in the detail that they handle issues which were of particular concern at the time. From their inception, however, these international assessments of forest resources have been orientated to the capacity of forests to supply products and to carry out their environmental functions.

Basic ideas about the reason for world forest resource assessment are provided by the introduction to "World Forest Inventory 1958". This introduction states that the formulation of a sound national forest policy requires as precise a knowledge as possible of the wood (forest) resources of the country. With increasing population and relatively fixed forest resources the study points to the need for world scale efforts to ensure forest output rises commensurately with world needs. Forest needs are by no means coterminous with forest resources. Hence the need arises for coordination of national forest policies. Nations and regions are interdependent with respect to meeting and supplying the needs for forest products. Forests are a repository of important raw materials but also play a decisive role in the agricultural economy, protecting croplands and regulating the water regime.

In Forest Resource Assessments published in 1976 the introduction stated the function of regional examination of the data of forests is to provide a basis for estimating their ability to meet requirements of the community of the region for products and services, and to indicate their potential to contribute to the economies of individual countries, to the region as a whole and to the world.

The Tropical Forest Resources, FAO/UNEP, 1982, states the following immediate objectives:

(a) to assess, at regional and global levels, the present state of closed tropical forests and woodlands and the rate and pattern of their depletion and degradation, as a prerequisite for the definition and implementation of the appropriate measures referred to in the long-term objectives;

(b) to determine the methodology and the means needed for the continuous updating of this first assessment.

Forest Resources of the ECE Region, 1985, was considered as a basic reference document for a wide range of research, planning and policy making in the forest sector.

The scope and primary focus of the assessments has evolved over the years. The 1958 World Forest Inventory indicates that to furnish all the elements necessary for policy formulation, the inventory should yield information on forested area, ownership, composition and management status, as well as estimates of standing timber, annual growth, fellings and removals.

Considering the most recent international forest resource assessments, Tropical Forest Resources and the the Forest Resources of the ECE Region:- Tropical Forest Resources, though it did not include specific data on ownership, did introduce consideration of forest other than closed forest, including forest fallow, mixed forest and grassland formations, and shrubs. Secondly it made specific assessment of change in forest area through deforestation and afforestation.

The 1985 ECE Assessment followed the earlier framework. There were, however, three important innovations, namely:- the attempt to assess forest biomass in addition to standing volume of stems and main branches to a certain size (diameter) limit; an assessment of the distribution of forest supplying environmental and other non wood goods and services and the inclusion of an assessment of trees outside the forest.

The common ground in the several statements of objective is that the world forest resource assessment provides the international reference material on forest resources for national, regional and international institutions in their policy making in relation to the forest sector. To fulfill current requirements of policy makers the basic information of the earlier world forest inventories is essential. In addition it is necessary that useful assessment of wooded lands other than closed forests is included, that there is an adequate assessment of change including deforestation, degradation and afforestation. Assessment of the extent of other uses than wood production is also highly relevant to policy development.

Considerations in reviewing objectives and scope

The above, in brief, is the position reached in international assessments of forest resources in providing information for policy. In reviewing objectives and scope for the next assessments it is well to consider major areas of concern relating to forests to ensure that the assessment will do its best to provide data for rational and informed policy formulation.

The following statement from the recent report of the World Commission on Environment and Development chaired by Prime Minister, Gro Harlem Brundtland, of Norway provides a lead: "The ability to anticipate and prevent environmental damage requires that the ecological dimensions of policy be considered at the same time as the economic,

trade, energy, agricultural and other discussions. They should be considered on the same agendas and in the same national and international institutions. This orientation is one of the chief challenges of the 1990s and beyond!"

Deforestation, erosion, depletion of ground water, species loss, desertification, precipitation and global warming are among the environmental issues relating to forestry identified in that report.

Specifically in the field of forestry the international community confronted by the alarming rate of destruction and degradation of tropical forest has adopted the Tropical Forest Action Plan (TFAP) to mobilise political, financial and institutional support and the involvement of local people to harness the forest resource potential to meet their development needs now and for the future.

The dependence of rural people in developing countries on forests and trees, their products and their services, and for the supply of household energy is the basis for programmes on forests, trees and people and wood for energy. Among the objectives of the newly formed International Tropical Timber Organisation (ITTO) are the support to the development of industrial tropical timber, reforestation and forest management activities, and the development of national policies aimed at sustainable utilisation and conservation of tropical forests and their genetic resources, and at maintaining the ecological balance.

Negative impacts on the forests of temperate countries of forest fires and atmospheric pollution are factors recognised as threatening the capacity of forests to deliver products and services the community needs and are prominent among international concerns.

Dimensions of forests and policy

In the broader discussion of policy and the assessment of forests many characteristics arise for which good quantitative information would help towards sound policy formulation. The precision and detail in which information is required increases as one moves from broad policy considerations towards planning and management decision making. There is perhaps a tendency when speaking of forest resource assessment to think first, almost exclusively, of timber characteristics and to omit from consideration characteristics relative to the environment, the service functions and the social context of the utilisation of trees and forest lands. Each consideration implies the identification of a different set of characteristics. Some of these are set out in the following:-

From the point of view of understanding the biological potential, the forest may be classified according to ecological, edaphic and climatic indicators. From the point of view of assessing economic and commercial potential, the area, stock of growing trees, and indications of utilisation such as species size and quality, features which indicate growth potential - increment and age - and features which indicate relative ease of commercialisation - accessibility for harvesting and management and nearness to markets - are relevant. Ownership, legal status and the degree of management development are important considerations. In assessing the total potential of forests and trees in fibre supply, forest and tree biomass in contiguous forest areas, in scrub lands, in small woodlots and in trees outside the forest - orchards, roadside and field trees, palms and bamboos - are all relevant.

Environmental considerations bring many dimensions into play. Considering oxygen, carbon dioxide balance, area, biomass volume and increment, and changes such as cutting, clearing and particularly burning are important. For protection of soil, avalanche control, watershed protection and the prevention of desertification, the area

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zones are important indicators. In relation to wildlife and conservation of species and ecosystems, the vegetation type, species composition, degree of disturbance and legal status are relevant considerations. From the point of view of recreation and amenity, the type of forest, its accessibility for people, species composition, legal status and degree of disturbance are relevant, as well as such very qualitative characteristics as their natural beauty.

For special economic considerations such as the forest in relation to agriculture and rural development, the extent of forest with pasture and providing fodder, areas under shifting cultivation, areas accessible for collecting fuelwood and for other forest products - fruits, mushrooms, plant material and for hunting - are relevant. Particularly important in this context are the trees outside the forest, orchards, palms, bamboo, roadside and field boundary trees and homestead woodlots. The forests treated as common, the scattered woodland and scrub are significant forest types. Of great importance to policy is an understanding of the legal status of such woodlands.

The assessment of change

In respect of all these different ways of viewing the forest, two types of information are required; first the assessment of the current situation and secondly the assessment of change. Both the existing state and the way in which it is changing are essential information to the sound formulation of policy. Once a policy is set, assessment of change is then the measure of the degree to which policy is being carried out. The emergence of unexpected change and the recognition of change of kinds not previously perceived are information for the process of policy formulation. In view of its importance, but greater difficulty of assessment, specific types of change and their relation to policy are discussed.

The Tropical Forestry Action Plan focusses on the destruction and degradation of tropical forest. This total process is made up of a complex of different types of change involving different agents and a multiplicity of situations with varying impact on the productive capability of the forest and its ability to perform environmental and other services. Samples from this spectrum of change include the clearance of virgin closed tropical forest and its conversion to other use. The clearance of logged forest, of open forest, savannah woodland, scrub and the conversion of the land to other use. All these types of clearance represent change from forest to other land use. There are then the partial changes: logging in previously virgin forest, destructive cutting in closed forest reducing it to open woodland, persistent overcutting of tree vegetation reducing it to scrub or coppice, shifting cultivation reducing closed forest to open woodland and forest fallow, burning and grazing reducing the stocking and preventing regeneration so that forests are reduced to open woodland, scattered trees and scrub woodland.

These changes represent shifts in area through the forest types and changes of the stock within types. These types of change may take place on any land types. In mountainous or hill lands and in water catchment areas they may have serious consequences for soil and water conservation. They have consequences for the stock, increment and availability of products of the forest. They may have consequences for the species composition, genetic conservation, the availability of other products than wood such as fruit and foliage and the habitat for wildlife may be effected. Precise identification of the impact of concern to particular policy areas requires specific identification of the characteristics of the change taking place.

Clearance of the forest may be followed by reafforestation. This involves a change in the stock situation and increment and productive potential and may alter the forest type and species composition. It may have impact on the genetic resources. There may be associated

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indeed the change from mature forest to young plantation may have impact on the recreational, amenity and wildlife aspects and on the service function relating to soil and water. Planting may be outside the forest in small woodlots, on field boundaries, roadsides, canals, with impact on wood supply, supply of fodder and fruits and on service functions such as shelter and water relations. Other types of change are those resulting from disaster such as from wind, fire, attacks of pests or disease, atmospheric pollution. Finally an important area of change affecting the ability to carry through policy is that relating to the ownership, legal status and management of forests.

Variations in priorities

This listing of some of the characteristics of the forest situation is provided as an indication of the intricate tissue of information on forest resources needed for policy formulation-resource management.. In particular countries,certain topics will have greater importance and the information will be required in great detail. Thus certain countries and regions in Europe and North America have recently been confronted by greatly increased incidence of forest damage attributed to air pollution. This has led to intense survey and assessment effort as well as special research to clarify the situation and relationships in working towards appropriate policy. In particular countries the issue of particularly endangered species of plant or animal or ecosystem leads to intensive review of the situation and the impact of changes in land use,sometimes in relation to quite small areas. On the other hand there are general characteristics of forest which require to be known in every country in order to formulate policy for the sector.

This brief exploration of the intricate tissue of forest resource information relating to policy illustrates the implications of the Bruntland report's admonition to consider these many dimensions in the agenda of forest resource assessment.

Establishing the framework for an international assessment

In designing a national or an international resource assessment these many issues must be addressed, the priority of information needs determined and a programme of assessment to meet these needs established. Our next and universal consideration is the availability and allocation of resources. The collection, processing and dissemination of information on forests requires the deployment of competent staff, the performance of appropriate surveys, remote sensing, aerial photography, ground survey ahd the associated organisation of survey teams, interpretation, mapping and data analysis. It requires serious organisation and significant investment in people, facilities and equipment. Substantial cost is involved and the programme must be tailored to deliver the priority information for policy formulation and management.

We are dealing here with international assessment which has two complementary and interrelated functions (i) the assembly of the essential information for an international appraisal of the forestry situation, and (ii) the promotion of adequate assessment of the forestry situation to meet the needs of each country and the dissemination of sound standards for national assessments.

It is clear that though the requirements of individual countries are paramount and that the international assessment would deal basically with questions essential to national assessments, it is also clear that the coverage and detail appropriate to meet the needs of individual countries will normally be much greater than appropriate to the international assessment, but will vary from country to country.

Quoting from the presentation of the 1947 assessment: "It has become evident that a comprehensive inventory of the world's forests requires a truly international approach entailing international acceptance

of definitions, as well as concerted and sustained efforts to encourage completion of adequate surveys", so that the information can be provided.

FAO, in conjunction with ECE and with UNEP, has carried out a programme of periodic international assessments on a world and a regional basis. In their preparation FAO and ECE have benefited from advice and review of the approach to the assessments and on the definitions to be employed, from international fora, expert groups and individual national experts. The evolution of the issues, of the situation of forests and of the means available for assessment requires that the approach to international assessment must be reviewed by competent experts from the many differing national situations. This is both to ensure the maintenance of the greatest possible degree of comparability within assessments and between successive assessments but at the same time to ensure that each new assessment takes full advantage of new developments in technology and responds to the changed requirements arising from social and economic change.

Topics to be included

This Forest Resource Assessment meeting is part of the process of consultation and review which will set the form for the 1990 assessment and the elaboration to be sought for future assessments. In order that this assessment will be able to pursue the objectives for international assessment sketched out in this paper, a first requirement is the establishment of an agreed standard basic framework for the assessment. The following are the main components:-
(i) a listing of topics recommended for consideration in national assessments covering environmental and social considerations as well as timber. From this a minimum list of topics appropriate to the international assessment is selected accommodating important differences between regions. (ii) Agreed definitions for the components of the

international assessment are established. (iii) An agreed approach to the international assessment is formulated relating, for example, to the timetable and the participation of countries with international organisations.

Selection of topics

Secretariat papers on the global framework, tropical and temperate zone assessments provide background on the topics and detail covered by past assessments,as well as a lead to the future. The paper on the scope will discuss detailed issues and the country statements will fill in a picture of the state of the art. By way of introduction to these discussions a number of issues are highlighted which arise from consideration of the objectives to be served. This is done in reference to the broad structure of the tropical and temperate assessments. (Table 1) In this discussion major issues giving rise to consideration of significant revision compared with previous assessments are raised first, followed by some more detailed points of compatibility between the different approaches.

TABLE I

Summary of Topics Covered by Forest Resources of the Tropics and Forest Resources in the ECE Region

TROPICS

Area Classification

Type of Forest

Natural	Plantation		
Coniferous	Broadleaved	Bamboo	
Closed	Open	Scrub	Fallow

Human Intervention/Economic/Political

Virgin	Logged	(Natural Plantation)
Managed	Unmanaged	(Fallow)
Operable	Inoperable	(Physical Reasons) (Legal Reasons)

Area Change Deforestation Plantations

Volume

ECE

Area Classification

Type of Forest

Coniferous	Non-Coniferous	
Closed	Other Wooded Land	Trees outside the Forest
(high forest, coppice)	(open, windbreaks, scrub)	
Age Class		

Human Intervention/Economic/Political

Public (state, other)	Private (industry, farm, other)	
Managed with plan	Controlled, no plan	No Control
Size of Holding		
Exploitable	Unexploitable	(National Parks, etc.) (Other)

Area Change

Volume Increment Fellings (removals, harvesting losses)

Biomass

Area by Function Wood production, protection, conservation, biological uses, recreation

Coverage of functions other than wood production

Concern for the environmental and social functions of forest lead to a need for assessment and monitoring of forests in these roles. Thus the assessment of the area of forests with significance for soil and watershed protection and the prevention of desertification is required. In the 1947 assessment: "It was recognised that there are, in many lands, large areas of denuded soils which ought to be reforested". Thus besides forest with a protective function there may be a concern to assess the area where afforestation is needed for protection.

The ECE assessment includes an estimate of area of forest with a protective role; the tropical assessment separates non-industrial plantations which include plantations for soil protection along with plantations for fuelwood and non wood products such as fruits and gum arabic. Inoperable natural forests due to physical reasons are also associated with protective functions.

Hunting and grazing are other functions carried out on forest land which have social and economic importance in both developing and developed countries. Recreation and landscape are also important service functions. These are estimated in the ECE assessment.

Conservation of genetic resources and ecosystems are of great social concern. In specific detail these can only be handled in detailed national or local surveys orientated to the status of particular species of animal or plant or ecosystem. In the tropical assessment reference is made respectively to virgin forest and to inoperable forest for legal reasons which includes national parks and nature reserves. The ECE assessment separates areas under the unexploitable area in national parks and nature reserves from physically or economically unexploitable.

There may be specific areas such as national parks and nature reserves which may be precisely identified and which correspond fairly

well to a policy concern "ecosystem conservation." In most of these broad environmental and social functions the boundaries are not precise and there is a tendency to the overlapping of multiple functions. It may

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the ECE assessment and to carry out broad estimates of the area of forest performing particular functions supported by descriptive assessments.

Footnote:-

The following quotation from the ECE enquiry on the role of forests in supplying environmental and other non wood goods and services illustrates the importance attached to these topics and the difficulty involved in such an assessment.

"Forestry serves many purposes. It is the task of forest policy to ensure that the various functions of the forests are fulfilled in a well balanced mix. Forestry produces goods such as wood, berries etc. and services such as soil protection, recreation, filtering of air and water, etc. These goods and services are all forest products and they have a value that we can try to describe in some way. For most of them, however, we cannot express that value in monetary terms or in any other uniform unit.

What is actually produced depends on the needs (protection against avalanches is only produced in mountainous regions where avalanches occur), on human regulations (regreation is only produced if the accesc to a piece of land is allowed) and on the capacity or properties of the area (certain rare birds need very special biotopes).

The forest resource appraisals undertaken by ECE/FAO are meant to be used as a tool in forest policy making. They have so far concentrated on wood production only. As discussed at the ad hoc meeting in May 1979, however, it is felt that future appraisals have to take into account the other functions of forests in addition to wood production. The two main purposes for such additional information are to indicate:

(1) what goods and services, in addition to wood, are produced in the forests and what is their importance. This is relevant for the proper appreciation of the role of forestry for economic and social welfare and as a tool in planning the utilization of forests;

(2) to what extent other functions than wood production may impose restrictions on wood production. This is relevant in the context of timber trends and prospects studies and as a tool in planning the utilization of forests.

The first purpose requires an identification of the 'other functions' of forestry and an indication of their importance. Proper tools for such an evaluation either do not exist yet or are still very inadequate. This is no use saying, however, that the evaluation problem is impossible to solve, since those who are responsible for land use policies have to take decisions, whether the necessary background information is available or not.

This enquiry, therefore, is an attempt to obtain a largely verbal description of the importance of other (non-wood) functions. Such a description should provide as good as possible a basis for comparison between various land use alternatives.

Forests and the community

Rural people are dependent on forests and trees for fuelwood and wood as raw matrial. They are also dependent on them for supplies of fruit, herbs, honey, wild life products and fodder. These supplies may come from closed forest but they frequently come from open forest, shrub, homestead woodlots and trees, orchards and trees on roadsides, river banks or on field boundaries. This makes the assessment of other wooded land and trees outside the forest of vital importance to consideration of the supply to rural communities. In many developing countries it is the most important source of forest supply.

The area of scrub and fallow is assessed in the Tropical Assessment but not the volume. The ECE Assessment includes open forest, small woodlots, scrub and trees outside the forest, and estimates of commercial volume and other biomass.

Ownership and legal status

In relationship to the ability to put policy measures into effect, the legal status of forest is an important factor. In the first instance, the ownership status, whether public forest owned centrally by the state or locally by the community or private forest owned by large property owners or enterprises, by farmers or by individuals, provides a good indication. There remains, however, very substantial areas of forest where the nominal owners have little effective control due to the exercise of common usage, either legal or defacto. Thus a further subdivision "subject to common usage" would be helpful in clarifying the actual institutional status of forest. This clearly raises basic problems of definition.

The area of ownership type is included in the ECE Assessment. This is dealt with through specific descriptions for each country only in the Tropical Assessment.

Volume and increment

The total tree volume has potential for utilisation. Its stratification into utilisation classes and qualities has importance for assessing particular industrial potential. As was mentioned, the volume from other wooded land may be as important or more so to rural communities than the "commercial volume" from closed forest. Thus the assessment of the biomass as well as commercial volume, from both closed forest, other wooded land and trees outside the forest, is needed for a complete assessment of forest resource potential.

Estimates of commercial volume and tree biomass are included in the ECE Assessment. The Tropical Assessment includes the growing stock of closed forest.

Footnote:-

The following quotation from the ECE enquiry into tree biomass illustrates the importance of this topic and the difficulty associated with assessment:-

"The forest resource enquiry is to collect information which will be partly in the form of estimates, on the volume and mass of tree and other woody biomass. This is an extension of the traditional forest inventory, which in most countries has been concerned with the volume of the stem and main branches down to a certain size (diameter), often that assumed to be the minimum usable for commercial purposes. With increasing need to optimize the use of the forest resource, notably since the escalation of oil prices after 1973, attention has been turning to the possibilities of harvesting and using a larger part of the forest biomass, including the biomass of trees outside the forest. An important step in that direction is a better knowledge about the extent of the hitherto uninventoried parts of the forest and tree biomass, both above and below ground. Many countries are now engaged on investigations to improve this knowledge. This special enquiry is intended to obtain some broad estimates."

Change

The monitoring of change is the most important but the most difficult part of forest resource assessment. Due to evolution of survey methodology, classifications and definitions and the imperfection of their application successive assessments are rarely comparable and, unless specifically designed to provide an estimate for change, cannot be used for that purpose. The Tropical Assessment includes an estimate of deforestation and plantation while the ECE Assessment includes a partial estimation of gross and net change in forest area for some countries.

Most straight forward is the assessment of clearance of mapped forest and afforestation and deafforestation, either from records or surveys. More difficult is the assessment of change due to irregular clearance, due to shifting cultivation and scattered felling and the degradation due to uncontrolled cutting, grazing and burning which result in the downgrading of the forest type and depletion of the growing stock. It is this type of change which is frequently most important from the points of view of supplies to local communities and the conservation of soil and water catchments.

Assessment of change which is significant in terms of particular environmental concerns - soil and water conservation, desertification, conservation of genetic resources or ecosystems require a basis in survey taking account respectively of specific physiographic or ecological detail.

Other types of change of environmental as well as economic importance include forest damage resulting from atmospheric pollution, fire and from pests or diseases.

The assessment of area change for the main forest types is essential. An estimate of change in growing stock may be derived from change in area of forest types. However more precise estimation of the impact of degradation requires a basis in special surveys. The attribution of change

to areas with particular environmental importance may be estimated in broad

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Assessment for timber production

Concerning the framework for assessment of forest resources for timber production, the main issue relates to the alignment of the classification and definitions between the Tropical and ECE Assessments to establish a common framework to the greatest extent possible. The main limitations arise from real differences in the type of forest and the possible absence of certain types of information, not derived from physical survey, for example on ownership, in some developing countries.

It would appear appropriate that differences in the detail appropriate for temperate as distinct from tropical, such as detail of species composition or the detail of functions of forest, will be retained and may be extended to subregions or even to individual countries.

Topics to support policy requirements

Summing up the discussion of information needs for policy formulation, information is required on area, volume and change.

Area

Assessment of forest types should be in sufficient detail to permit estimation of the resource and its capacity for production. Coverage of closed forest, open woodland, scrub, forest with shifting cultivation and trees outside the forest should be comprehensive because of the importance for production, for communities and for the environment. Both because of relevance to understanding production dynamics and

environmental relationships, a basis in a biological classification of forest types is relevant.

For purposes of assessing economic production potential, accessibility for production operations is an important dimension.

For effective design of policy instruments relating to the production, environmental and social functions of forests, the ownership, legal status and management control are important dimensions.

In relation to social and environmental policy, the area of forest serving major functions such as soil and watershed protection, prevention of desertification, biological conservation, range, hunting, recreation and landscape are dimensions with varying priority between countries.

Volume

Both commercial volume and total biomass are relevant parameters. Commercial volume, increment and drain are essential to assessing the immediate commercial potential of the forest. Biomass is relevant to productive potential, both commercially and for local communities' autoconsumption of fuelwood and material. Biomass volume increment and drain is relevant to macro assessments of biosphere and atmospheric dynamics.

Change

Deforestation, reafforestation and afforestation are important dimensions in relation to productive, environmental and social roles of the forest. Equally important is the change from one forest type, for example degradation due to felling, burning or grazing. Damage to the forest due to air pollution, fire, pest and diseases or wind may also be significant causes of change.

These then are topics that must be considered in designing national and international assessments of forest resources.

Accuracy and consistency of national data in international assessments

An important consideration in international assessments is the comparability of data provided by different countries. The data - if it is to be forthcoming - must be derived from assessments which will have their own priorities, definitions and underlying surveys. Thus there may be differences between the classification and definitions adopted for the international assessment and those underlying national data. National surveys may have a different reference date, information for some topics may be based on precise survey, while for other topics it is based on broad estimates. These issues will be discussed in detail under the agenda item on methodology.

The issues to be resolved will relate to the degree to which the differences in basis should be resolved by adjustment or accepted as inevitable discrepancies but highlighted in the presentation. One possibility perhaps worth exploring is that of separating magnitudes based on survey from magnitude derived from broad estimates. It is important that estimates for the area not covered by survey are included. Another possibility is to include statistics on the extent of survey coverage of different topics. In addition indication of methods of estimation and adjustment of data to meet the international assessment standards may be included.

There are important topics where precise survey data are not available. These will have to be covered by estimates. Where people feel uncomfortable in providing specific area estimates, it may be preferable to use a system of magnitude classes relating to the percentage of surveyed areas. This may apply to assessing areas serving particular functions.

Several of the topics, such as economic access and the protective and conservation functions of forest, have important geographical dimensions. These may relate to physiographic characteristics - topography, geology, river basins or to political geography, the location of towns, ports or infrastructure. Clearly within countries mapping and integrated geographical information systems are relevant. There may be discussion as to whether summary mapping is appropriate also to international assessments.

The message emerging from this review is that for the social and environmental topics relating to the forest as well as for the commercial production, the forest resource assessment provides relevant estimates of magnitude and change.

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联合国粮食及农业组织
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

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ECE/FAO/FINNIDA

Forest Resource Assessment Meeting

Concepts and Methodology of Tropical Forest Resources Assessment (1990)

BY

K.D. SINGH

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Chart A: Classification of Natural Woody Vegetation

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References

1. Introduction

The objective of the paper is to present the concepts and methodology of the tropical forest resources assessment for 1990 as envisaged by FAO. There is a separate secretariat paper which describes the proposed data-base design, analysis and the main output for this assessment.

Forest resources appraisals on a global basis are a part of FAO's mandate. Article I of FAO's Constitution, describing the functions of the Organization, states that "the Organization shall collect, analyse, interpret and disseminate information relating to nutrition, food and agriculture ... The term agriculture and its derivatives includes fisheries, marine products, forestry and primary forest products". Following a first survey of forest resources in 1946, i.e. only a year after the founding of FAO, the 6th Session of the FAO Conference in 1951 recommended that the Organization should, at five-yearly intervals, collect and publish available information on the forest resources of the world. Such surveys were accordingly carried out in 1953, 1958, 1963, 1976 and 1981. The next assessment is planned for the year 1990.

Within the Organization, the work of the global forest resources assessment is currently being shared between two divisions: the FAO/ECE Agriculture and Timber Division in Geneva covers the developed countries of Europe, the USSR and North America, which are essentially temperate; while the Forest Resources Division at FAO Headquarters in Rome carries out the assessment of forest resources in the developing countries, thus mainly covering the tropical region, plus subtropical and temperate regions found in these countries.

The last assessment of tropical forests, implemented by FAO/UNEP during 1979-81, deserves a special mention here, because this assessment, like the first one done in 1946, included a prior, in-depth study of problems involved; and the elaboration of a classification system and methodology, as described in the following section.

2. Information Categories and their Classification in the 1980 FAO/UNEP Assessment

A detailed discussion of this topic is available for reference in Lanly (1982). Therefore, only a brief account will be presented here.

2.1 Classification System

The FAO/UNEP data-base is organized hierarchically at three levels (Ref. Chart A): natural woody vegetation, forest formations and management classes. The first level (i.e. natural woody vegetation) includes forests, shifting cultivation, shrubs and other land uses. At the second level, forests are sub-divided into forest formations: natural and man-made (syn. plantations), the former being further divided into broadleaved, bamboo and coniferous forests. The broadleaved category is further split into closed and open forests.

At the third level various forest formations are broken down into the following five management classes:

Operable Forests

- Unmanaged
  - Virgin (i)
  - Logged (ii)
- Managed (iii)

Inoperable Forests

- Due to Physical Reasons (iv)
- Due to Legal Reasons (v)

The assessment contains information on: area, volume and change at the country or sub-country level, the latter particularly in the case of large and ecologically heterogeneous countries.

Three volume concepts are used in the assessment: VOB (volume overbark of free bole of all living trees more than 10 cm diameter overbark at breast height); AAC (annual allowable cut in case of managed forests only); and VAC (volume actually commercialized in respect of unmanaged forests).

The change information is of two types: deforestation and plantations. Deforestation is reported by vegetation types, forest formations and management classes.

Plantations are divided into two main groups: softwoods and hardwoods (syn. conifers and broadleaved) which are further sub-divided into industrial and non-industrial uses. The hardwoods are finally sub-divided into fast growing and others.

For plantations, areas are given at five-yearly intervals up to the end of 1980 and projected up to the end of 1985 by utility classes (Chart B).

2.2 Methodology of Assessment

The FAO/UNEP Tropical Forest Resources Assessment covered 76 tropical countries representing about 97% of the tropical forest area. A two step approach was followed for the creation of the database. As a first step, existing country data (in varying format) were collected through an intensive search of existing documents and maps, correspondence with individuals and institutions; and visits to selected countries and organizations. In some cases, where it was found that the existing information was weak or seemingly not very reliable, data was collected by interpretation of most recent Landsat imagery. The information collected was then re-appraised into standard FAO/UNEP classes, as indicated above.

Use was made of a standard system for classifying the area of natural woody vegetation; and of a uniform procedure for estimating volume in various area classes. Further, all area and volume figures were adjusted to a common reference date, namely the end of 1980, to make the data comparable at regional and global levels. Estimates were provided on the rates of change for the period 1976-80; and on the estimated rates of change for the period 1981-85.

The country briefs, which included standard statistical tables and a variety of other useful data and descriptive information about forests and forestry, constituted the basic reporting unit of the project. Country information was synthesized in the form of three regional reports (FAO 1981) and a global report (Lanly 1982).

The data-base was also computerized to make the access and processing easy (Singh & Lanly 1981). A system with an acronymn FORIS (Forest Resources Information System) was created to edit, store and retrieve data (see sample print-out attached, Chart C).

3. Approach to Tropical Forest Resources Assessment (1990)

3.1 Conceptual Background

For developing the 1990 assessment, an in-depth review was made of the world forest inventories implemented so far by FAO, starting from the first one in 1946 until the last one. Going through various documents, a gradual evolution of concepts and definitions can be observed. In the process, one also gets a definite impression that the 1980 assessment (i.e. the last one) constitutes a major landmark in the evolution of FAO's world forest inventories. This is true for the temperate as well as the tropical forest resources assessment, but epecially for the latter one, which differed from the earlier efforts in two main ways:

- an in-depth review was carried out of problems involved in the assessment of tropical forest resources; and a new system of classification, definitions and estimation procedures was developed; and

- assessment was carried out by a cohesive team of specialists under the supervision of an inventory specialist making use of all available data of a country.

The temperate forest resources assessment (1980) has been also considerably improved compared to previous inventories. In this case, however, information is based on questionnaires completed by chosen national focal points. The system seems to work in a satisfactory manner for the countries concerned.

Thus, for 1980 two different systems were used by FAO - one for the temperate and the other for the tropical forest resources assessment. This seems justifiable, as the landuse and forestry processes in these two zones are quite different. Some distinctive features of the tropical forests and tropical forestry are: deforestation, shifting cultivation, site and growing

stock degradation, lack of management, presence of large areas of mixed-species and mixed-aged forests, etc. This, coupled with the relative lack of reliable, nationwide inventories and lack of strong, local inventory institutions, calls for a special approach. The FAO/UNEP Tropical Forest Resources Assessment recognized these problems and this was one of the major reasons why it succeeded in breaking new grounds and coming up with reasonably reliable estimates of tropical forest resources; and of description of various, on-going processes of deforestation and degradation, receiving worldwide acceptance in both political (governmental and non-governmental) and scientific circles.

Since the completion of the FAO/UNEP Tropical Forest Resources Assessment in 1982, a review of concepts and definitions and an extension of the assessment to the remaining developing countries, has been continued by FAO's Forestry Department at HQ under its Regular Programme. Some work has also been carried out within the framework of a FAO Regional Project in Asia based in Bangkok with the participation of six countries of the region. A report on the subject has already been circulated to participants of the present meeting. The experiences gained so far indicate that considerations taken into account in the 1980 assessment remain valid also for the 1990 assessment and that the broad framework and methodology of the 1980 FAO/UNEP Tropical Forest Resources Assessment, with whatever further improvement and extension are possible, should continue to be used. There seems, however, a definite requirement that the tropical and temperate assessments identify the highest common data-base which could be pooled easily to produce a global synthesis to meet the needs of the international community.

3.2 Main Objectives

Keeping in view the above considerations, the main objectives of the forest resources assessment for 1990 are proposed as follows:

(i) Assess the forest resources of the tropical countries by end 1990; estimate changes that have taken place since 1980 and build alternative scenarios about forest changes by the year 2000.

(ii) Assess the forest resources of the non-tropical developing countries as done for the tropical countries.

(iii) Integrate the forest resources assessment of the developing countries with those of the developed countries and prepare a global synthesis.

(iv) Update FAO vegetation maps showing the distribution of main types of vegetation by eco-floristic zones at 1:5 million scale and integrate these with other ecological and socio-economic data as part of a geographic information system for undertaking location specific studies.

(v) Assess the environmental implications of deforestation and forest degradation with particular reference to fragile ecosystems of the tropical world (mountain systems, moist tropical forests, arid zone and coastal formations).

(vi) Disseminate the methodology of assessment to the developing countries.

3.3 Methodology and Classification

The assessment for 1990 will largely follow the methodology and classification used for the FAO/UNEP Tropical Forest Resources Assessment (1980) described earlier. Some improvements will consist in:

(i) expansion of scope to include information on some additional variables on demands of users of international statistics;

(ii) reorganization of the data-base to facilitate synthesis of the tropical with the temperate assessment;

(iii) use of geographic information system to estimate approximate distribution of vegetation and forest types by country and ecological zones and to study the environmental implication of deforestation and degradation.

Table 1 provides a comparative list of variable included in 1980 and proposed for 1990 assessment. A perusal of the table will show the close relation in the two assessments. Some new elements introduced relate to biomass estimation and ecological distribution of forest areas.

In the next assessment a distinction is made between the primary and supplementary data-base. The primary data-base constitutes the core of the assessment and provides the current, a backward and a forward look of the forestry situation in the country concerned. Thus, for the next assessment, 1990 will constitute the current, 1980 the past and 2000 the future reference years. The supplementary data-base is mostly concerned with one time data and intended to provide detailed information on some of the variables included in the primary data-base.

Some new concepts will be introduced in the 1990 assessment with a view to facilitating integration of tropical and temperate assessment. This will be a major concern of the Finland meeting on the subject and more ideas will emerge during the meeting.

During the next assessment, a study will be made of the possibility to use a geographic information system to obtain distribution of existing vegetation and forest types by ecological zones using an overlay of the following three data-bases in map-form:

- distribution of actual vegetation types

- limits of eco-floristic zones

- national boundaries.

An information system on the lines indicated above has already been developed for tropical Asia and Africa, while that for Latin America is under preparation. Such data-base is expected to be useful for a number of studies related to environmental functions of forests.

3.4 Expected Output

The following outputs are proposed for the next assessment:

- Country briefs for tropical and non-tropical developing regions containing information on the current status of forest resources, past trends and future prospects.

- Regional reports (five in all) containing a synthesis of country information at the regional level highlighting regional issues and problems.

- A global report containing a synthesis of regional information highlighting global issues and problems.

- Updated vegetation maps computerized and integrated with other ecological data-bases.

- Report on environmental implications of deforestation and degradation.

- Methodology for forest resources monitoring at national level of use to the developing countries.

4. Conclusion

In the light of the foregoing discussions, it would be obvious that for the 1990 assessment it is proposed (i) to use the same methodology and classification as for the 1980 assessment; (ii) to expand its scope to meet the demand of additional information, in particular related to environmental function of forests, and (iii) to adapt it to make a global synthesis of the tropical and temperate assessment possible.

Table 1: Comparison of scope of the 1980 with the 1990 (proposed) Tropical Forest Resources Assessment (TFRA)

Item	Scope in 1980	Proposed Scope in 1990	
	PRIMARY DATA-BASE		
I. Area data			
1. Vegetation types	yes	yes	
2. Forest formations	yes	yes	
3. Management classes	yes	yes	
II. Volume data			
1. VOB (Volume Overbark of all species up to 10 cm dbh	yes	yes	
2. VAC (Volume Actually Commercialized)	yes	yes	Retained as supplementary information
3. AAC (Annual Allowable Cut)	yes	yes	
4. Woody biomass above ground	no	yes	
III. Change data			
(1) Natural Forests			
Area deforested by forest formations during the last 5 years	yes	yes	(but for 10 year interval)
(2) Plantations			
Area by six utility and 5 year age classes	yes	yes	(but by species and 5 year age classes)

Table 1 (cont.)

	Item	Scope in 1980	Proposed Scope in 1990
	SUPPLEMENTARY DATA-BASE		
IV.	Other information		
1.	Area of managed forests by formation classes and their Annual Allowable Cut (AAC)	yes	yes
2.	Area logged annually by formation classes and volume actually commercialized (VAC)	yes	yes
3.	Ownership classes by forest formations	yes	yes
4.	Distribution of vegetation type and forest formations by ecological zones	no	yes
5.	Wood production data taken from FAO Yearbook of Forest Products	yes	yes
6.	Trees in non-forest lands		
(i)	area of permanent woody crops by main categories (FAO ESS data)	no	yes
(ii)	Homestead and village woodlots	no	yes
7.	Forest Degradation Risk	no	yes
8.	Non-wood forest products	yes	yes

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Chart A

Classification of National Woody Vegetation

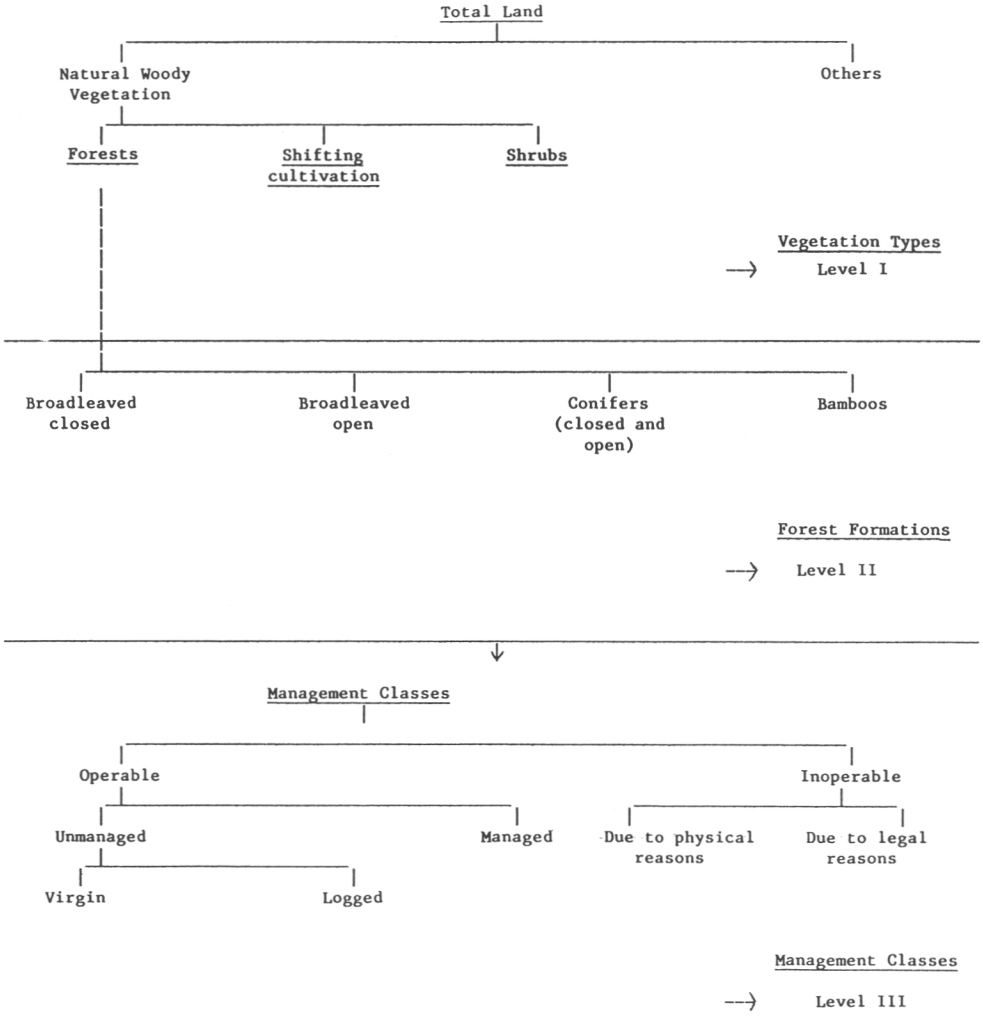


Chart B

Classification of Plantations

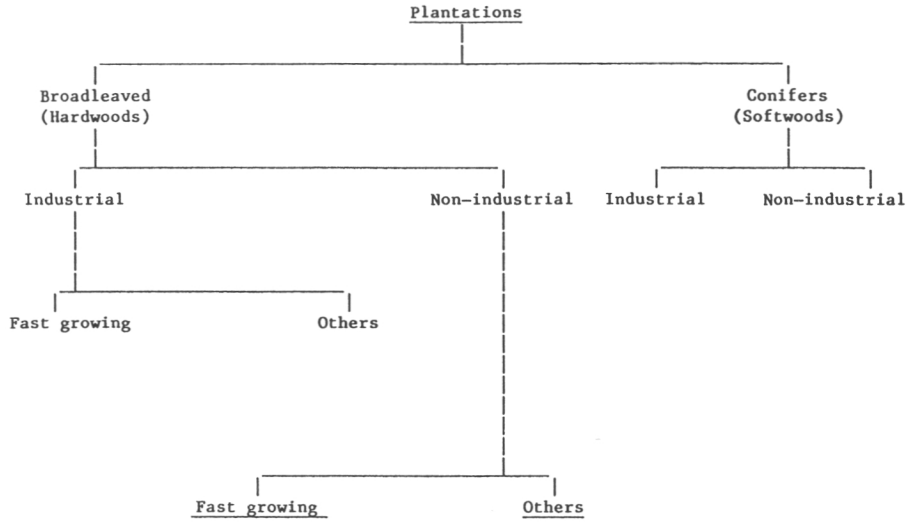


Chart C

Forest Resources Information System (FORIS)

Country: BURMA Year: 1980

	Areas (in 1000 ha)	Area Changes	Total Volumes (10^6 m3)
Total Land Area	65774		
- Wooded and Forest Land	52657	-9.9	
- Forests	31957	-104.7	
* Natural Forest	31941	-105.0	
- Broadleaved Closed	31193	-101.5	4521
- Operable	23116	-101.5	3794
- Unmanaged	19697	-3.0	3281
- virgin	14107	-235.4	2536
- logged	5590	149.0	745
- Managed	3419	-15.1	513
- Inoperable	8077	-€	727
- for Physical Reasons	7778	-€	-
- for Legal Reasons	299	0.0	-
- Bamboos	632	-3.0	-
- Operable	632	-3.0	-
- Unmanaged	632	-3.0	-
- virgin	620	-3.0	-
- logged	12	0.0	-
- Managed	0	0.0	-
- Inoperable	€	0.0	-
- for Physical Reasons	€	0.0	-
- for Legal Reasons	0	0.0	-
- Coniferous	116	-0.5	16
- Operable	116	-0.5	16
- Unmanaged	116	0.0	16
- virgin	88	-0.9	14
- logged	28	0.4	3
- Managed	0	0.0	0
- Inoperable	€	-€	€
- for Physical Reasons	€	-€	-
- for Legal Reasons	0	0.0	-
* Man-made Forest (Plantations)	16	0.3	
- Broadleaved	16	0.3	
- Under Shifting Cultivation	18100	94.8	
- Broadleaved Closed Areas	17560	91.8	
- Bamboos Areas	360	3.0	
- Coniferous Areas	180	0.0	
- Shrubs	2600	0.0	
- Non Forest Land	13117	9.9	

ECE/FAO/FINNIDA

Aspects of Temperate Forest Resource Assessment Relevant to Global Framework

by
V. Sokolov

Introduction

The main objective of the paper, amongst those mentioned in the background note relating to the provisional agenda of the meeting, is to analyse the recent FAO/ECE enquiry on the forest resources of the ECE region so as to:

(1) show the difficulties experienced by the ECE member countries in providing reliable information for certain parts of the enquiry;

(2) present the structure and methods of forest inventory data collection in the ECE region with emphasis on the forest elements needed for the World Forest Resource Assessment (WFRA) and, at the same time, to suggest possible innovations such as assessment of forest biomass and forest distribution according to the supply of environmental and other non-wood goods and services. It seems to be essential to come to a common solution on aligning national classifications and definitions and those of the FAO/ECE Forest Resources of the ECE Region (Europe, the USSR and North America) on the basis of experience in carrying out previous forest assessments;

(3) make the appropriate proposals on the form and structure of the questionnaire of the WFRA. The establishment of a WFRA questionnaire which should achieve conformity between country and regional data will be the most important part of the discussion in this paper.

The opportunity of bringing together experts from the ECE region as well as other regions should be fully utilized so as to ensure that everyone contributes his experience and opinions to the drawing up of a realistic outline for the WFRA. It should be made clear that the proposals put forward by the ECE and FAO secretariats in this and other background papers are intended as a basis for discussion and should not be seen as their view of the final recommendations.

The Forest Resources of the ECE Region (Europe, the USSR, North America)

This publication was prepared under the auspices of the Joint FAO/ECE Working Party on Forest Economics and Statistics. It was published in July 1985 with the symbol ECE/TIM/27. At its forty-third session in October 1985 "the Timber Committee warmly welcomed the publication of the study, which it considered was a basic reference document for a wide range of research, planning and policy making in the forest sector".

There are three parts of the publication:

Part I - General forest resource inventory data

Part II - The volume and mass of tree and other woody biomass

Part III - The role of the forest in supplying environmental and other non-wood goods and services.

Part I "General forest resource inventory data" brings together the latest general forest inventory data from the countries of the ECE region.

The original enquiry form for Part I consisting of 12 tables together with the terms and definitions used in the survey are attached in Appendix I and II (p. 198 and 202 of the FAO/ECE publication) 2/.

Part I covers the following aspects and elements:

(1) Land classification (diagram 1), tables 1, 2, 3

(2) Ownership, management status, number and size of holdings (diagram 2), tables 4 and 5

(3) Age-class of predominately even-age stands, table 6

(4) Forest and other wooded land by recognized major functions (diagram 3), table 7

(5) Changes in land-use, table 8

(6) Standing volume and growing stock (diagram 4), table 9

(7) Annual increment (diagram 5), table 10

(8) Growing stock and net annual increment by main species in exploitable closed forest, table 11

(9) Fellings and removals (diagram 6), table 12.

As can be seen, practically all forest aspects and forest elements, which are closely connected and interdependent, are presented in the publication.

Looking through the final published results of the survey (Part I), we can see that each group of tables is followed by "Notes and comments" explaining or qualifying the data given in the tables. The information is presented first at the aggregated level in the tables and then becomes increasingly specific. The most degree of detail is for exploitable closed forest, for which the statistics are generally the best in quality and coverage. Where specific information is available for only a few countries, special tables were prepared.

The first, general impression of the publication is of two kinds. On the one hand, there are some forest areas where the information is rather comprehensive and reliable; on the other hand, there are other forest areas where the ECE member countries experienced difficulties in supplying forest inventory data or misunderstood the intentions of the enquiry.

Furthermore, there were many problems with terms and definitions of forest elements.

What were the main difficulties for the ECE countries in supplying reliable information on forest inventory? We can divide these into two groups: common and specific difficulties.

There were two common areas of weakness:

(1) Difficulties in the timing of countries' forest inventory activities, which meant that country data do not relate to the same period. This created considerable problems in trying to collect forest inventory data which were comparable between one country and another and even between one period and another in the same country. It is doubtful if this problem can be overcome in the 1990 WFRA. The only way to solve it would be to try to set a certain period of time (for example 1980-1990) and to establish an FAO/ECE computerized system of the forest inventory situation with a data base for all countries which could be continuously up-dated by countries supplying resuts of their latest inventories as they become available. The creaction of such a system is under preparation now and will be discussed at the meeting.

(2) In many cases the definitions applicable to the data provided by the countries differed from those given in Appendix I under "Terms and definitons". As a result, a large number of "Notes and comments" follow each group of tables in the publication which made it difficult to avoid discrepancies since definitions and classfications were usually based on, for instance, determination of distribution of area between coniferous and non-coniferous or subjective assessments of land-use and on how much of the wood biomass growing on a given area should be considered as a tree crop. These aspects ought to be discussed in depth at the meeting, and all countries' methodologies of forest inventory and their approaches to this subject, including the adopted national terms and definitons of forest elements, should be taken into account as much as possible. As a final result of the discussion, some clear criteria on the classification and definitions of the forest elements needed for WFRA should be established.

It can be seen that the structure and coverage of the enquiry is rather complicated. Some countries of the ECE region were not in a position to provide full and reliable information or even estimates for each table of the enquiry. There were some cases where official data were lacking or out of date. Amongst the weakest areas where countries experienced difficulties, the following may be mentioned:

(a) Structure of holdings of forest and other wooded land (table 5 of the original enquiry)

The main problem was to provide reliable and up-dated information on size of holdings of privately owned forest; at the same time the information on the public sector was fairly full and reliable.

(b) Stocked exploitable closed forest by age-classes (table 6)

The information on the age-class structure of stocked exploitable closed forests by main commercial species groups and forest type is particularly useful for forest policy makers and managers. It is necessary to have such information for the planning of the desirable structure of forest stands with the highest productivity as well as of the forest operations needed for forest management as a whole. In other words it helps to increase forest efficiency and levels of utilization.

Unfortunately, many temperate zone countries were not able to provide data on this subject. Probably the same problem would arise for the countries of other regions.

(c) Changes in land-use (table 8)

Perhaps surprisingly, this subject was the weakest in the enquiry. Few countries were able to show the main changes in forest coverage over a period of time resulting from such actions as removal of forest cover for use of the land for some other purpose than forestry, afforestation or conversion of other wooded land to closed forest. Many countries did not even have such change data. It was left to countries to select their own periods over which to report changes, but even so this did not seem to help greatly. It seems necessary to devise a different approach to change statistics in future enquiries.

(d) Growing stock and net annual increment by main species in exploitable forest (table 11)

The purpose of this table was to supplement the general information on growing stock and net annual increment in previous tables with details for the main commercial species. As was mentioned before, the lack of information on the main commercial species created difficulties in covering this aspect adequately.

Thus, the four mentioned forest inventory aspects or areas represented by four tables out of twelve are considered as difficult and complicated to some extent for the ECE countries. Many of them were unable to cope with the task of providing reliable and/or full information. It could be that this task would be even more difficult for many of the countries of other regions. However, it does not mean that these questions should not be thoroughly discussed at the meeting.

Taking into account the main objectives of the World Forest Resource Assessment, which are well presented in the background notes to the provisional agenda of the meeting, and the above mentioned comments based on the analysis of the ECE/FAO forest resource enquiry. as well as the results of close cooperation in this field between the ECE and FAO secretariats, the following recommendations and proposals on the form and structure of WFRA can be presented for consideration and discussion.

PART I - OVERALL LAND CLASSIFICATION

This is shown in diagram 1 which is covered by either three tables (the first version) or two (the second version).

The first version

The three tables are practically the same as in the previous ECE/FAO enquiry with small modifications in table 1, where "Closed forest" and "Other wooded Land" elements are excluded in order to avoid repetition with table 2.

Terms and definitions are considered the same as in the ECE/FAO enquiry with the exception of "Other land" for which a definition is needed.

The second version (combination of table 1 and 2)

II FOREST AND OTHER WOODED LAND BY OWNERSHIP AND MANAGEMENT STATUS
(diagram 2 and table 4)

Unchanged

III FOREST AND OTHER WOODED LAND BY RECOGNIZED MAJOR FUNCTIONS
(diagram 3, table 5)

Taking into account the growing interest in other forest functions other than timber production, it seems to be reasonable to include this aspect in WFRA.

More information and recommendations on this subject is expected to be given by Mr. K. Janz (Sweden).

IV STANDING VOLUME
(diagram 4, table 6 and 6A)

The previous table 9 of the ECE enquiry is divided into two for better understanding and with the purpose of obtaining additional species information. Whereas before the detailed information was asked in respect of standing volume (= growing stock and dead trees), experience showed that countries can generally provide this information for growing stock rather than standing volume. A modification has therefore been proposed to table 6 to reflect this situation.

V ANNUAL INCREMENT
(diagram 5, table 7)

Unchanged

VI FELLINGS AND REMOVALS
(diagram 6, table 8)

There are two possibilities concerning the previous ECE/FAO table 12.

The first is to leave it as it is with the division of Total fellings and removals into commercial and other cuttings; while

The second is to obtain the information on Total felling and removals only.

This is a question for discussion.

PART II - THE VOLUME AND MASS OF TREE AND OTHER WOODY BIOMASS

The original enquiry form is presented in Appendix III, page 208 of the FAO/ECE publication.

Over the past decade there has been increasing interest in using a larger part of the forest biomass both as a source of raw material and of energy.

The results of the enquiry on this problem have been published in Part II of the FAO/ECE publication. This was the first attempt to collect comparable and comprehensive data on an international basis and can be considered rather satisfactory and worthwhile as a first step in a process of improving knowledge of the forest biomass resource of the ECE region.

It would be a worthwhile experiment to include this question in the WFRA, despite the difficulties that could be expected for some of the other countries than the ECE to provide reliable and full data. Anyway this is a question for discussion and consideration. As a first step a simplified variant could be proposed; i.e the estimation of tree biomass of the inventoried part only.

The general picture of the relationship of woody biomass components is shown on figure 1 and chart 1.

PART III - THE ROLE OF FOREST IN SUPPLYING ENVIRONMENTAL AND OTHER NON-WOOD GOODS AND SERVICES

The enquiry form for Part III is shown in Appendix IV, page 213 of the FAO/ECE publication..

More detailed information on this subject will be given by Mr. K. Janz.

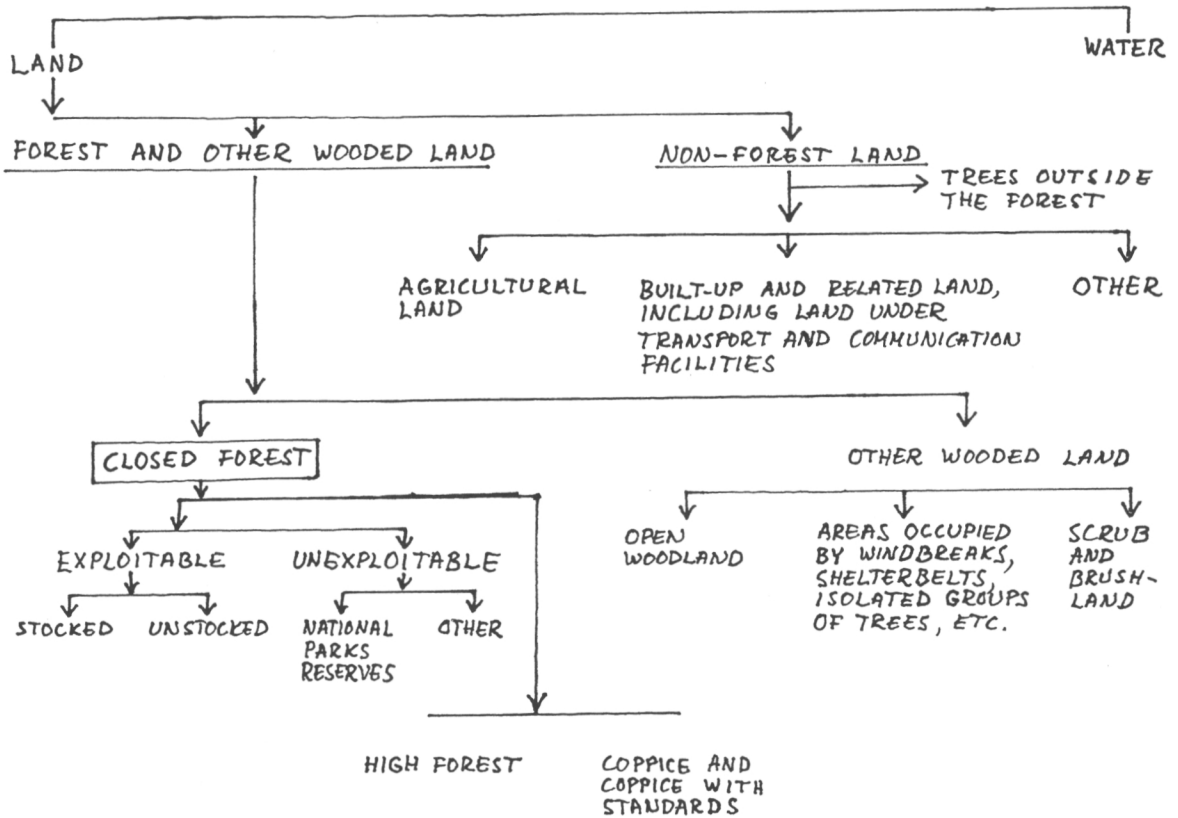
In addition to the questions mentioned in the paper a list of problems has been prepared by the secretariat which can be discussed by the participants.

Problems

1. "Exploitable" as applied to e.g. USSR and Canada
   - possibly introduce a sub-item to cover their situation.
2. "Coniferous" and "non-coniferous". Need to standardize definition to distinguish area. Mixed forest. Clear definition is needed.
3. Growing stock. Biomass estimation. Needs to develop a common bais of measurement or at least a method to convert national data based on national basis to a common basis unit (table 9, footnote a/).
4. Increment. The above (3) applies also to increment.
5. Multi-layer forest. Is consideration of this type of forest needed or not?
6. Information on GS and increment by quality. As a minimum, need to know something about dimensions; if possible also about quality, at least of larger dimensions.
7. Distribution. Possibly by use of maps.
8. Economic zoning. Possibly as sub-divisions of "exploitable". See 1 above.
9. Quality site. Definition and consideration are needed.

DIAGRAM 1. OVERALL LAND CLASSIFICATION

TOTAL AREA



I VERSION

Table 1

OVERALL LAND CLASSIFICATION

Purpose of table: To show the area of forest and other wooded land within the total land area of the country

Country:.....

Period/year to which data relate:.....

Description	AREA (1000 ha)
TOTAL AREA	
- WATER	
- LAND	
- FOREST AND OTHER WOODED LAND	
- NON-FOREST LAND	
- AGRICULTURAL LAND	
- BUILT UP AND RELATED LAND, INCLUDING LAND UNDER TRANSPORT AND COMMUNICATIONS FACILITIES	
- OTHER	

Solid lines shown in the tables indicate that the same information is requested in another table. Respondents should therefore make sure that those figures are the same in the two tables.

I VERSION

Table 2

FOREST AND OTHER WOODED LAND BY TYPE AND SPECIES GROUPS

Purpose of table: To provide a broad categorization of the area of forest and other wooded land by main tree cover groupings and species

Country:.....

Period/year to which data relate:.....

Description	Total	Coniferous a/	Non-coniferous a/
	(1000 ha)		
Forest and other wooded land			
- Closed forest			
- High forest			
- Coppice and coppice with standards			
- Other wooded land			
- Open woodland			
- Areas occupied by windbreaks, shelterbelts, isolated groups of trees, etc.			
- Scrub and brushland			
Trees outside the forest b/			

a/ State basis on which distribution of area between coniferous and non-coniferous is determined:.....

.....

.....

b/ Lines of trees along roads, canals, streams, etc. should be converted to area using a factor of 0.8 ha per 1,000 m. Area occupied by other trees outside the forest should be included, where possible to estimate.

I VERSION

Table 3

Purpose of table: To obtain more detailed data on exploitable and unexploitable closed forest,

CLOSED FOREST BY MAIN CATEGORIES

Country:.....

Period/year to which data relate:.....

DESCRIPTION	TOTAL	CONIFEROUS a/	NON-CONIFEROUS a/
	(1000 HA)		
CLOSED FOREST			
- EXPLOITABLE (OPERABLE)			
- STOCKED			
- UNSTOCKED			
- UNEXPLOITABLE (INOPERABLE)			
- NATIONAL PARKS AND NATURE RESERVES			
- OTHER			

a/ Distribution of area between coniferous and non-coniferous should be on same basis as in table 2.

PURPOSE OF TABLE: TO SHOW THE AREA OF FOREST AND OTHER WOODED LAND WITHIN THE TOTAL LAND AREA OF THE COUNTRY

TABLE

II VERSION

FOREST AND OTHER WOODED LAND BIOTYPE AND SPECIES GROUPS WITHIN THE OVERALL LAND CLASSIFICATION

COUNTRY: .....

PERIOD/YEAR TO WHICH DATA RELATE: .....

DESCRIPTION	TOTAL (1000 ha.)		
TOTAL AREA OF THE COUNTRY			
- WATER			
- LAND			
- NON-FOREST LAND			
- AGRICULTURAL LAND			
- BUILT UP AND RELATED LAND....			
- OTHER			
	TOTAL	CONIFEROUS a/ (1000 ha.)	NON-CONIFEROUS a/
- FOREST AND OTHER WOODED LAND			
- CLOSED FOREST			
- HIGH FOREST			
- COPPICE AND COPPICE WITH STANDARDS			
- OTHER WOODED LAND			
- OPEN WOODLAND			
- AREAS OCCUPIED BY WINDBREAKS, ETC..			
- SCRUB AND BRUSHLAND			
- TREES OUTSIDE THE FOREST b/			

a/ State basis on which distribution of area between coniferous and non-coniferous is determined:.....

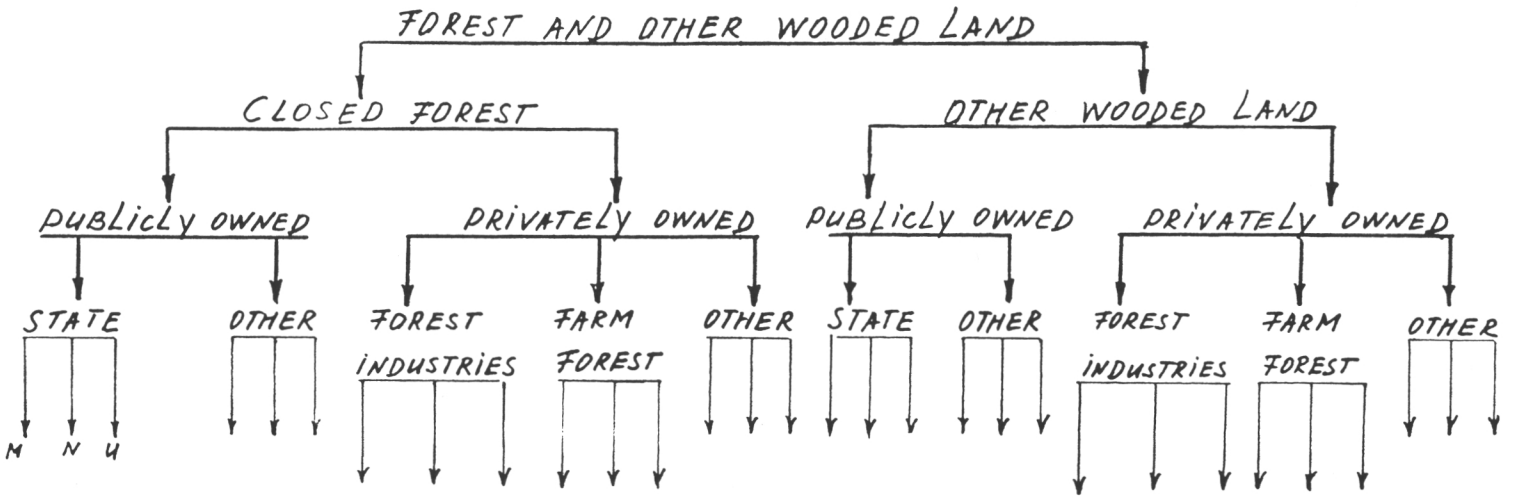
.....

b/ Lines of trees along roads, canals, streams, etc. should be converted to area using a factor of 0.8 ha per 1,000 m. Area occupied by other trees outside the forest should be included, where possible to estimate.

Solid lines shown in the tables indicate that the same information is requested in another table. Respondents should therefore make sure that those figures are the same in the two tables.

DIAGRAM 2

FOREST AND OTHER WOODED LAND BY OWNERSHIP AND MANAGEMENT STATUS



M - LAND MANAGED ACCORDING TO A PLAN

N - LAND NOT MANAGED ACCORDING TO A PLAN BUT HAVING CONTROLS RELATING TO MANAGEMENT OR USE

U - LAND HAVING NO CONTROLS RELATING TO MANAGEMENT OR USE

Table 4.

FOREST AND OTHER WOODED LAND BY OWNERSHIP AND MANAGEMENT STATUS

Purpose of table: To obtain information on: a) the distribution of forest and other wooded land between the main categories of public and private ownership; and b) the extent to which it is being managed or is under some form of legal control

Country:.....

Period/year to which data relate:.....

Description	Data in ETTS III				~~Latest data~~			
	Total	Land managed according to a plan	Land not managed according to a plan but having controls relating to management or use	Land having no controls relating to management or use	Total	Land managed according to a plan a/	Land not managed according to a plan but having controls relating to management or use b/	Land having no controls relating to management or use
	(million ha)				(1000 ha)			
Closed forest								
- Publicly owned								
- State								
- Other								
- Privately owned								
- Forest industries								
- Farm forest								
- Other								
Other wooded land								
- Publicly owned								
- State								
- Other								
- Privately owned								
- Forest industries								
- Farm forest								
- Other								

a/ Describe the official status, if any, of plans (e.g. whether approved by national or other official body:).....

.....

b/ Describe the nature of such controls:.....

.....

Table 5

ESTIMATES OF FOREST AND OTHER WOODED LAND BY RECOGNIZED MAJOR FUNCTIONS

Country:.....

Period/year to which data relate:.....

Purpose of table: To obtain a broad indication of the sub-division of forest and other wooded land according to three main recognized functions. It is understood that for some countries a degree of subjective judgement will be required to complete the table

Function a/	Total forest and other wooded land	Exploitable closed forest	Unexploitable closed forest	Other wooded land
	(1000 ha)			
Total				
of which:				
- With wood production the recognized major function				
- With protection, conservation and biological uses the recognized major functions				
- With recreation the recognized major function				

a/ Describe briefly the basis on which the estimates were made and comment on their relevance as indicators of the functions of the forest:.....

.....

.....

.....

DIAGRAM 3

FOREST AND OTHER WOODED LAND BY RECOGNIZED MAJOR FUNCTIONS

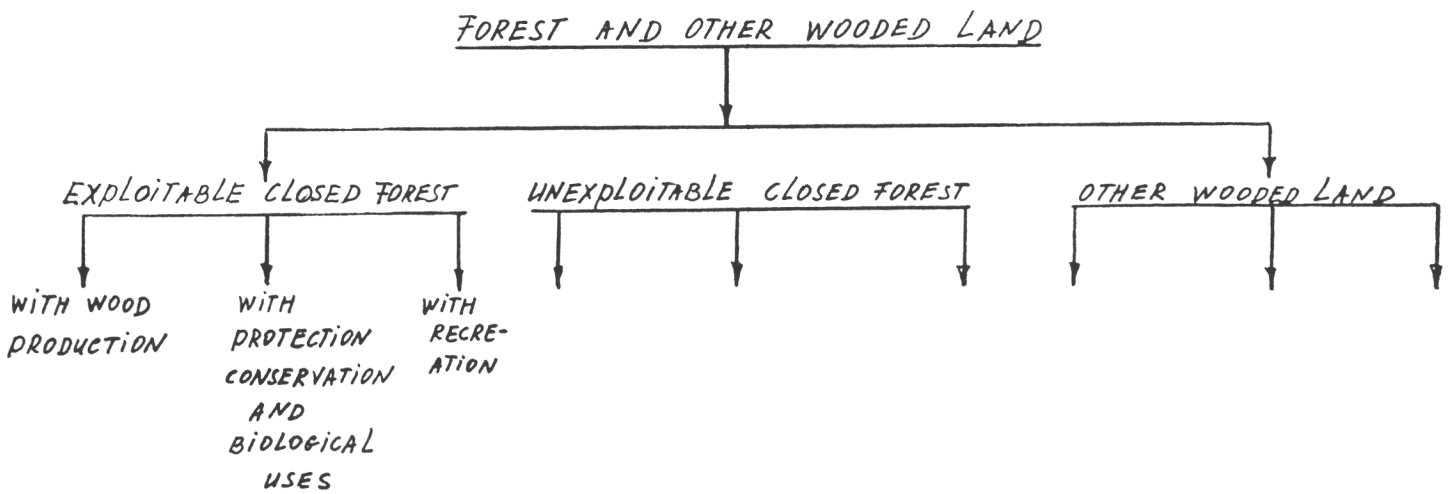
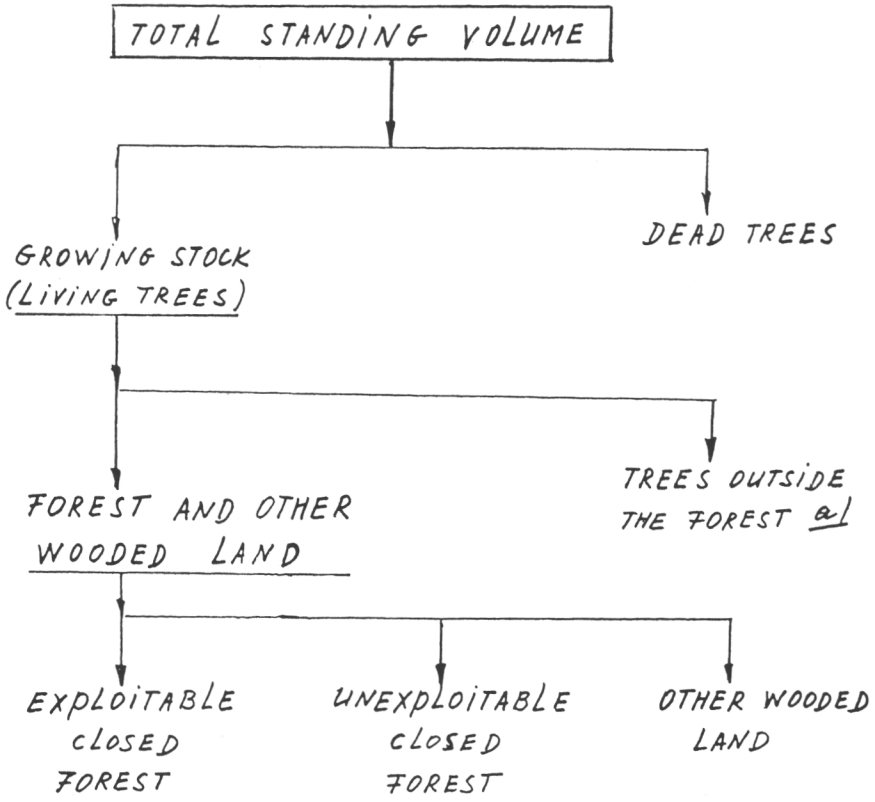


DIAGRAM 4

STANDING VOLUME



a/ GROWING STOCK OF TREES OUTSIDE THE FOREST CAN BE CALCULATED BY DEDUCTING GROWING STOCK ON FOREST AND OTHER WOODED LAND, TOTAL VOLUME FROM TOTAL GROWING STOCK (LIVING TREES)

Purpose of table: To obtain information on the standing volume (growing stock) according to species groups and broad categories of forest and other wooded land; also on standing volume on trees outside the forest. It is particularly important for the foot-note to be completed so that the basis of measurement is clearly defined

Table 6

STANDING VOLUME (including growing stock)[a/]

Country:.....

Period/year to which data relate:.....

DESCRIPTION	TOTAL	CONIFEROUS	NON-CONIFEROUS
	(million m3 overbark)		
TOTAL STANDING VOLUME, OF WHICH:			
- DEAD TREES			
- GROWING STOCK (LIVING TREES)			
— FOREST AND OTHER WOODED LAND			
— EXPLOITABLE CLOSED FOREST			
— UNEXPLOITABLE CLOSED FOREST			
— OTHER WOODED LAND			
— TREES OUTSIDE THE FOREST			

a/ It is very important to know precisely the basis of measurement of the standing volume, especially for determining the relationship between this volume and the estimates of total forest biomass in table 13 (Part II of the enquiry). Please define this basis, including:
top minimum diameter .....cms for coniferous and .....cms for non-coniferous; minimum diameter at breast height (dbh).....cms for coniferous and .....cms for non-coniferous; branches not included*/included* to a minimum diameter of .....cms for coniferous and .....cms for non-coniferous; coniferous trees of less than .....cms dbh and non-coniferous of less than ..... cms excluded. If further details on the basis of measurement can be provided, e.g. different bases for different species or parts of country, please give on separate sheet.

* delete whichever is not applicable.

Purpose of table: To obtain additional information on exploitable and unexploitable closed forest

TABLE 6 A (supplementory)
Growing stock on exploitable and unexploitable closed forest

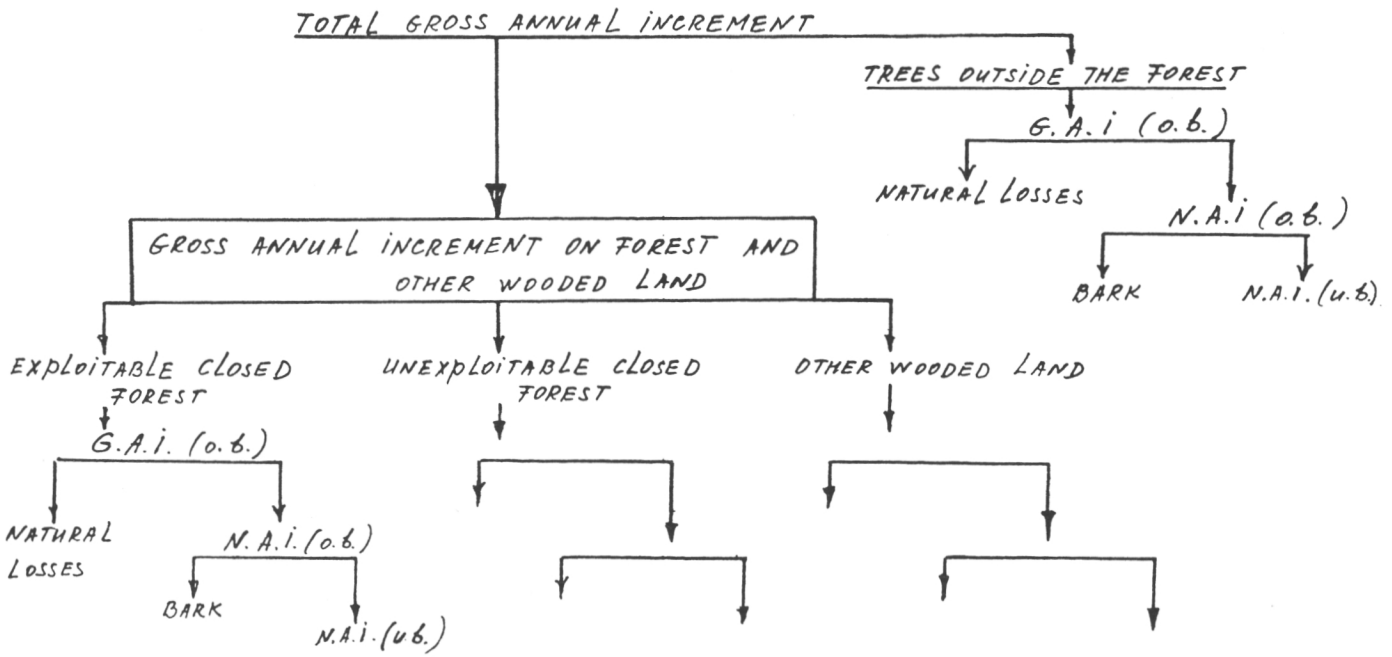
Country:.....

Period/year to which data relate:.....

Description	Total	Coniferous	Non-coniferous
	(million m^3 overbark)		
Exploitable closed forest (ECF)			
Total, of which:			
- on coniferous ECF a/			
- on non-coniferous ECF a/			
Unexploitable closed forest (UECF)			
Total, of which:			
- on coniferous UECF a/			
- on non-coniferous UECF a/			

a/ On areas defined as 'coniferous closed forest' there may, depending on how coniferous closed forest is defined (see footnote a/ to table 2), also be volumes of non-coniferous species, and vice versa. This would be the case, for example, if coniferous closed forest was defined as being a closed forest where more than 50% of the crown cover was of coniferous species.

DIAGRAM 5
ANNUAL INCREMENT



G.A.i. (o.b.) – GROSS ANNUAL INCREMENT OVERBARK
N.A.i. (o.b.) – NET ANNUAL INCREMENT OVERBARK
N.A.i. (u.b.) – NET ANNUAL INCREMENT UNDERBARK

Purpose of table: To obtain information on the gross and net annual increment according to main categories of forest and other wooded land and species groups and on trees outside the forest

Table 7

ANNUAL INCREMENT [a]

Country:.....

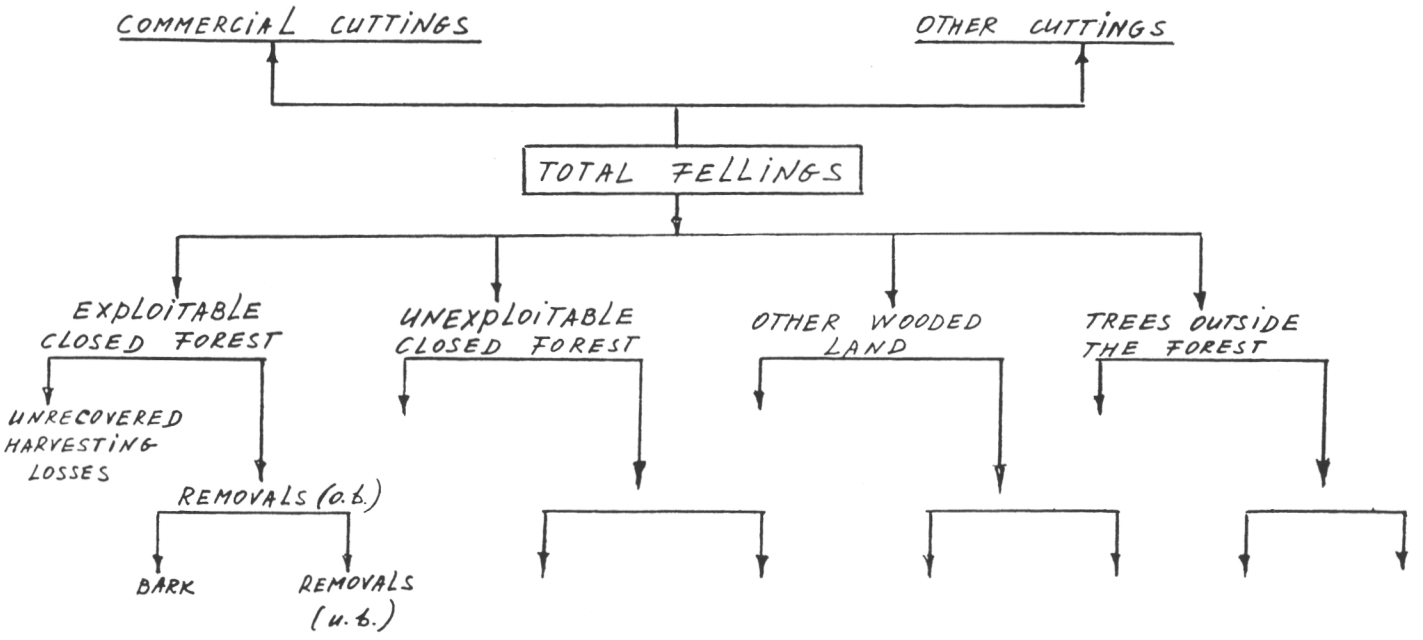
Period/year to which data relate:.....

Description	Data in ETTS III					Latest data				
	Gross annual increment	Natural losses	Net annual increment			Gross annual increment	Natural losses	Net annual increment		
			With bark	Bark	Without bark			With bark	Bark	Without bark
	(million m3 o.b.)			(mill.m3)	(mill.m3 u.b.)	(1000 m3 o.b.)			(1000 m3)	(1000 m3 u.b.)
Forest and other wooded land										
- Coniferous										
- Non-coniferous										
- Exploitable closed forest										
- Coniferous										
- Non-coniferous										
- Unexploitable closed forest										
- Coniferous										
- Non-coniferous										
- Other wooded land										
- Coniferous										
- Non-coniferous										
Trees outside the forest										
- Coniferous										
- Non-coniferous										
TOTAL ANNUAL INCREMENT										
- Coniferous										
- Non-coniferous										

a/ Increment should be current annual increment applicable to the period or year indicated at the top of the table. If mean annual increment data are shown, this should be indicated.

DIAGRAM 6

FELLING AND REMOVALS



Purpose of table: To provide information about the rate of cutting during a given period which, while not directly comparable with the increment data in table 10, will provide some broad indication of the relationship between wood depletion (drain) and increment

Table 8

FELLINGS a/

Country:.....

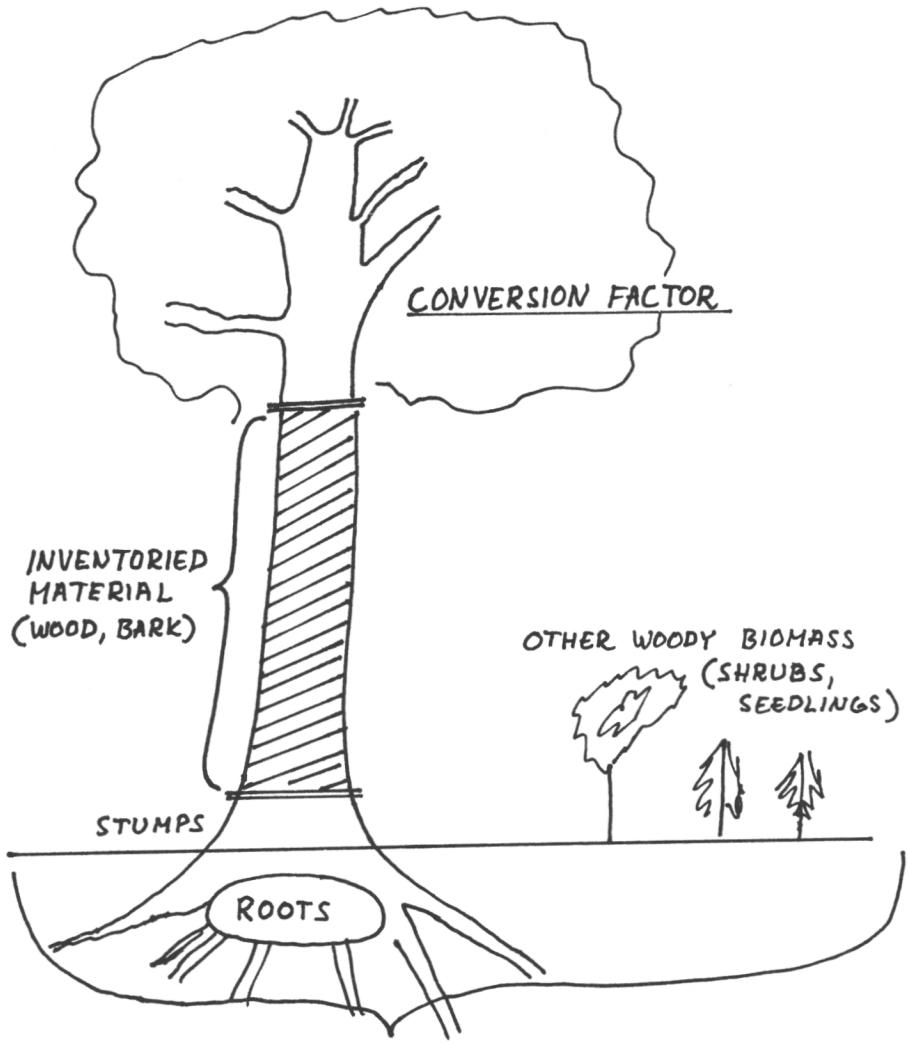
Period/year to which data relate:.....

	Unit (1000 m3)	TOTAL		On exploitable closed forest		On unexploitable closed forest		On other wooded land		Total forest and other wooded land		From trees outside the forest	
		Total	of which: Coniferous	Total	of which: Coniferous	Total	of which: Coniferous	Total	of which: Coniferous	Total	of which: Coniferous	Total	of which: Coniferous
Commercial cuttings													
Removals	underbark												
Removals	overbark												
Unrecovered harvesting losses	"												
Fellings	"												
Other cuttings b/													
Removals	underbark												
Removals	overbark												
Unrecovered harvesting losses	"												
Fellings	"												
Total													
Removals	underbark												
Removals	overbark												
Unrecovered harvesting losses	"												
Fellings	"												

a/ Fellings equal removals plus unrecovered harvesting losses.

b/ Cuttings not coming within the definition of commercial cuttings.

PART II INTERRELATIONSHIP OF WOODY BIOMASS COMPONENTS



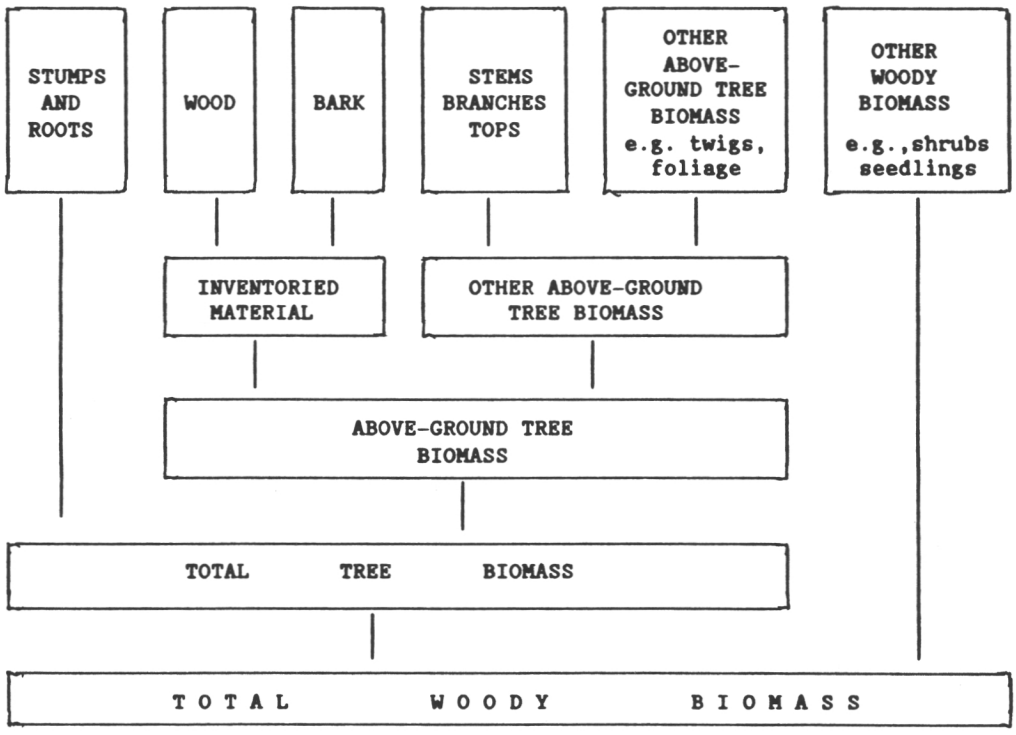


Figure 1

Interrelationship of woody biomass components

USUAL METHOD OF ESTIMATING BIOMASS

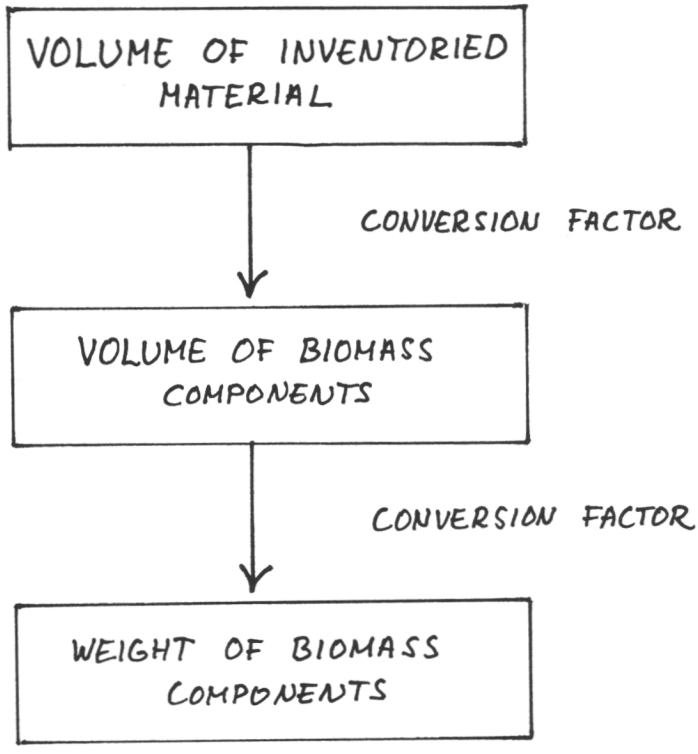


Table 1% (Basic)

Purpose of table: To attempt a preliminary assessment of total tree biomass in accordance with the proposals of the May 1979 ad hoc meeting on forest resource assessment

ESTIMATES OF VOLUME AND MASS OF THE STANDING VOLUME OF TOTAL WOODY BIOMASS

Country:.....

Period/year to which data relate:.....

	Exploitable closed forest		Unexploitable closed forest		Other wooded land		Trees outside the forest		TOTAL	
	Volume (1000 m3) a/	Mass (1000 m.t.) b/	Volume (1000 m3) a/	Mass (1000 m.t.) b/	Volume (1000 m3) a/	Mass (1000 m.t.) b/	Volume (1000 m3) a/	Mass (1000 m.t.) b/	Volume (1000 m3) a/	Mass (1000 m.t.) b/
Above-ground tree biomass c/										
- coniferous										
- non-coniferous										
- Inventoried material d/										
- coniferous										
- non-coniferous										
- Wood										
- coniferous										
- non-coniferous										
- Bark										
- coniferous										
- non-coniferous										
- Other above-ground tree biomass										
- coniferous										
- non-coniferous										
- Stems, branches, tops										
- coniferous										
- non-coniferous										
- Other (e.g. twigs and foliage)										
- coniferous										
- non-coniferous										
Stumps and roots of trees										
- coniferous										
- non-coniferous										
TOTAL TREE BIOMASS										
- coniferous										
- non-coniferous										
OTHER WOODY BIOMASS (e.g. shrubs, seedlings)										
- coniferous										
- non-coniferous										
TOTAL WOODY BIOMASS										
- coniferous										
- non-coniferous										

a/ Solid volume. b/ Oven-dry. c/ All tree biomass except stumps and roots. d/ Data as reported in table 9 in Part I of the enquiry.

منظمة الأغذية والزراعة للأمم المتحدة
联合国粮食及农业组织
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

September 1987

ECE/FAO/FINNIDA

Forest Resource Assessment Meeting

Towards a Structure for the Forest Resources Assessment 1990

by
F. Padovani

Contents

Introduction

Part 1:Forest Resources Assessment 1990 proposal

Part 2:Notes on the Tropical Forest Resources Assessment (FORIS)

Part 3:Notes on the Forest Resources Assessment of the ECE region

Part 4:Notes on the countries covered by reference to documents

Part 5:Notes on structural problem in integrating the ECE and FORIS data

P A R T 1

Introduction

An objective of this meeting is to discuss the formation of a world framework for the 1990 assessment of Forest Resources.
In this paper a preliminary proposal is put foreword on a broad framework that could apply to all regions.

This outline presents forest resources in the context of total land use. It shows a breakdown of forest resources by major forest types and a view of forest according to ownership and management. It does not include any view according to use or function of forest.

The structure is open as far as inclusion of dimensions. These may include area, volume, increment and drain as well as change is concerned such as afforestation, reafforestation, deforestation, reduction of volume degradation, damage such as by fire, atmospheric pollution, wind, attacks of pests or deseases.

Within countries and regions it is envisaged that more detailed subdivisions and views appropriate to their needs will be added.

This framework has been developed on the basis of the computer data and the related classification for the ECE and Tropical Forest Resources assessment.

The paper presents the independent structures of the Tropical Forest Resources assessment (Part 2) and for the Forest resources of the ECE region (Part 3) as well as for the sources utilized for the remaining countries covered by references (Part 4).
The convergence of the two assessments is sketched and the structural problems encountered in integrating them are listed (Part 5).

Definitions and explanations of terms used are listed in Part 2 and Part 3.

Notes on

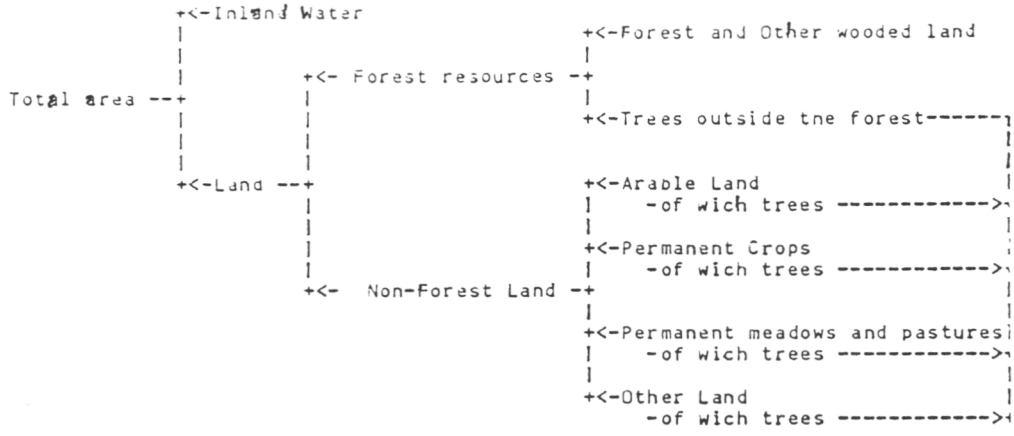
The

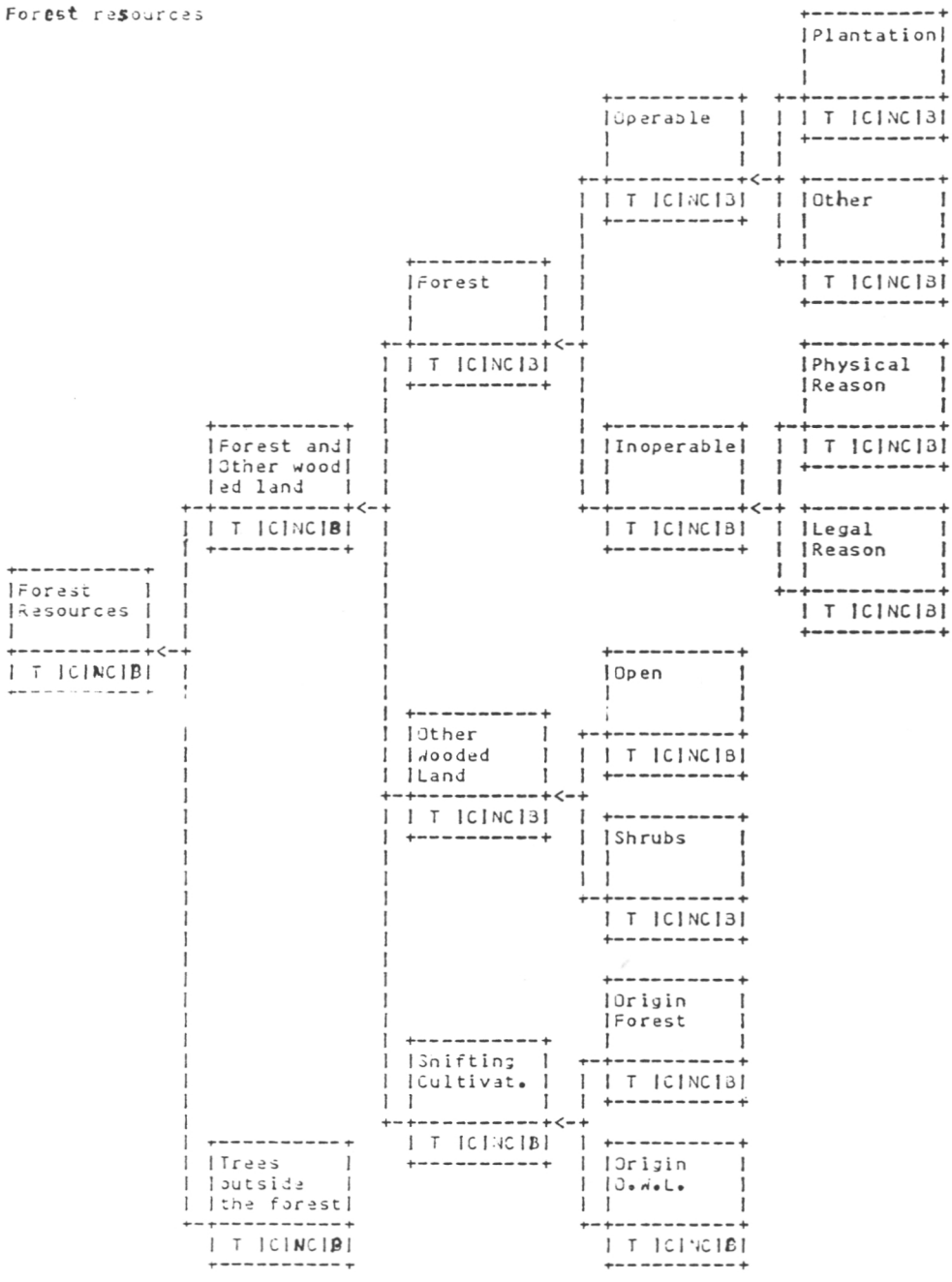
Forest Resources assessment

1990
(proposal)

- Land use classification chart
- Forest resources
- What to collect ?
- A structure related to species
- A basic questionnaire
- The ownership and management status view
- When ?

Land use classification chart



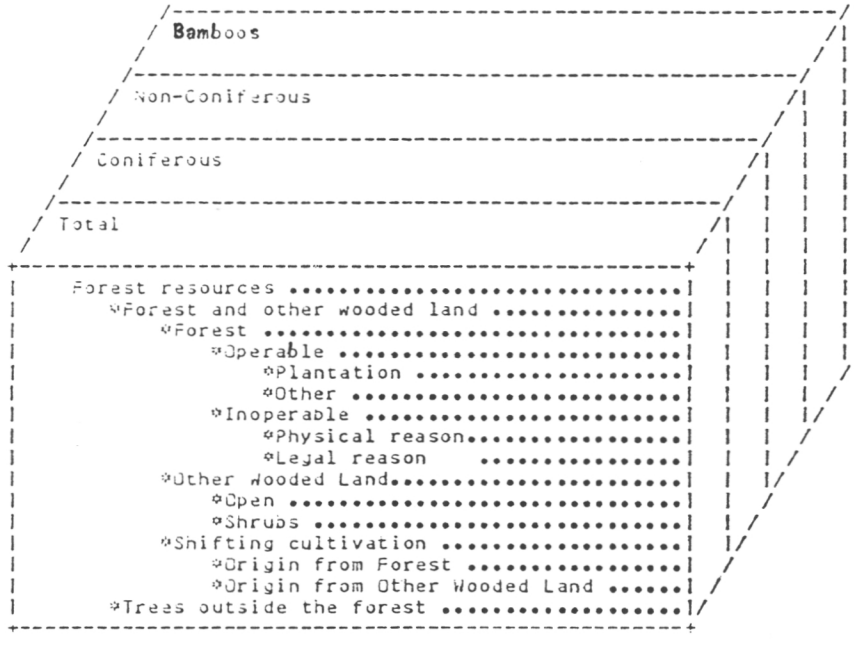


Legend: T=Total C=Coniferous NC=Non coniferous B=Bamboos

What to collect ?

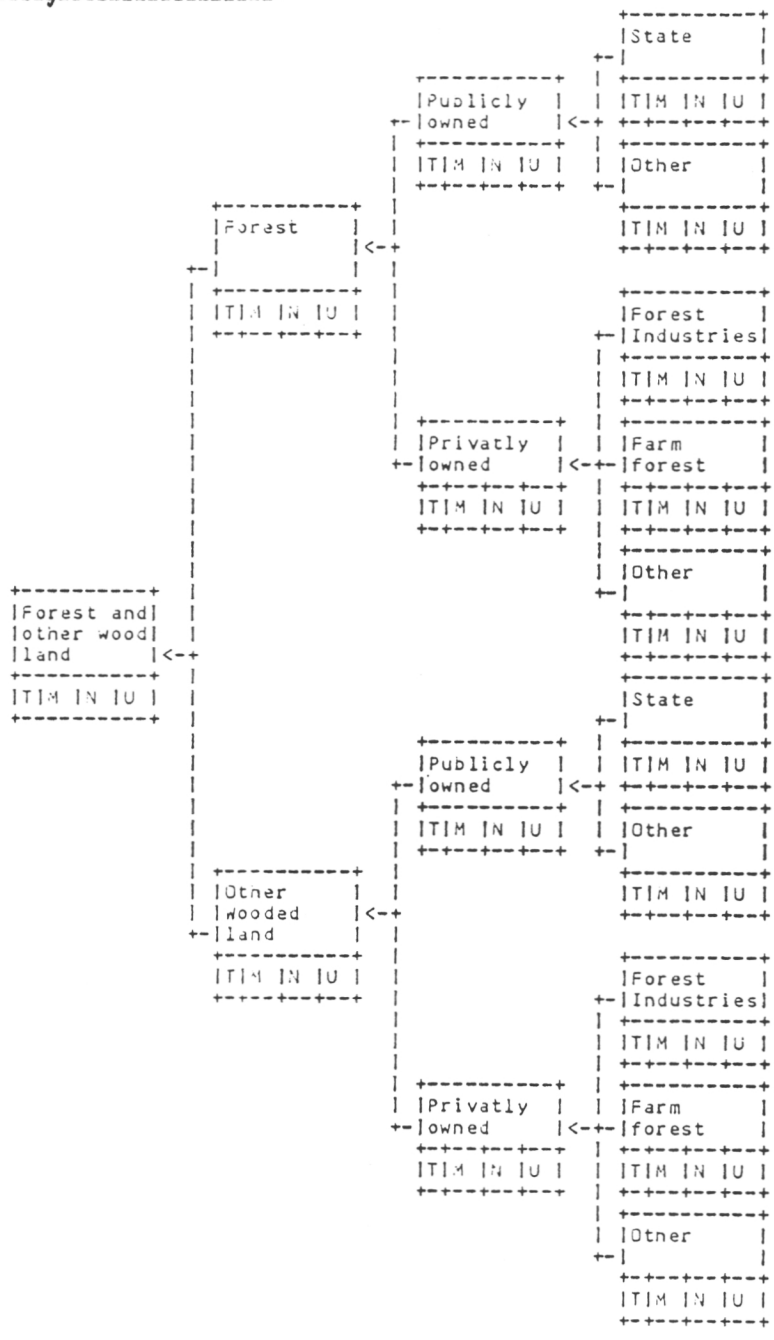
Data Stucture	1990 data
Forest resources	
*Forest and other wooded land	
*Forest	
*Operable	
*Plantation	
*Other	
*Inoperable	
*Physical reason	
*Legal reason	
*Other Wooded Land	
*Open	
*Shrubs	
*Shifting cultivation	
*Origin from forest	
*Origin from Other Wooded Land	
*Trees outside the forest	

A structure related to species



QUESTIONNAIRE Data Stucture	1990 data
Forest resources	
Coniferous	
Non-Coniferous	
Bamboos	
*Forest and other wooded land	
Coniferous	
Non-Coniferous	
Bamboos	
*Forest	
Coniferous	
Non-coniferous	
Bamboos	
*Operable	
Coniferous	
Non-Coniferous	
Bamboos	
*Plantation	
Coniferous	
Non-Coniferous	
Bamboos	
*Other	
Coniferous	
Non-Coniferous	
Bamboos	
*Inoperable	
Coniferous	
Non-Coniferous	
Bamboos	
*Physical reason	
Coniferous	
Non-Coniferous	
Bamboos	
*Legal reason	
Coniferous	
Non-Coniferous	
Bamboos	
*Other Wooded Land	
Coniferous	
Non-Coniferous	
Bamboos	
*Open	
Coniferous	
Non-Coniferous	
Bamboos	
*Shrubs	
Coniferous	
Non-Coniferous	
Bamboos	
*Shifting cultivation	
Coniferous	
Non-coniferous	
Bamboos	
*Origin from Forest	
Coniferous	
Non-Coniferous	
Bamboos	
*Origin from Other Wooded Land	
Coniferous	
Non-Coniferous	
Bamboos	
*Trees outside the forest	
Coniferous	
Non-Coniferous	
Bamboos	

Ownership and management status view.



WHEN?

Every year

P A R T 2

Notes on

the

TROPICAL FOREST RESOURCES ASSESSMENT

F O R I S
(FOrest Resources Information System)

1980 assesment

The structure

Area terms used

What is collected

Volume terms used

Structure of data aggregation

Country coverage

These notes have been prepared using the following reference matetial:
- Tropical Forest Resources, Forestry Paper 30.
- FAO Production Yearbook
- Format and guidelines for collection of data for forest resources assessement, Bangkok 1986.

by F. Padovani in consultation with J.Barraud and K.D.Singh

For standard FAO definitions used in 1980 assesment, refer to Forestry Paper 30.

The Structure

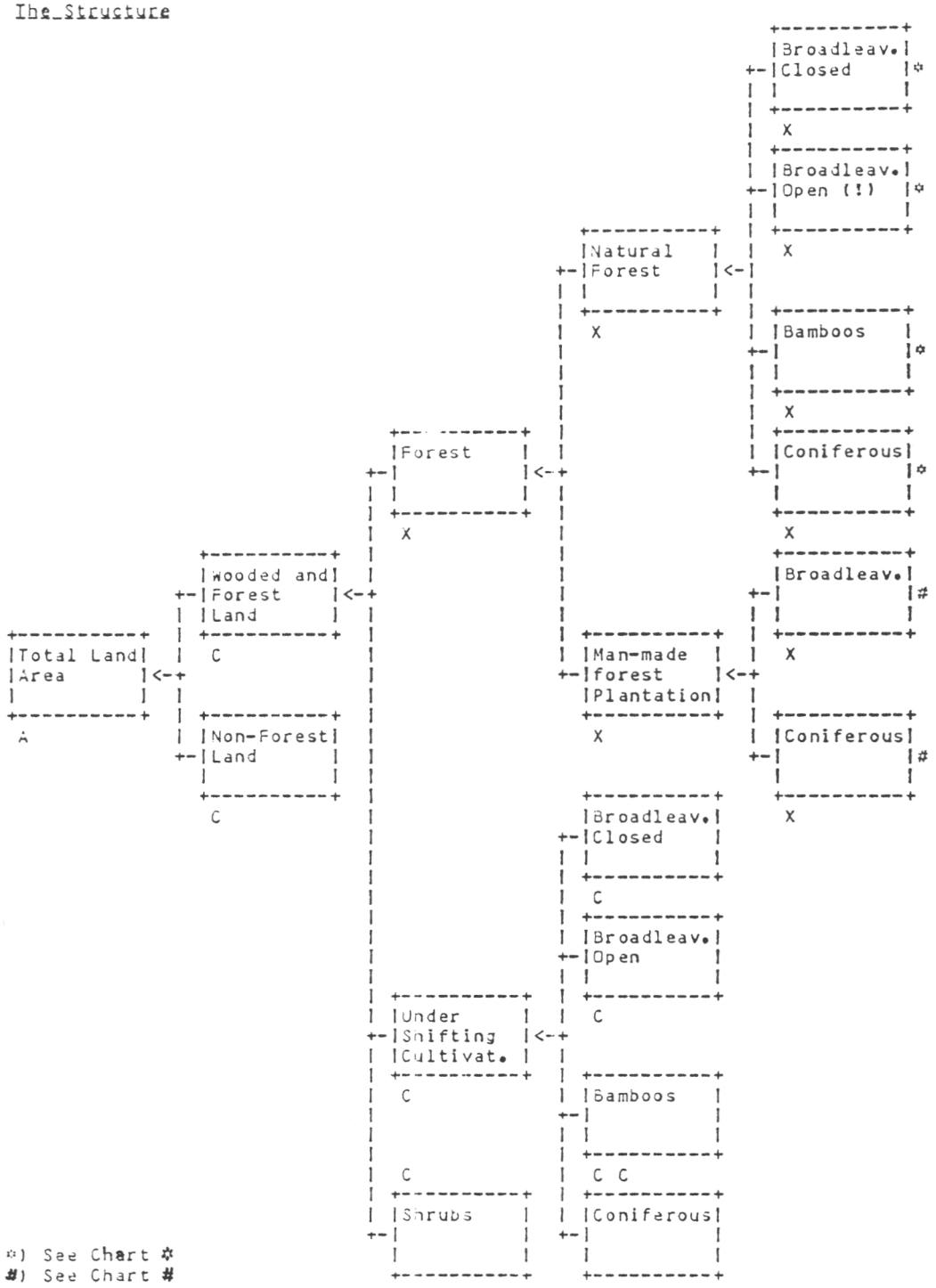
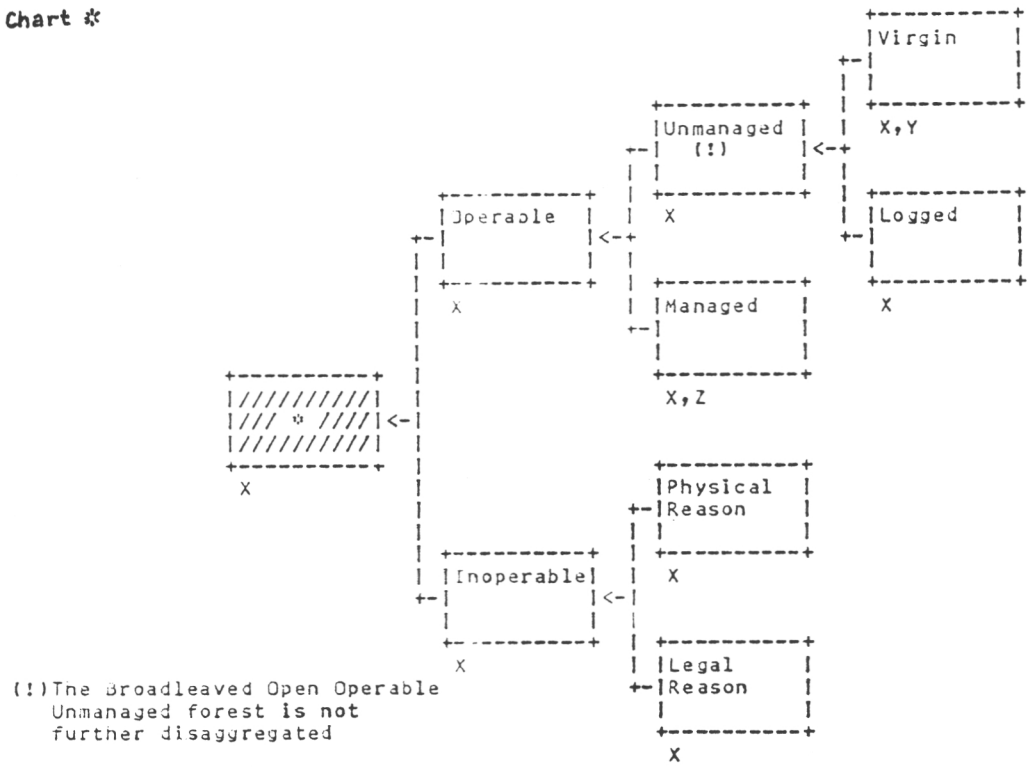
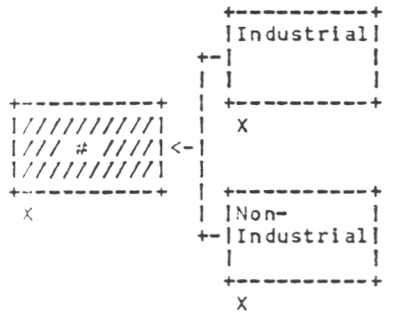


Chart *



(!)The Broadleaved Open Operable Unmanaged forest is not further disaggregated

Chart #



Legend:
A = Area :1000 Ha
C = Area :1000 Ha
Area Annual Changes for the period 1980-85 : 100 Ha
X = Area :1000 Ha
Area Annual Changes for the period 1980-85 : 100 Ha
Volume Over Bark (VOB) : 1000000 Cubic Meters (m3)
Y = Volume Actually Commercialized (VAC) : 1000000 Cubic Meters (m3)
Z = Gross Annual Allowable Cut (AAC): 1000000 Cubic Meters (m3)
In general it is equated with current annual yield.

AREA TERMS USED

Total Land Area:
It includes :
-Wooded and Forest Land:
-Non-Forest Land

Wooded and Forest Land:
Land under natural or planted stands of trees, whether productive or not. Includes cleared areas that will be planted in the foreseeable future. Land with little or no tree cover are not included (less than 10% of the ground).

Forest :
Refer to any vegetation type where the woody dominant element is the tree. A tree is defined as a woody perennial plant typically large and with a single stem carrying a more or less definite crown and with a mature height of more than 7 meters.
This is an aggregate to indicate what is normally understood as forest, namely natural forest and forest plantation.

Natural Forest:
Land where the woody elements cover more than 10 percent of the ground.
Natural refers to "not man-made". However it includes enrichment planting or underplanting areas. It also includes regeneration areas where the species are essencially similar to those they are replacing. In these cases the plantations are considered as forest management.
The division between closed and open hardwood forests is more of an ecological than physiognomic type and is not characterized necessarily by the crown cover percentage. In some woodlands the trees may cover the ground completly like closed forests. The distinction between closed and open forests has not been made for coniferous, since it has not the same ecological importance and is difficult, if not impossible, to apply.

*Broadleaved closed:
Stands of broadleaved (hardwood) forests, which when not recently cleared by shifting agriculture or heavily exploited, cover with their various storeys and undergrowth, a high proportion of the ground and do not have a continuous grass layer allowing grazing and spreading of fires. They are often, but not always, multistoried. They may be evergreen, semi-deciduous, or deciduous, wet, moist or dry. As an indication for remote sensing purposes the crown cover is 40 percent or more.

*Broadleaved Open:
This refers to mixed broadleaved forests/grassland formation with a continuous grasslayer in which the tree synusia covers more than 10 percent of the ground.

*Bamboos:
Refers to areas where a high proportion of the ground is covered with bamboo species, and where bamboo is clearly the predominant vegetation.

*Coniferous:
Refers to types with predominance (50 percent or more of crown cover) of trees of coniferous (gymnosperme) species.

* for further subdivision see Annex 1 (page 6).

Plantation:
This term refers to:
- forest stands established artificially by afforestation on land which previously did not carry forest.
- forest stands established artificially by reforestation on land which carried forest within the previous 50 years or within living memory and involving the replacement of the previous crop by a new and essentially different crop.

Areas that are planted with essentially the same species as they replace are not considered as plantation. Such plantation, as well as naturally regenerated areas, are considered as managed forests. Tree plantations that are normally outside the competence of foresters are not accounted for under this category. Such plantations include rubber, oilpalm, coconut, shade trees, etc. Areas and volume of such plantations should be recorded separately.

#Broadleaved:
Refers to types with a predominance (50 percent or more of crown coverage) of trees of broadleaved species (angiospermes), dicotyledons or monocotyledons (eg. palms, rattans).

Industrial:
"Industrial plantation" are established primarly for the production of industrial wood (sawlogs, veneerlogs, pulpwood, pit-props etc).

Non-Industrial:
"Non-Industrial plantation" are established mainly for one or more of the following reasons:
- production of fuelwood and wood for charcoal (also industrial energy)
- production of small wood for domestic consumption
- non-wood forest products (fruits from forest trees, palm hearts, gum arabic, cinnamon, etc)
- soil protection
- ornament

#Coniferous:
see before

Industrial:
see before

Non-Industrial:
see before

Shifting cultivation:
This type stands for all complexes of woody vegetation deriving from the clearing of forest land for shifting agriculture. It consists of a mosaic of various reconstitution phases and includes patches or uncleared forests and agriculture fields which can not be realistically segregated and accounted for area-wise, especially from satellite imagery
Excludes areas where site degradation is so severe that a reconstitution of the forest is not possible. Such areas should be included under "shrubs" or outside woody vegetation.

Under Broadleaved Closed area:
Forest fallow of broadleaved closed forests.

Under Broadleaved Open area:
Forest fallow of broadleaved open forests.

Under Bamboos area:
Forest fallow of bamboos forests.

Under Coniferous area:
Forest fallow of coniferous forests.

Shrubs:
Any vegetation type where the main woody elements are shrubs (broadleaved or coniferous species) of more than 50 cm and less than 7 meters height. The height limits between trees and shrubs should be interpreted with flexibility, particularly the minimum tree and maximum shrubs height which may vary between 5 and 8 meters, approximately.

Non-Forest Land:
It includes :

- Arable land: Land under annual and seasonal crops (double croped areas are counted only once), temporary meadows, market and kitchen gardens, temporary fallows (agricultural).
- Permanent crops: Land cultivated with crops that occupy the land for long periods such as rubber, cocoa, coffe etc. Excludes land under trees grown for wood or timber.
- Permanent meadows and pastures: Land used permanently (5 years or more) for herbaceous forage crops either cultivated or growing wild.
- Other land: Unused but potentially productive land, built-on areas, wasteland, parks, ornamental gardens, roads, etc. and other land not specifically listed else-where. Includes land with little or no tree cover.

Annex 1

Operable:
Operable forests are productive forests, managed or not, where the terrain and present regulations allow (or might allow) for production of wood for industry (sawlogs, veneerlogs, pulpwood, pitprops industrial poles). The distance to consumpion or export centres is not taken into account, which means that economically inaccessible forests may by included.

Managed:
"Managed forest" means in this classification that the forest is subject to intensive management. Silvicultural treatments are applied in connection with logging and there is strict control over harvesting methods and log out-take and prevention against fires, pests and desease, etc. These forests constitute a part of the productive forest estate in the country to which the concept of "annual allowable cut" can be meaningfully applied. Forests that are only under a harvesting plan (logging plan, annual area, etc) are not included in this category.

Unmanaged: (!)
"Unmanaged forests" are all forests other than those intensively managed.

Virgin:
It means a virgin forest or a forest where there has been no logging for the last 60 to 80 years.

Logged:
It is an unmanaged forest that has been logged-over one or more times during the past 60-80 years (the majority of these forests have been logged during the last 30-35 years).

Inoperable:
"Inoperable forests" are forests that are unproductive, not able to produce wood for industry, either for physical reasons or legal reasons.

Physical reasons:
It include:
- stands that cannot produce wood for industry because of their characteristics (forests with stunted and crooked trees or stands of monocotyledons such as palms or rattan stands.
- stands that are inoperable due to terrain conditions (physically not possible to harvest). The terrain is too steep or rough, permanently inundated, etc.

Legal reason:
It include stands where logging is prohibited by law or other regulations (national parks, reserves of different kinds etc). When forests belong to both categories at the same time (physically and legal) they should be accounted for only under the latter category "Inoperable for legal reasons".

(!)The Broadleaved Open Operable Unmanaged forest is not further disaggregated.

Data Collected	Area	Land	Forest	Natural Forest	Broadleaved closed	Operable	Unmanaged	Virgin	Logged	Managed	Inoperable	Physical reason	Legal reason	Broadleaved Open	Operable	Unmanaged	Managed	Inoperable	Physical reason	Legal reason	Bamboos	Operable	Unmanaged	Virgin	Logged	Managed	Inoperable	Physical reason	Legal reason	Coniferous	Operable	Unmanaged	Virgin	Logged	Managed	Inoperable	Physical reason	Legal reason	Plantation	Broadleaved	Industrial	Non-Industrial	Coniferous	Industrial	Non-Industrial	Under shifting cultivation	Broadleaved Closed	Broadleaved Open	Bamboos	Coniferous	Shrubs	Non-Forest Land	Volume	Volume Broadleaved	Volume Coniferous	Annual Increment	Annual Cut
Total Land Area	y																																																						
Wooded and Forest Land	y	y																																																					
Forest	y	y	y																																																			
Natural Forest	y	y	y																																																		
Broadleaved closed	y	y	y																																																	
Operable	y	y	y																																																	
Unmanaged	y	y	y																																																
Virgin	y	y	y	y																																															
Logged	y	y	y																																																
Managed	y	y	y		y																																													
Inoperable	y	y	y																																															
Physical reason	y	y	y																																															
Legal reason	y	y	y																																															
Broadleaved Open	y	y	y																																															
Operable	y	y	y																																															
Unmanaged	y	y	y																																															
Managed	y	y	y		y																																												
Inoperable	y	y	y																																															
Physical reason	y	y	y																																															
Legal reason	y	y	y																																															
Bamboos	y	y	y																																															
Operable	y	y	y																																															
Unmanaged	y	y	y																																															
Virgin	y	y	y	y																																														
Logged	y	y	y																																															
Managed	y	y	y		y																																												
Inoperable	y	y	y																																															
Physical reason	y	y	y																																															
Legal reason	y	y	y																																															
Coniferous	y	y	y																																															
Operable	y	y	y																																															
Unmanaged	y	y	y																																															
Virgin	y	y	y	y																																														
Logged	y	y	y																																															
Managed	y	y	y		y																																												
Inoperable	y	y	y																																															
Physical reason	y	y	y																																															
Legal reason	y	y	y																																															
Plantation	y	y	y																																															
Broadleaved	y	y	y																																															
Industrial	y	y	y																																															
Non-Industrial	y	y	y																																															
Coniferous	y	y	y																																															
Industrial	y	y	y																																															
Non-Industrial	y	y	y																																															
Under shifting cultivation	y	y																																																
Broadleaved Closed	y	y																																																
Broadleaved Open	y	y																																																
Bamboos	y	y																																																
Coniferous	y	y																																																
Shrubs	y	y																																																
Non-Forest Land	y	y																																															

Volume terms used

Volume_over_bark_(VOB):
This is the gross volume over bark of the free bole (from stump-point or buttress to crownpoint or first main branch) of all living trees more than 10 cm diameter at breast height (or above buttress if higher). This volume applied to all natural forests and forest plantation. For plantations, only the VOB volume concept is used.
It is measured in 1,000,000 Cubic Meters (m3)

Volume_actually_commercialized_(VAC):
This is the volume under bark that is actually extracted from the forest. This volume concept applies to natural forest categories only.
It is measured in 1,000,000 Cubic Meters (m3)

Gross_Annual_Allowable_Cut_(AAC):
It is the annual capacity of forest intensively managed. In general, it is equated with current annual yield.
It is measured in 1,000,000 Cubic Meters (m3)

D A T A D E R I V E D

Growing_stock: VOB/Area, measured m3/HA

```
  Data                                  Collected
  Aggregation                          +-+-+-+-+-+-----
                                       |A|C|V|V|A|
                                       |r|h|O|A|A|
                                       |e|a|B|C|C|
                                       |a|n| | | |
                                       | |g| | | |
                                       | |e| | | |
*Total Land Area...............|y| | | | |
|<*Wooded and Forest Land......|y|y| | | |
| |<*Forest.....................|y|y|y| | |
| | |<*Natural Forest..........|y|y|y| | |
| | | |<*Broadleaved closed....|y|y|y| | |
| | | | |<*Operable.............|y|y|y| | |
| | | | | |<*Unmanaged.........|y|y|y| | |
| | | | | | |<-Virgin...........|y|y|y|y| |
| | | | | | |<-Logged...........|y|y|y| | |
| | | | | |<-Managed............|y|y|y| |y|
| | | | |<*Inoperable...........|y|y|y| | |
| | | |   |<-Physical reason...|y|y|y| | |
| | | |   |<-Legal reason......|y|y|y| | |
| | | |<*Broadleaved Open......|y|y|y| | |
| | | | |<*Operable.............|y|y|y| | |
| | | | | |<-Unmanaged.........|y|y|y| | |
| | | | | |<-Managed............|y|y|y| |y|
| | | | |<*Inoperable...........|y|y|y| | |
| | | |   |<-Physical reason...|y|y|y| | |
| | | |   |<-Legal reason......|y|y|y| | |
| | | |<*Bamboos................|y|y|y| | |
| | | | |<*Operable.............|y|y|y| | |
| | | | | |<*Unmanaged.........|y|y|y| | |
| | | | | | |<-Virgin...........|y|y|y|y| |
| | | | | | |<-Logged...........|y|y|y| | |
| | | | | |<-Managed............|y|y|y| |y|
| | | | |<*Inoperable...........|y|y|y| | |
| | | |   |<-Physical reason...|y|y|y| | |
| | | |   |<-Legal reason......|y|y|y| | |
| | | |<*Coniferous.............|y|y|y| | |
| | |   |<*Operable.............|y|y|y| | |
| | |   | |<*Unmanaged.........|y|y|y| | |
| | |   | | |<-Virgin...........|y|y|y|y| |
| | |   | | |<-Logged...........|y|y|y| | |
| | |   | |<-Managed............|y|y|y| |y|
| | |   |<*Inoperable...........|y|y|y| | |
| | |     |<-Physical reason...|y|y|y| | |
| | |     |<-Legal reason......|y|y|y| | |
| | |<*Plantation..............|y|y|y| | |
| |   |<*Broadleaved...........|y|y|y| | |
| |   | |<-Industrial..........|y|y|y| | |
| |   | |<-Non-Industrial......|y|y|y| | |
| |   |<*Coniferous.............|y|y|y| | |
| |     |<-Industrial..........|y|y|y| | |
| |     |<-Non-Industrial......|y|y|y| | |
| |<*Under shifting cultivation|y|y| | | |
| | |<-Broadleaved Closed......|y|y| | | |
| | |<-Broadleaved Open........|y|y| | | |
| | |<-Bamboos.................|y|y| | | |
| | |<-Coniferous..............|y|y| | | |
| |<-Shrubs.....................|y|y| | | |
|<-Non-Forest Land.............|y|y| | | |
```

Country coverage:

No.	Country	No.	Country	No.	Country
1	ANGOLA	2	BANGLADESH	3	BELIZE
4	BENIN	5	BHUTAN	6	BOLIVIA
7	BOTSWANA	8	BRAZIL	9	BRUNEI
10	BURKINA FASO	11	BURMA	12	BURUNDI
13	CAMEROON	14	CENT AFR REP	15	CHAD
16	COLOMBIA	17	CONGO	18	COSTA RICA
19	CUBA	20	DOMINICAN RP	21	ECUADOR
22	EL SALVADOR	23	EQ GUINEA	24	ETHIOPIA
25	FR GUIANA	26	GABON	27	GAMBIA
28	GHANA	29	GUATEMALA	30	GUIN BISSAU
31	GUINEA	32	GUYANA	33	HAITI
34	HONDURAS	35	INDIA	36	INDONESIA
37	COTE D'IVOIRE	38	JAMAICA	39	KAMPUCHEA DM
40	KENYA	41	LAOS	42	LIBERIA
43	MADAGASCAR	44	MALAWI	45	MALAYSIA
46	MALI	47	MEXICO	48	MOZAMBIQUE
49	NAMIBIA	50	NEPAL	51	NICARAGUA
52	NIGER	53	NIGERIA	54	PAKISTAN
55	PANAMA	56	PAPUA N GUIN	57	PARAGUAY
58	PERU	59	PHILIPPINES	60	RWANDA
61	SENEGAL	62	SIERRA LEONE	63	SOMALIA
64	SRI LANKA	65	SUDAN	66	SURINAME
67	TANZANIA	68	THAILAND	69	TOGO
70	TRINIDAD TOB	71	UGANDA	72	VENEZUELA
73	VIET NAM	74	ZAIRE	75	ZAMBIA
76	ZIMBABWE				

New assessed countries

1 AFGANISTAN	2 ALGERIA	3 BAHRAIN
4 SOLOMON IS.	5 CAPE VERDE	6 COMOROS
7 EGYPT	8 FIJI	9 IRAN
10 IRAQ	11 JORDAN	12 KUWAIT
13 LEBANON	14 LESOTHO	15 LIBYA
16 MAURITANIA	17 MAURITIUS	18 MOROCCO
19 NEW CALEDONIA	20 VANUATU	21 QUATAR
22 DJIBOUTY	23 REUNION	24 SAINT HELENA
25 SAO TOME / PR.	26 SAUDI ARABIA	27 SEYCHELLES
28 SOUTH AFRICA	29 SWAZILAND	30 SYRIAN
31 OMAN	32 TUNISIA	33 U A EMIRATS
34 SAMOA	35 YEMEN ARAB REP	36 YEMEN, DEMOCRATIC

P A R T 3

Notes on
THE FOREST RESOURCES OF THE ECE REGION
1980

Data structure

Data collected

Definitions

Data aggregation and/or validation

Country coverage

Views

Relationship among the basic structure and "Views"

The computerized data structure

These notes have been prepared using the structure of tables reported in Annex 3 and the Definitions reported in "The forest resources of the ECE region" by F. Padovani in consultation with Mr T. Peck and S. Sokolov.

Data Stucture	Data collected 1980									
	Area	Volume	Stock	Type	Growth	Increment	Loss	Net Increment	Wood Biomass	Wood Biomass
	A	B	C	D	E	F	G	H	I	I
Total area	y									
Water	y									
Land	y									
Forest resources (*)	d	y	y	y	y	y	y	y	y	y
Coniferous	d	y	y	y	y	y	y	y	y	y
Non-Coniferous	d	y	y	y	y	y	y	y	y	y
Forest and other wooded land(1)	y		y		y	y	y	y	y	y
Coniferous	y		y		y	y	y	y	y	y
Non-Coniferous	y		y		y	y	y	y	y	y
Closed	y		d		d	d	d	d	d	d
Coniferous	y		d		d	d	d	d	d	d
Non-coniferous	y		d		d	d	d	d	d	d
Exploitable	y		y		y	y	y	y	y	y
Coniferous	y		y		y	y	y	y	y	y
Non-Coniferous	y		y		y	y	y	y	y	y
Stocked	y									
Coniferous	y									
Non-Coniferous	y									
Un-stocked	y									
Coniferous	y									
Non-Coniferous	y									
Unexploitable	y		y		y	y	y	y	y	y
Coniferous	y		y		y	y	y	y	y	y
Non-Coniferous	y		y		y	y	y	y	y	y
National parks & Nat.R.	y									
Coniferous	y									
Non-Coniferous	y									
Others	y									
Coniferous	y									
Non-Coniferous	y									
Other wooded land	y		y		y	y	y	y	y	y
Coniferous	y		y		y	y	y	y	y	y
Non-Coniferous	y		y		y	y	y	y	y	y
Non-Forest land	y									
Trees outside the forest	y		y		y	y	y	y	y	y
Coniferous	y		y		y	y	y	y	y	y
Non-Coniferous	y		y		y	y	y	y	y	y
Other land	y									
Agricultural land	y									
Built-up	y									
Other	y									

Legend:
(*) The term "Forest resources" define the forest resources available. It includes "Forest and other wooded land" and "trees outside the forest".

(1) See Annex 1 for Type and species group(1) and Ownership and Management(2).

y = yes
d = derived

Data_collected:

(A) Area:
It is measured in 1000 ha.

(B) Standing volume:
Volume of standing trees, all species, living or dead, all diameters down to a stated minimum diameter. Species which do not have an upright trunk (brush, etc.) are not considered as trees. It includes dead trees laying on the ground which can still be used for fibre or as fuel.
It is measured in 1000000 m3 o.b.

(C) Growing stock:
The living part of the standing volume.
It is measured in 1000000 m3 o.b.

(D) Dead trees:
The dead part of the standing volume.
It is measured in 1000000 m3 o.b.

(E) Gross increment:
Average volume of increment over given period of all trees (all diameters down to a stated minimum diameter. Also included is the recruitment (ingrowth) of small trees when they reach the minimum diameter.
It is measured in 1000 m3 o.b.

(F) Natural losses:
Losses over given period to growing stock due to mortality from disease, insects, fire, windblow, floating and other causes, including competition and over-maturity.
It is measured in 1000 m3 o.b.

(G) Net increment (with bark):
Average gross increment LESS natural losses over given period.
It is measured in 1000 m3.

(H) Bark

(I) Without bark

D E F I N I T I O N S

Coniferous:
All trees classified botanically as Gymnospermae.

Non-coniferous:
All trees classified botanically as Angiospermae.
••••••••••••••••••••••••••

Total area:
It refers to the total area of the country, including area under inland water bodies.

Water:
It (inland water) includes area occupied by major rivers, lakes and dams.

Land:
Land area refers to total area, excluding area under inland water bodies. The definitions of inland water bodies generally includes major rivers and lakes.

Forest resources: (provisional term)
The term "Forest resources" define the available forest resources. It includes "Forest and other wooded land" and "trees outside the forest".

Forest and other wooded land:
It includes "Closed" and "Other wooded Land".

Closed:
All land with a "forest cover", i.e. with trees whose crown cover more than about 20% of the area (with a stand density of more than 20%) and used primarly for forestry. 1/
Included are:
(a) All plantations, including one-rotation plantations, primarly used for forestry purposes;
(b) Area normally forming part of the closed forest area which are unstocked as a result of human intervention or natural causes but which are expected to revert sooner or later to closed forest;
(c) Young natural stands and all plantations established for forestry purposes which have not yet reached a crown density of more than about 20%;
(d) Forest roads and streams and other small open areas, as well as forest nurseries, that constitute an integral part of the forest;
(e) Closed forests in national parks and nature reserves;
(f) Areas of windbreak and shelterbelt trees sufficiently large to be managed as forest.
Exclude are:
(a) Isolated groups of trees smaller than 0.5 ha;
(b) City parks and gardens;
(c) Areas not meeting the conditions of closed forests as described above, even if administrated by Forest Autnority.

1/"Forestry" may be broadly defined as activities related to the production of wood and other goods and services of the forest.

Exploitable (Operable):
Closed forest in which commercial cutting have occurred or could occur periodically. This implies at least one commercial cutting during a rotation period.

Stocked:
Land, more than about 20% of whose area is covered by tree crowns (or with a stand density of more than about 20%); also forest nurseries and seed orchards.

Unstocked:
Forest land on which a crown cover has been reduced to than 20% (or with a stand density of less than 20%) or nas been removed as a result of human intervention or natural causes, e.g. by felling or burning, but which is expected to revert sooner or later to stocked forest.

Unexploitable (Inoperable):
Closed forest in which commercial cutting is prohibited or severely restricted by law (e.g. protection forests); or in which physical productivity is too low or transportation costs to the nearest market are too high to warrant periodical commercial cuttings.

National Parks and Natural Reserves:

Others:

Other wooded land:
Land which has some forestry characteristics but is not forest as defined under "Closed forest" above. It includes:
(a) Open woodland: Land with trees whose crowns cover about 5-20% of the area (or with a stand density of less than 20%);
(b) Areas occupied by windbreaks, shelterbelts and isolated groups of trees of less than 0.5 ha;
(c) Scrub and brushland: Land with shrubs or stunted trees covering more than about 20% of the area, not primarly used for agricultural or other non-forestry purpose, such as grazing of domestic anilals.

Non-Forest land:
All land not falling within the definitions of closed forest and other wooded land.

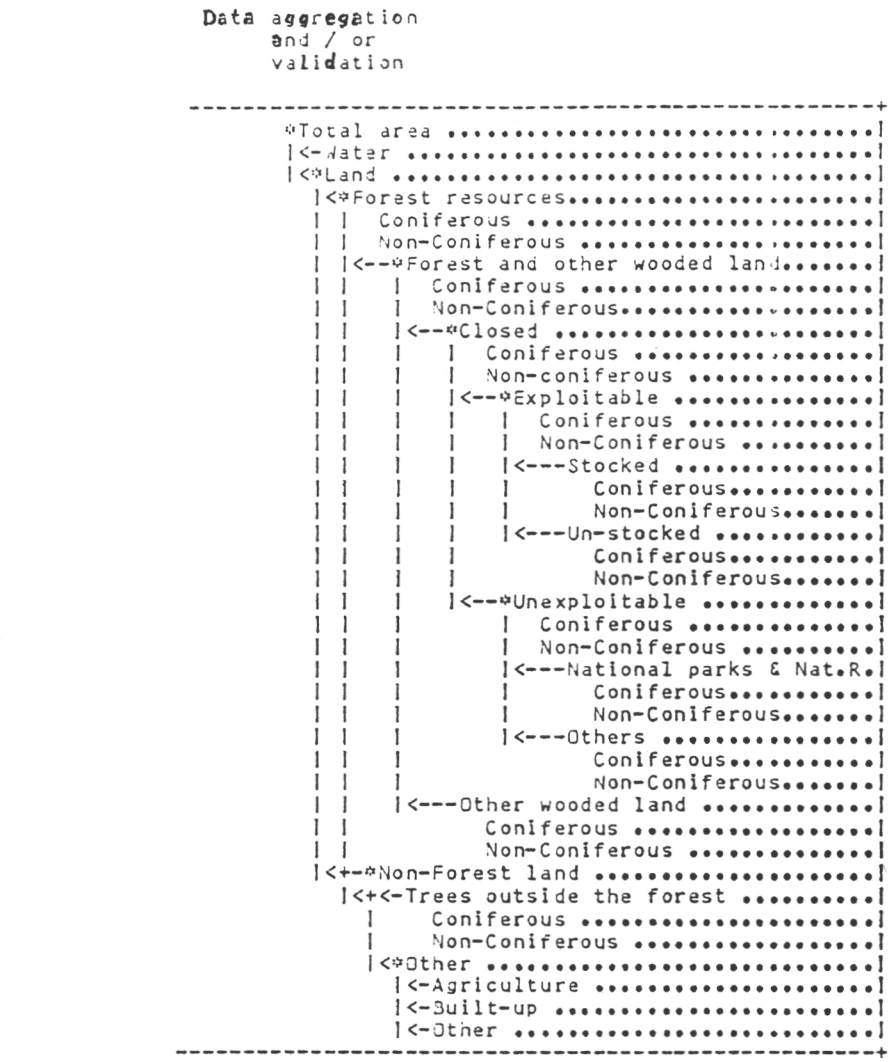
Trees outside the forest:
Trees in city parks, gardens, orchards, hedgerows and lines along roads, canals, streams, etc.) and on agricultural or other non-forest land. These are trees on land areas other than "Closed forest" and "other wooded land".

Other land:

Agricultural land:

Built-up:
Built up and related land, including land under transport and communications facilities.

Other:



General note:
The sum of Coniferous + Non-coniferous is equal to each forest element.
This is applied to all forest elements.

Country coverage

No.	COUNTRY	
1	ALBANIA	
2	AUSTRIA	
3	BELGIUM	
4	BULGARIA	
5	CANADA	
6	CYPRUS	
7	CZECHOSLOVAK	
8	DENMARK	
9	FINLAND	
10	FRANCE	
11	GERMAN DR	
12	GERMANY FR	
13	GREECE	
14	HUNGARY	
15	ICELAND	
16	IRELAND	
17	ISRAEL	
18	ITALY	
19	LUXEMBURG	
20	MALTA	
21	NETHERLANDS	
22	NORWAY	
23	POLAND	
24	PORTUGAL	
25	ROMANIA	
26	SPAIN	
27	SWEDEN	
28	SWITZERLAND	
29	TURKEY	
30	UK	
31	USA	
32	USSR	
33	YUGOSLAVIA	
34	AUSRALIA	(used the same questionnaire
35	JAPAN	(used the same questionnaire
36	NEW ZEALAND	(used the same questionnaire

V I E W S Annex 1 page 1 of 3

(1) Type and species groups

	Area
Forest and other wooded land	d
Coniferous	d
Non-Coniferous	d
Closed forest	y
Coniferous	y
Non-Coniferous	y
High Forest	y
Coniferous	y
Non-Coniferous	y
Coppice and Coppice with standards	y
Coniferous	y
Non-Coniferous	y
Other wooded land	y
Coniferous	y
Non-Coniferous	y
Open woodland	y
Coniferous	y
Non-Coniferous	y
Area occupied by windbreaks, etc.	y
Coniferous	y
Non-Coniferous	y
Scrub and brushland	y
Coniferous	y
Non-Coniferous	y
Trees outside the forest	y
Coniferous	y
Non-Coniferous	y

Definitions

Forest_and_other_wooded_land:
see before

Closed_forest:
see before

High_Forest:
Closed forest normally composed of trees of seedlings origin. Included are other kinds of forest in process of transformation into high forest.

Coppice_and_Coppice_with_standards:
Closed forest composed of stool-shoots or root suckers with or without scattered trees of seedlings origin (standards).

Other_wooded_land:
see before

Open_woodland:

to be provided

Area_occupied_by_windbreaks,_etc.:
to be provided

Scrub_and_brushland:
to be provided

Trees_outside_the_forest:
see before

(2) Ownership and Management	*			
	T	M	N	U
Forest and other wooded land	d	d	d	d
Publicly Owned	d	d	d	d
State	d	d	d	d
Other	d	d	d	d
Privatly owned	d	d	d	d
Forest Industries	d	d	d	d
Farm forest	d	d	d	d
Others	d	d	d	d
Closed forest	y	y	y	y
Publicly Owned	y	y	y	y
State	y	y	y	y
Other	y	y	y	y
Privatly owned	y	y	y	y
Forest Industries	y	y	y	y
Farm forest	y	y	y	y
Others	y	y	y	y
Other Wooded Land	y	y	y	y
Publicly Owned	y	y	y	y
State	y	y	y	y
Other	y	y	y	y
Privatly owned	y	y	y	y
Forest Industries	y	y	y	y
Farm forest	y	y	y	y
Others	y	y	y	y

* Data collected

y=collected
d=deriverd

Total area (T):
It is the sum of Managed(M), Not managed(N) and No-controls(U).

Managed according to a plan (M):
Forest and other wooded land managed on the basis of a plan drawn up by professionally qualified foresters, which defines areas or quantities for felling, silvicultural treatment, etc. It may be approved by the national forest administration or other official body.

Not Managed (N):
Not managed according to a plan but having controls relating to management or use.
Fores and other wooded land not managed according to a plan but for which provision or controls exist which effectively regulate its management or use.

No-controls (U):
Land having no controls relating to management or use.

Definitions (Ownership and Management)

Publicly Owned:

State:
It includes forest and other wooded land:
(a) owned by national, state, and regional governments or by government-owned corporations; Crown forests;
(b) belonging to towns, villages and communes;

Other:
It includes any other publicly owned forest not elsewhere specified.

Privatly owned:

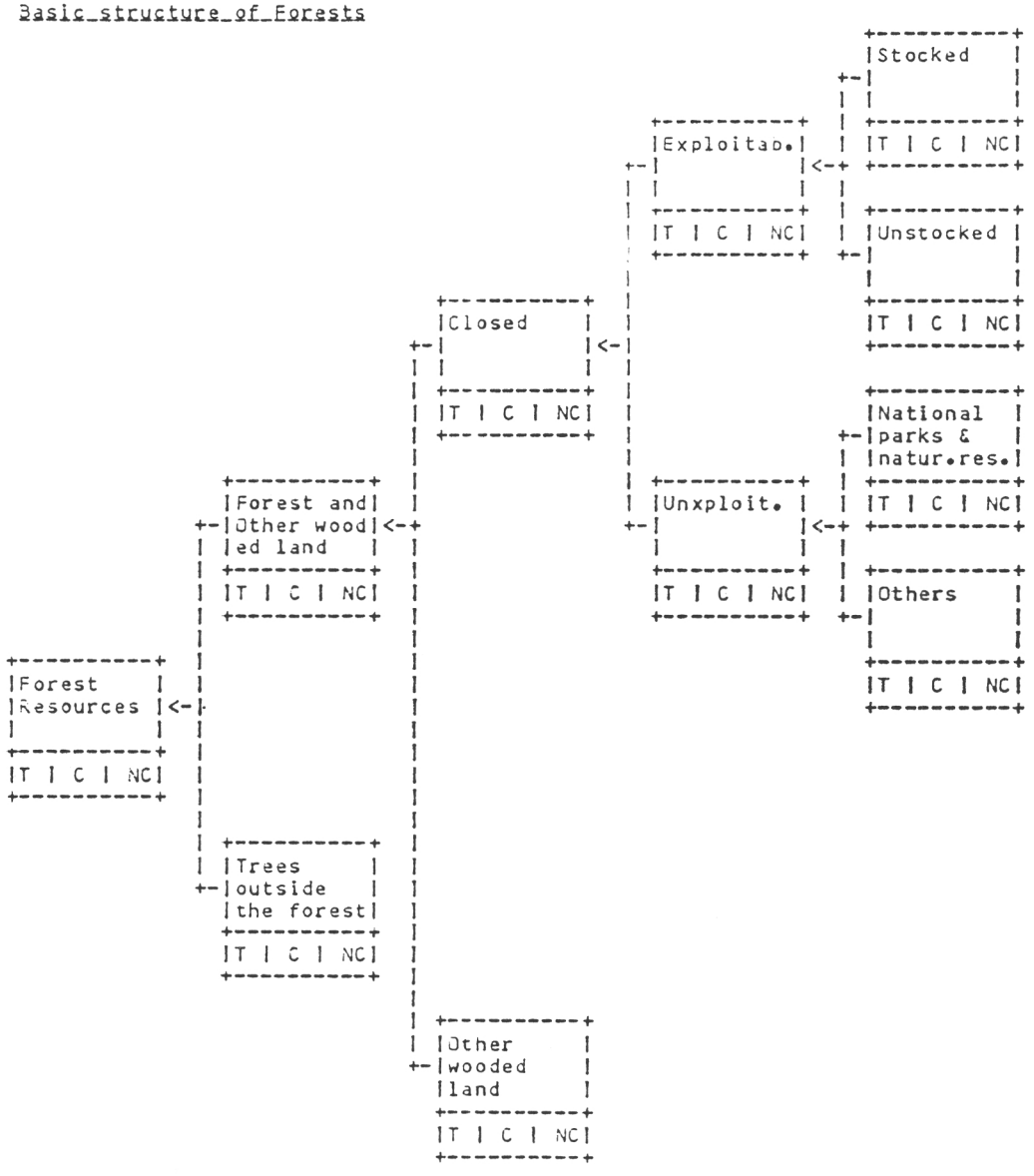
Forest Industries:
It includes forests and other wooded land wich is owned by forest industry.

Farm forest:
It includes forest and other wooded land owned by individuals, families or corporations engaged in agriculture as well as forestry;

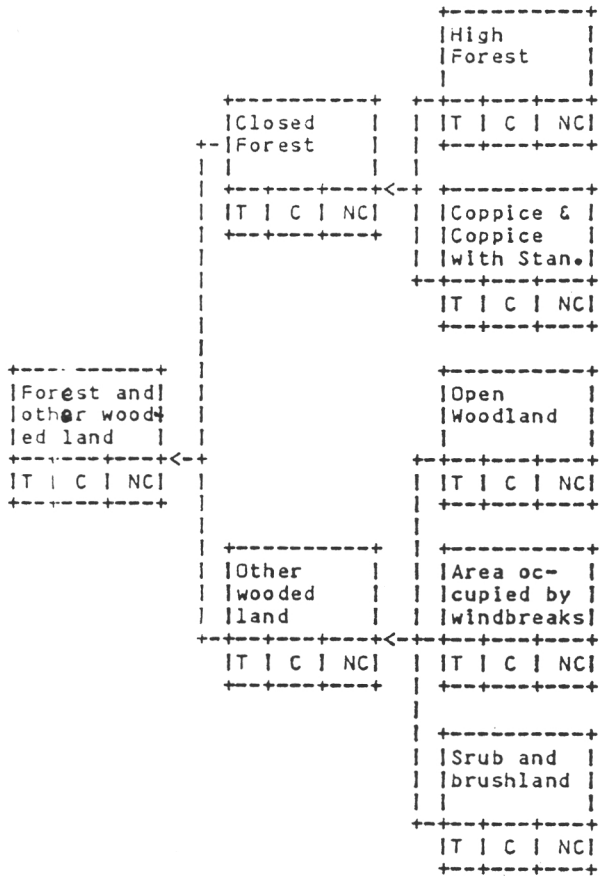
Others:
It includes forest and other wooded land privately owned not elsewhere specified, including forest owned by institutions (religious, educational, etc.).

Relationship among basic structure and "Views".

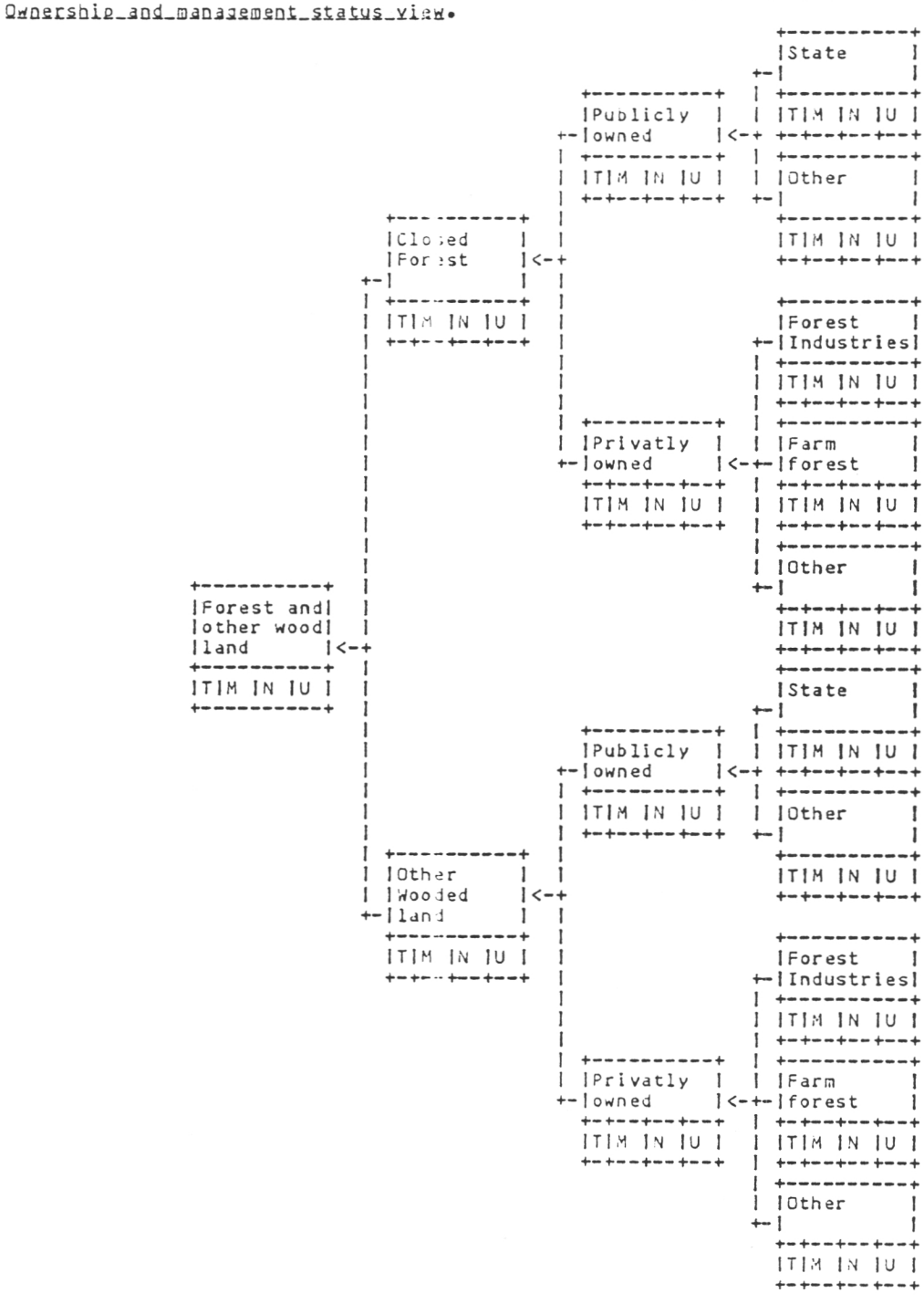
Basic structure of Forests



Type and species groups view.



Ownership and management status view.



N O T E S

on

The computerized data structure
of

THE FOREST RESOURCES OF THE ECE REGION
1980

TABLE 1 : Overall land classification

TABLE 2 : Forest and other wooded land by type and species groups

TABLE 3 : Closed Forest by main categories

TABLE 4 : Forest and other wooded land by ownership and management status

TABLE 9 : Standing volume

TABLE 10: Annual increment

Back-ground material prepared in Geneve by Mr.F.Padovani and Mr.G.Najera
the 6-7 April 1987

TABLE 1: Overall land classification

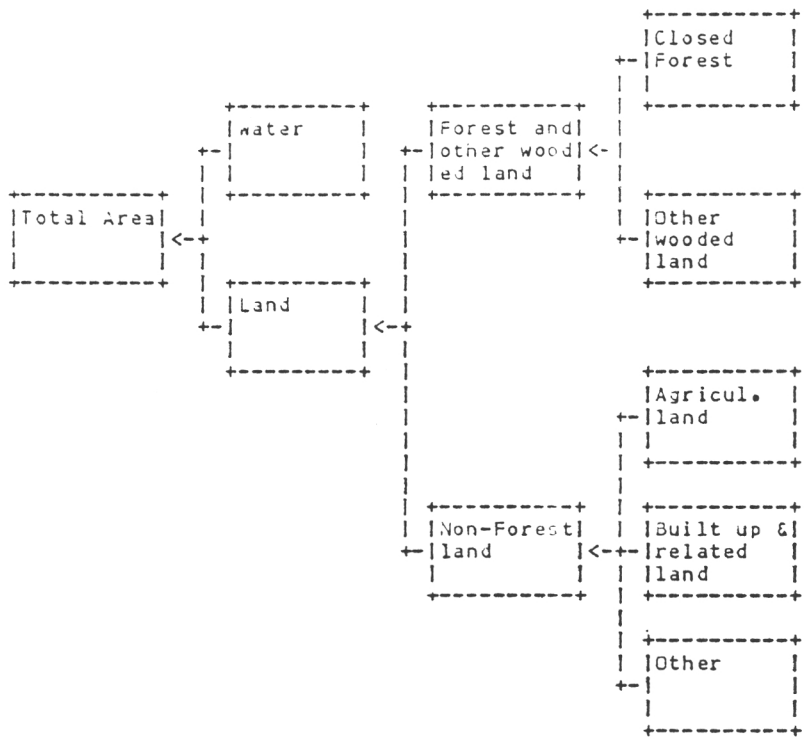


Table 1: Overall Land Classification. Area in 1000 HA.

Total area
- Water
- Land
  - Forest and other wooded land
    - Closed forest
    - Other wooded land
  - Non-forest land
    - Agricultural land
    - Built up and related land, etc.
    - Other

TABLE 2: Forest and other wooded land by type and species groups.
Forest and other wooded land - Trees outside the forest

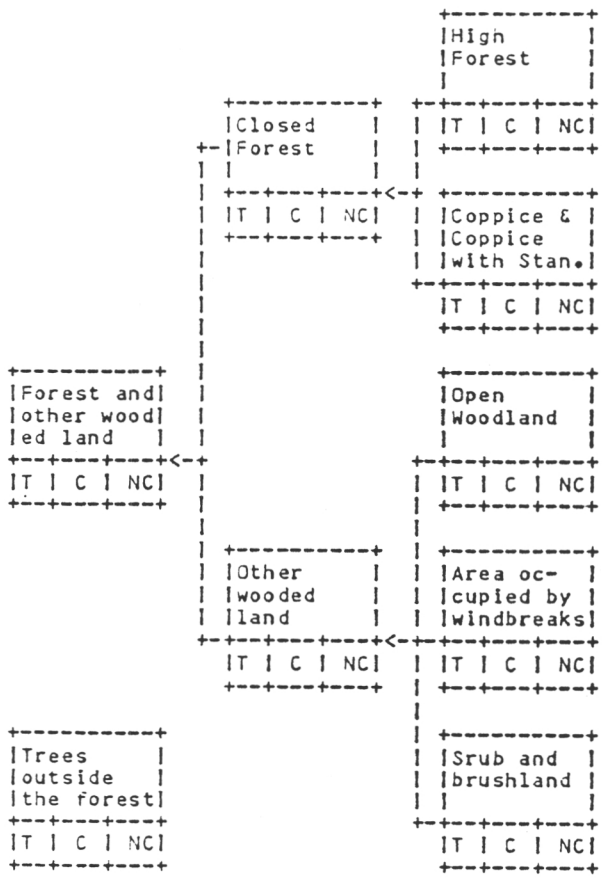


TABLE 2: Forest and other wooded land by type and species groups.
Forest and other wooded land - Trees outside the forest
Area in 1000 HA.

Forest and other wooded land
  Coniferous
  Non-Coniferous
    Closed forest
      Coniferous
      Non-Coniferous
        High Forest
          Coniferous
          Non-Coniferous
        Coppice and Coppice with standards
          Coniferous
          Non-Coniferous
    Other wooded land
      Coniferous
      Non-Coniferous
        Open woodland
          Coniferous
          Non-Coniferous
        Area occupied by windbreaks, etc.
          Coniferous
          Non-Coniferous
        Scrub and brushland
          Coniferous
          Non-Coniferous
Trees outside the forest
  Coniferous
  Non-Coniferous

TABLE 3: Closed Forest by main categories

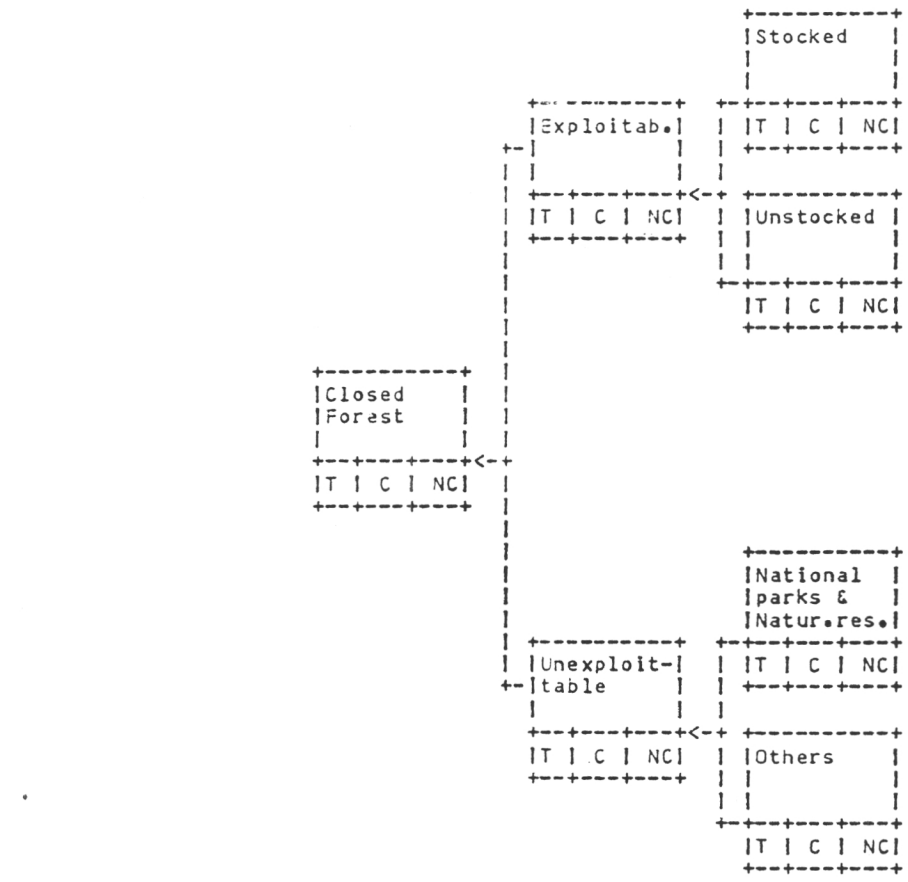


Table 3. Closed Forest. Area in 1000 HA.

- Closed forest
  - Coniferous
  - Non-Coniferous
    - Exploitable
      - Coniferous
      - Non-Coniferous
        - Stocked
          - Coniferous
          - Non-Coniferous
        - Unstocked
          - Coniferous
          - Non-Coniferous
    - Unexploitable
      - Coniferous
      - Non-Coniferous
        - National Parks & Natur.Res
          - Coniferous
          - Non-Coniferous
        - Others
          - Coniferous
          - Non-Coniferous

TABLE 4:Forest and other wooded land by ownership and management status

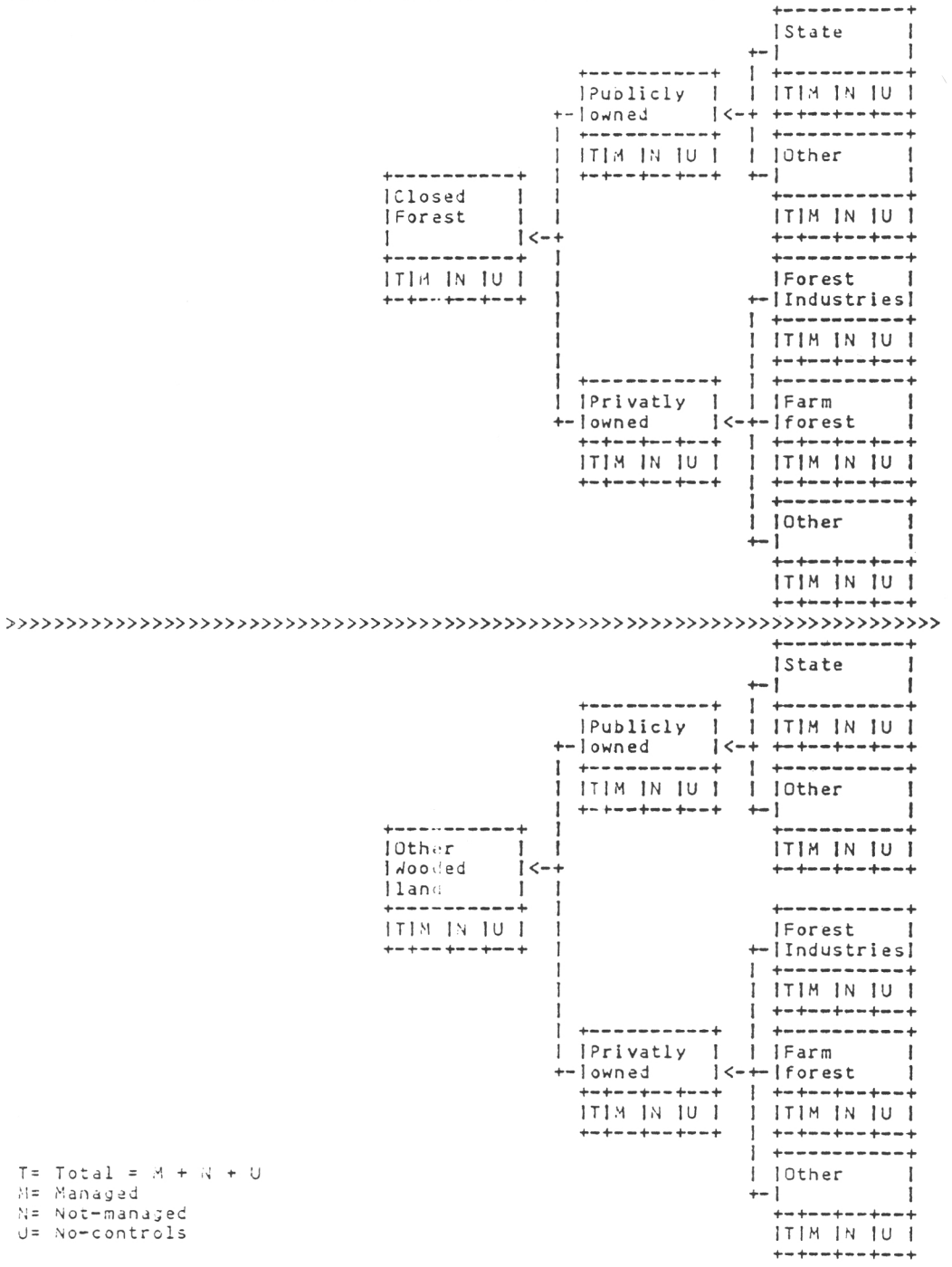


Table 4. Forest and Other Wooded Land. Area in 1000 HA.*

Closed forest
- Publicly Owned
  - State
  - Other
- Privatly owned
  - Forest Industries
  - Farm forest
  - Others

Other Wooded Land
- Publicly Owned
  - State
  - Other
- Privatly owned
  - Forest Industries
  - Farm forest
  - Others

*Total
- Land managed according to a plan
- Land not managed according to a plan but having controls relating to management or use
- Land having no controls relating to management or use

TABLE 9: Standing volume
(including growing stock)

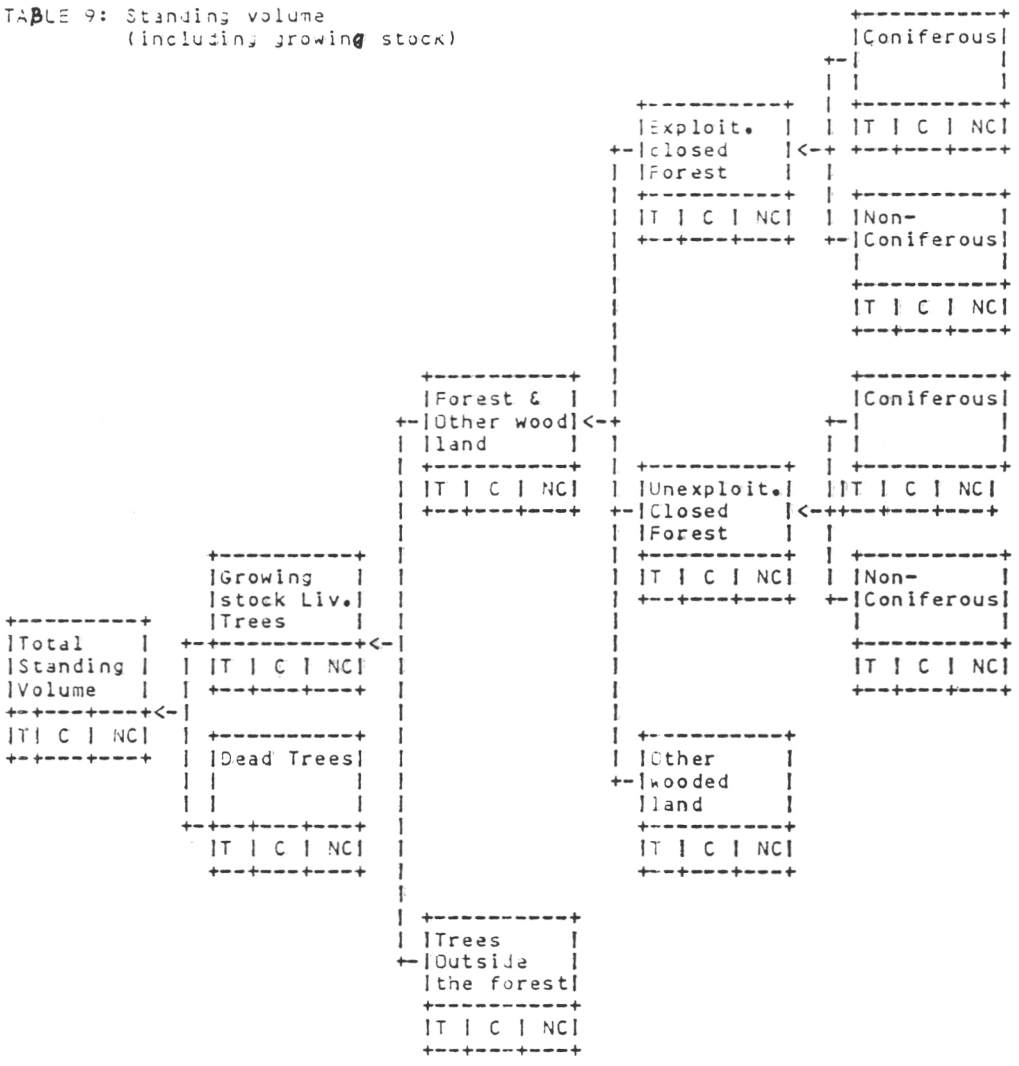
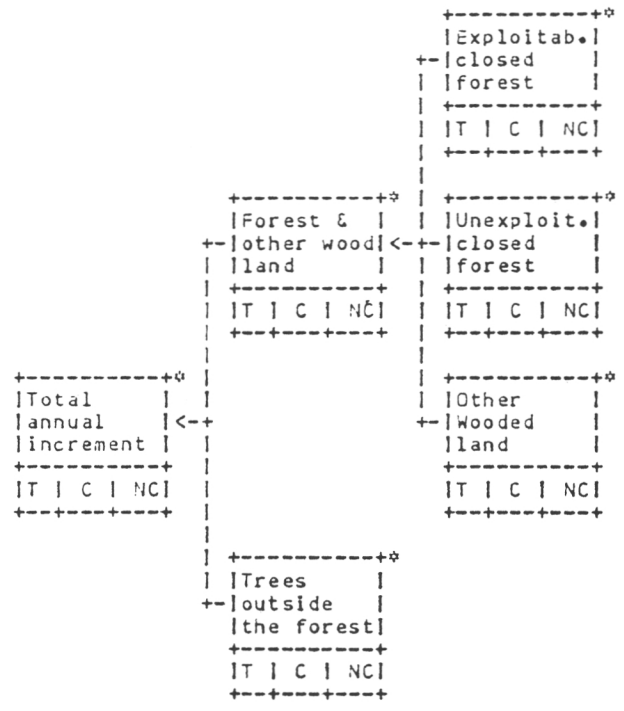


Table 9. Standing volume. millions m3 VOB.*

- Total Standing Volume
  - Coniferous
  - Non-Coniferous
    - Growing Stock (Living trees)
      - Coniferous
      - Non-Coniferouus
        - Forest and other wooded land
          - Coniferous
          - Non-Coniferous
            - CLOSED (derived)
              - CONIFEROUS (derived)
              - NON-CONIFEROUS (derived)
                - Exploitable
                  - Coniferous *
                  - Non-Coniferous *
                - Unexploitable
                  - Coniferous *
                  - Non-Coniferous *
            - Other wooded land
              - Coniferous
              - Non-Coniferous
          - Trees outside the forest
            - Coniferous
            - Non-Coniferous
      - Dead trees
        - Coniferous
        - Non-Coniferous

*Witnin composition of coniferous and non-coniferous.
(See page 39, of The "Forest resources of the ECE region 1980).

TABLE 10: Annual increment*



* Note: The data collected for each forest class

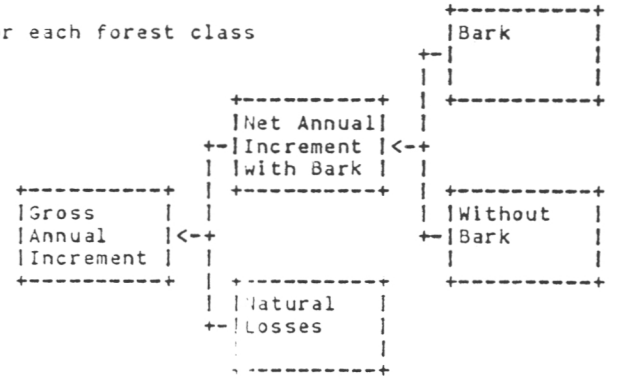


Table 10. Annual increment.

Total annual increment		*
Coniferous		*
Non-Coniferous		*
Forest and other wooded land		*
Coniferous		*
Non-Coniferous		*
CLOSED	(derived)	
CONIFEROUS	(derived)	
NON-CONIFEROUS	(derived)	
Exploitable		*
Coniferous		*
Non-Coniferous		*
Unexploitable		*
Coniferous		*
Non-Coniferous		*
Other wooded land		*
Coniferous		*
Non-Coniferous		*
Trees outside the forest		*
Coniferous		*
Non-Coniferous		*

Gross annual increment
Natural loss
Net annual increment with bark
Bark
Net annual increment without bark

P A R T 4

Notes on the Countries covered by reference to Documents for Forest Resources assessment 1980

The Stucture

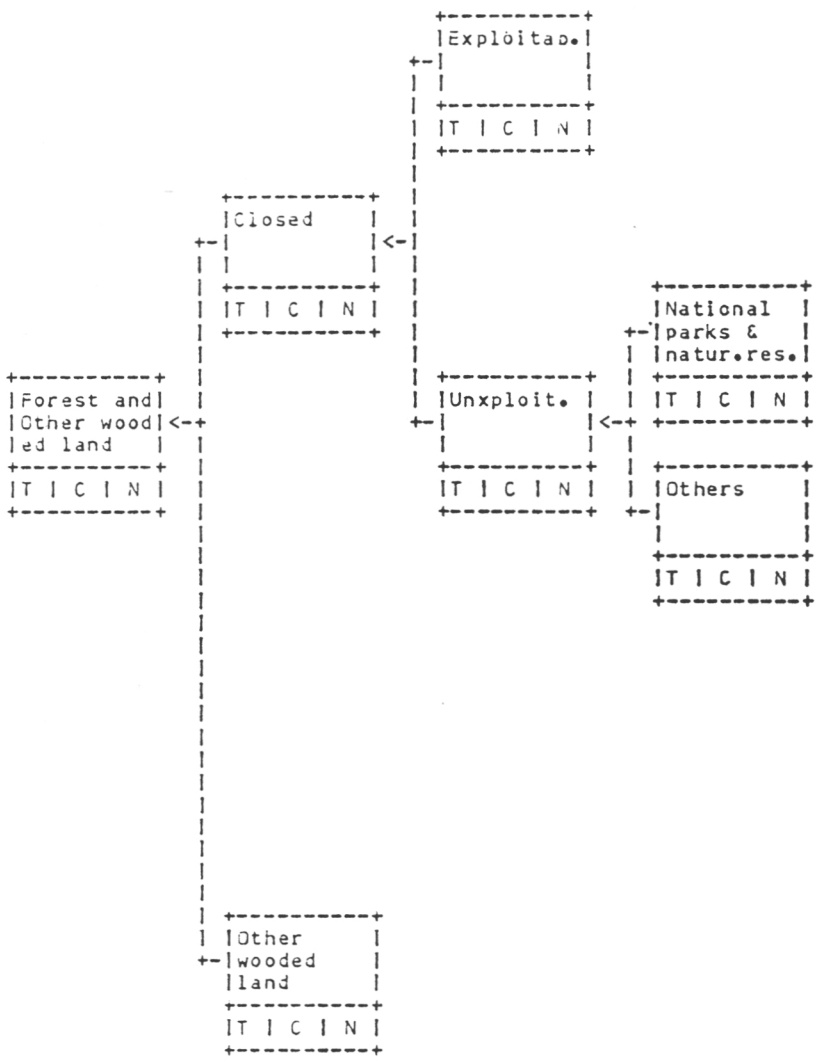
Data collected

Country coverage

Documents used

These notes have been prepared by F. Padovani in consultation with P. Wardle.

The structure



Data Stucture	Data collected: Area (A)	Data collected: Standing volume (S)
Forest and other wooded land	y	
Coniferous	y	
Non-Coniferous	y	
Closed	y	
Coniferous	y	
Non-coniferous	y	
Exploitable	y	
Coniferous	y	y
Non-Coniferous	y	y
Unexploitable	y	
Coniferous	y	y
Non-Coniferous	y	y
National parks &	y	
Coniferous	y	
Non-Coniferous	y	
Others	y	
Coniferous	y	
Non-Coniferous	y	
Other wooded land	y	
Coniferous	y	y
Non-Coniferous	y	y

Legend:

y = yes

Data collected:

(A) Area:
It is measured in 1000 ha.

(B) Standing volume:
Volume of standing trees, all species, living or dead, all diameters down to a stated minimum diameter. Species which do not have an upright trunk (brush, etc.) are not considered as trees. It includes dead trees laying on the ground which can still be used for fibre or as fuel.
It is measured in 1000000 m3 o.b.

Country coverage:

No.	COUNTRY
1	AFGHANISTAN
2	ALGERIA
3	ARGENTINA
4	BAHRAIN
5	CAPE VERDE
6	CHILE
7	CHINA
8	DJIBOUTI
9	DOMINICA
10	EGYPT
11	FIJI
12	GREENLAND
13	GUADELOUPE
14	IRAN
15	IRAQ
16	JORDAN
17	KOREA DPR
18	KOREA REP
19	KUWAIT
20	LEBANON
21	LESOTHO
22	LIBYA
23	MARTINIQUE
24	MAURITANIA
25	MAURITIUS
26	MONGOLIA
27	MOROCCO
28	NEWCALEDONIA
29	OMAN
30	PUERTO RICO
31	QATAR
32	REUNION
33	SAMOA
34	SAO TOME PRN
35	SAUDI ARABIA
36	SEYCHELLES
37	SOLOMON IS
38	SOUTH AFRICA
39	ST HELENA
40	SWAZILAND
41	SYRIA
42	TUNISIA
43	U A EMIRATES
44	URUGUAY
45	VANUATU
46	WESTN SAHARA
47	YEMEN AR
48	YEMEN DEM
49	ZIMBABWE

Documents used:

No.	COUNTRY	Documents
1	AFGHANISTAN	WFR
2	ALGERIA	WFR
3	ARGENTINA	WFR / P52 , FOR/CF(84), B6321 n. 340
4	BAHRAIN	WFR
5	CAPE VERDE	WFR
6	CHILE	WFR / 583 16 n. 6
7	CHINA	Forestry Paper N.35,Commonwelth FO.REWIEW 59(1) 1980
8	DJIBOUTI	WFR
9	DOMINICA	WFR
10	EGYPT	WFR
11	FIJI	WFR
12	GREENLAND	Production Yearbook
13	GUADELOUPE	WFR
14	IRAN	WFR / REP
15	IRAQ	WFR / REP
16	JORDAN	FOL CF 569.5
17	KOREA DPR	WFR
18	KOREA REP	Korea: Forestry Statistics
19	KUWAIT	WFR
20	LEBANON	WFR
21	LESOTHO	WFR
22	LIBYA	WFR
23	MARTINIQUE	WFR
24	MAURITANIA	WFR
25	MAURITIUS	WFR
26	MONGOLIA	WFR / TA 3093
27	MOROCCO	WFR / REP
28	NEWCALEDONIA	WFR
29	OMAN	WFR
30	PUERTO RICO	WFR
31	QATAR	WFR
32	REUNION	WFR
33	SAMOA	WFR
34	SAO TOME PRN	WFR
35	SAUDI ARABIA	WFR
36	SEYCHELLES	WFR
37	SOLOMON IS	WFR
38	SOUTH AFRICA	WFR / REP
39	ST HELENA	WFR
40	SWAZILAND	WFR / REP
41	SYRIA	REP
42	TUNISIA	WFR / REP
43	U A EMIRATES	WFR
44	URUGUAY	WFR / ODC (899)
45	VANUATU	WFR
46	WESTN SAHARA	WFR
47	YEMEN AR	WFR
48	YEMEN DEM	WFR
49	ZIMBABWE	WFR / REP

WFR: World forest resources
Institutionen for skogstaxering
Department of forest survey,
Rapporter och Uppsatser/Research Notes
Reidar Persson
SKOGSHOGSKOLAN
Royal college of forestry, Stockholm

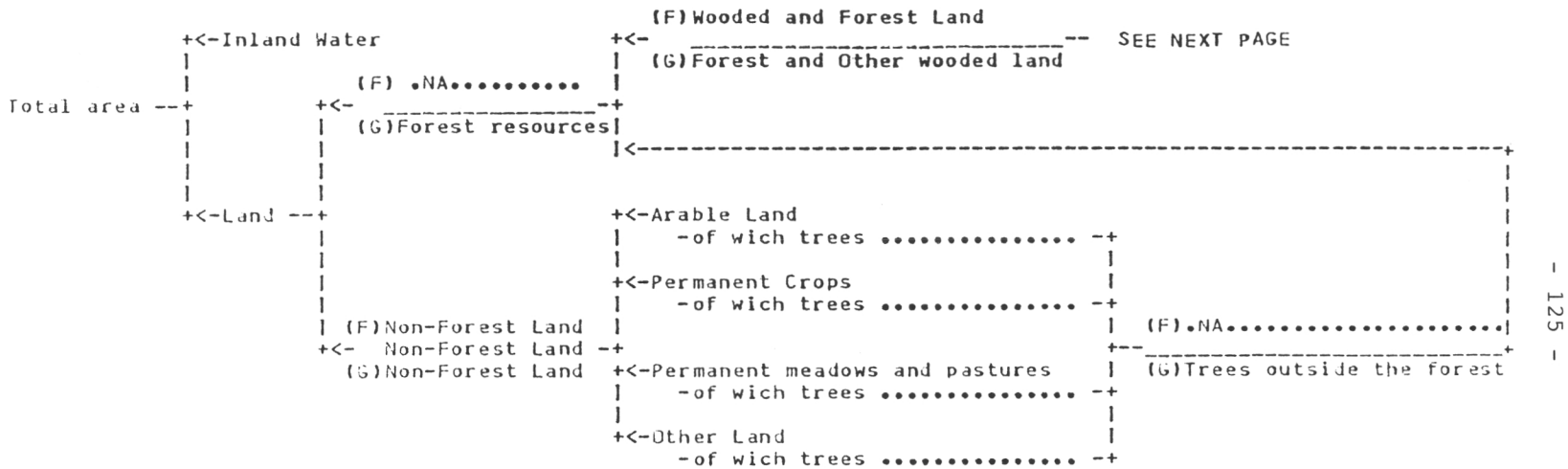
P A R T 5

Notes on

Structural problem in integrating the ECE and FORIS data

- Land use classification chart
- First attempt
- Second attempt
- Notes
- A possible common structure

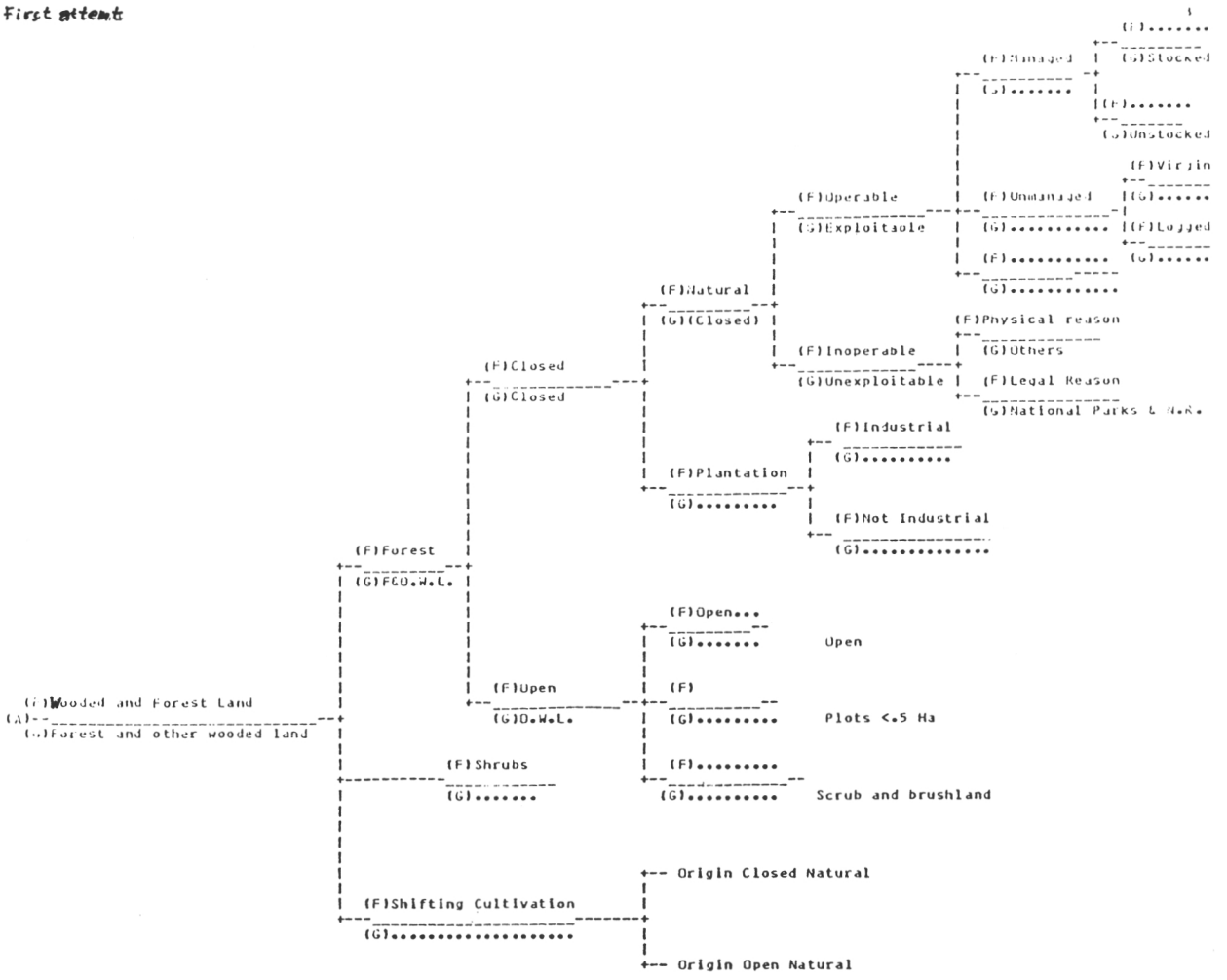
Land use classification chart

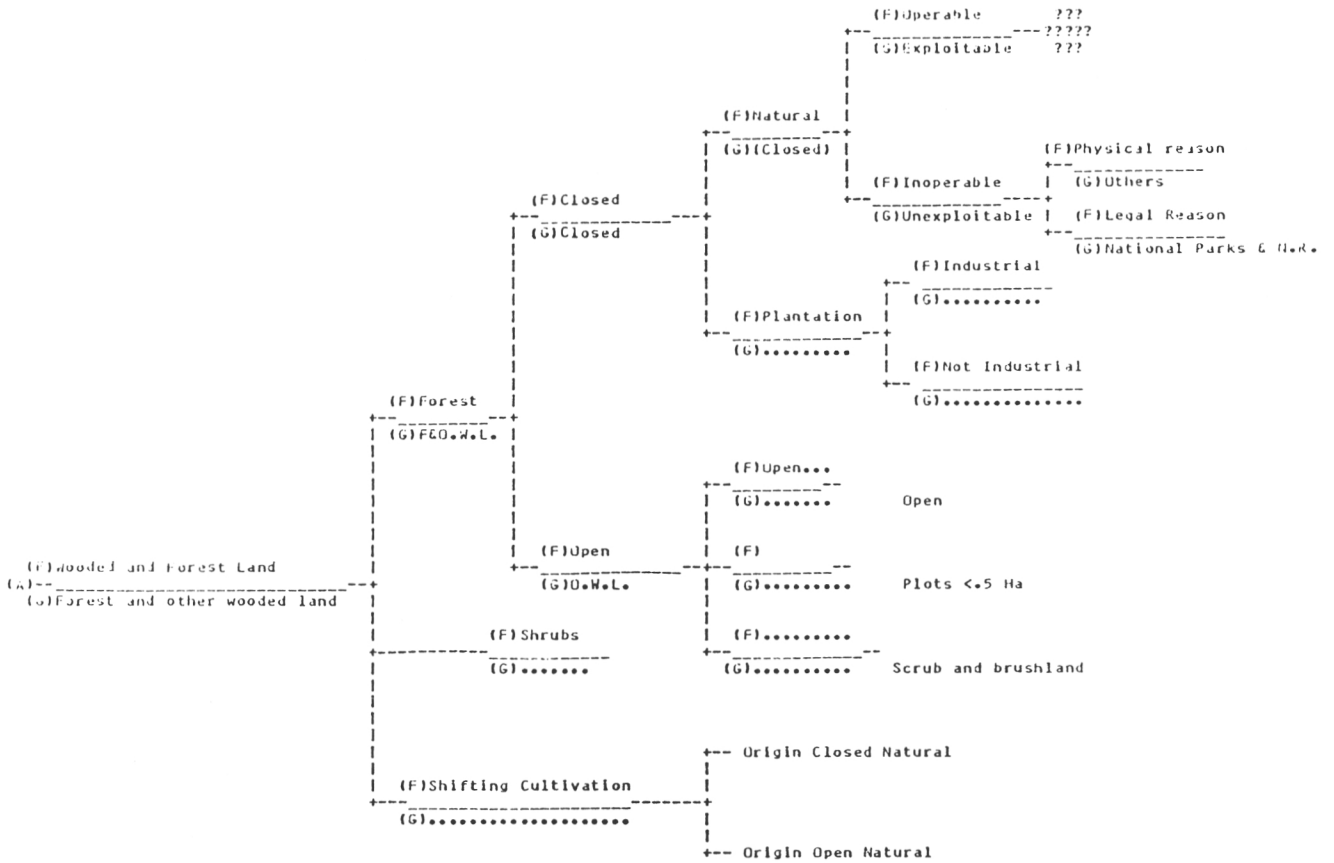


Legend: F= FORIS , G=Geneva , NA=Not Available

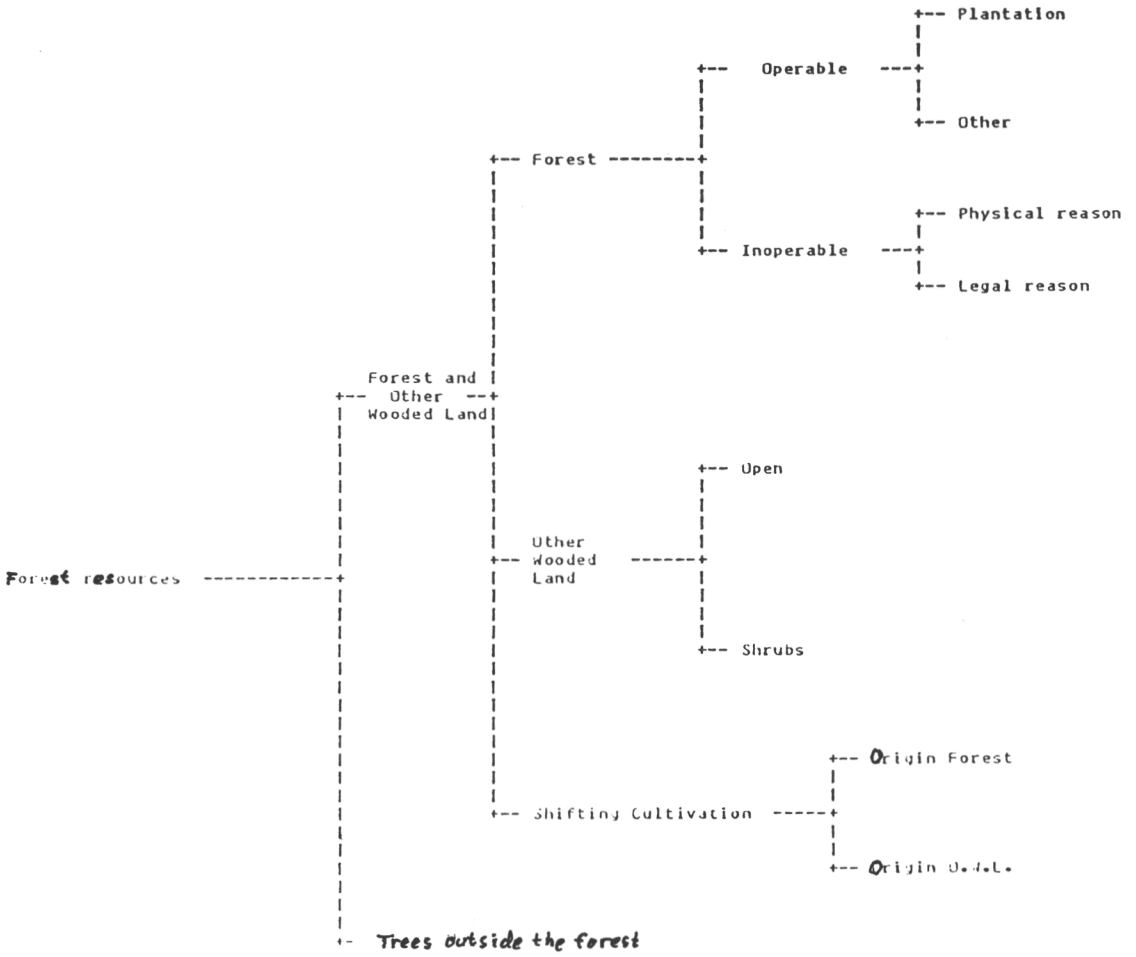
Notes:
In (F) "Trees outside the Forest" is not recorded.

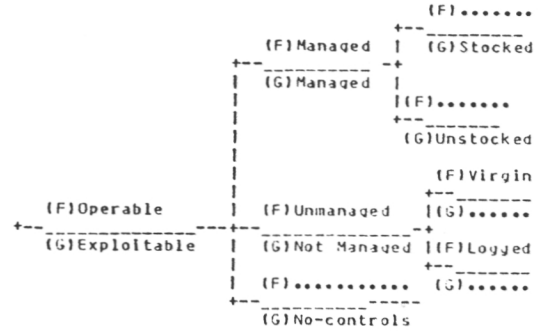
First attempt




(F)Operable ???
(G)Exploitable ???
(F)Natural
(G)(Closed)
(F)Physical reason
(G)Others
(F)Inoperable
(G)Unexploitable
(F)Legal Reason
(G)National Parks & W.R.
(F)Closed
(G)Closed
(F)Industrial
(G).....
(F)Plantation
(G).....
(F)Not Industrial
(G).....
(F)Forest
(G)F&O.W.L.
(F)Open...
(G).....
Open
(F)Wooded and Forest Land
(G)Forest and other wooded land
(F)Open
(G)O.W.L.
(F)
(G).....
Plots <.5 Ha
(F)Shrubs
(G).....
(F).....
(G).....
Scrub and brushland
Origin Closed Natural
(F)Shifting Cultivation
(G).....
Origin Open Natural

A possible common structure





Notes

1) Shifting cultivation is "0" zero in (G).
2) Shrubs / Scrub and brushland have similar definition in (F) and (G)
3) In (G) the (Closed) includes also plantation, do not have a separate class
4) The meeting held the 31/8/87 suggest to include the "plots <.5 Ha" as part of the "Trees outside the forest".
5) "Open" in (F) it is repeated in upper and lower levels in (G) it is include as a component of "Uther wooded land".
6) "Closed" are viewed in a different ways from (F) and (G) in relation to management:
   - In (F) see page 2 chart "0".
   - In (G) see Annex 2 page 1 of 3 and, page 3 of 3.

....

The problem is: It is possible combine in a common structure the (F) and (G) structures ? ?? ??? ???? ?????

Part II

NATIONAL REPORTS

NATIONAL REPORT: AUSTRIA

by
Johann Haszprunar

1. Development of the Austrian Forest Inventory

Austria carries out a systematic sample test survey on mathematical-statistical basis. This survey evolved from the "Waldstandsaufnahme", performed in the years 1952 to 1956, which should make available data for assessing the condition of the forests after World War II. The "Waldstandsaufnahme" was an extensive survey of the condition of each forest stand as it is done in making a rather large-scale forest management plan with the support of aerial photos. When the evaluations were finished, Dr. Braun, at that time chief of the WA, has shown the drawbacks of this method. These drawbacks arose especially in uneven-aged stands in estimating standing crop and increment, and was caused by using the compartment system and estimates by means of yield-tables. This led to an inventory being carried out since 1961, similar to the Swedish Survey, using the method of random sampling.

Since 1961 the Austrian Forest Inventory is based on a systematic satellite-sample test using a combined method of tract-, sample plots- and line-survey. The sample plots are arranged along the circumference of the squared tracts.

The main target of the forest inventory period 1961 to 1970 was to give basic data for volume and increment in the different units (management classes, ownership classes, geographical units etc) for the whole of Austria, collected in an uniform manner and showing a low standard-error.

The second period of the forest inventory from 1971 to 1980 recorded attributes, which made it possible, besides the current checking of volume and increment, to give a better insight into the interior structure of the commercial forests. Moreover it was intended to get results concerning trend development. These calculations, however, did not yield satisfactory results, because by the small changes of the estimates for the relatively short periods increases or decreases are covered by the standard-deviation.

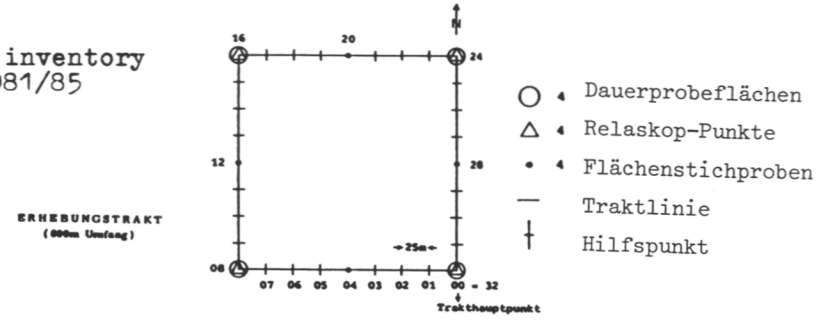
2. Periods of Forest Inventory 1981/85 and 1986/90

2.1. Period of Inventory 1981/85

Since 1981 the Austrian Forest Inventory has changed the method of survey using the manner of the so-called "Folgeinventur" ("Continuous Inventory"). The sample plots are now as before not individually distributed over the whole survey area, but combined in an unit of survey called "tract" with four sample plots each (satellite sample test). These tracts are distributed evenly with a distance of 3.89 km in the ten year grid over the territory of Austria so that the distance per year amounts to 8.7 km approximately. Accordingly every year 1,100 tracts are surveyed, which are likewise distributed evenly over the territory of Austria. In the years 1981 to 1985 there are established four sample plots for each tract by the way of permanent plots and subsequently the control-measurements are taken in intervals of five years. In the management-classes high forest/commercial forest, high forest/protection forest with yield and coppice the centres of these permanent sample plots are marked durably but invisibly by zinced iron pipes. By these continuous surveys it will be probably possible to catch trend-developments concerning the condition of the forest stands with great accuracy also for smaller units. According to Dr. Schmid-Haas (Switzerland), one of the advising experts of the Austrian Forest Inventory after 1980, a four- to sixfold increase of precision is to be expected.

The tract as unit of survey was retained in the hitherto existing form (a square 200 m by 200 m), the south-eastern corner (cardinal point of tract) fixed by coordinates. Each of the four tract-corners is the centre of a permanently established sample plot (permanent sample plot) and at the same time also point for the ascertainment of stand volume and increment by relascope and also centre of an invariable circle for the recording of trees with small diameters. All trees with diameters at breast height (d.b.h.) of more than 105 mm are chosen by means of the Bitterlich method, but in addition their location is registered by polar-coordinates. Moreover for each permanent sample plot all trees from 50 to 104 mm d.b.h. in the high forest are measured as sample trees in the invariable circle with a radius of 2.60 m (21 sqms) and their location is registered by polar-coordinates. The choice of the sample trees in coppices takes place for the main stands in the same manner as in high forests. Underwood is surveyed in an invariable circle with a radius of 3.99 m.

Tract of inventory period 1981/85



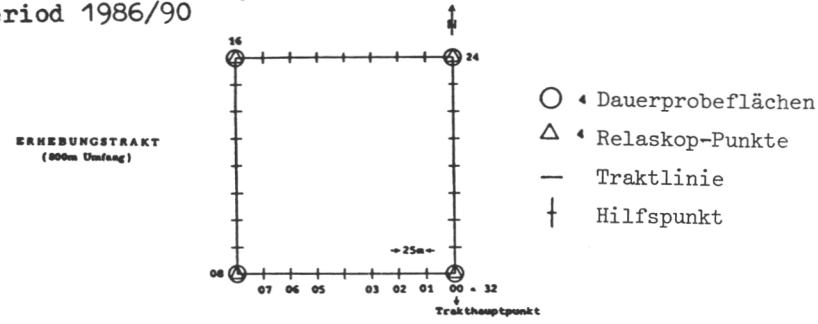
Characteristics of the sampling area were surveyed on the four permanent sample plots, which are used as area sample plots, and on four further area sample plots situated halfway of the sides of the tract. The volume increment of the sample trees is determined as difference between two calculations of volume five years apart. In order to compare results of this kind with results found out by hitherto existing methods of taking cores there was established a fifth sample plot for each tract for this special survey. In this sample plot an additional core is taken on the occasion of the first periodical control-measurement.

The surveys of volume felled during the years 1961/70 and 1971/80 were affected with high systematic survey errors and were dropped in the hitherto existing form of the stump inventory in 1981.

2.2 Period of Inventory 1986/90

On the sample plots established in permanent form between 1981 and 1985 the first continuous surveys are carried out since 1986. Therefore the sample plots of the tracts established 1981 in permanent form were visited in 1986, those of 1982 were visited in 1987 and so on. The continuous surveys are carried out on the sample plots in the corners of the tracts. The area sample plots established in the survey years 1981/85 as a special survey for the comparison of increment are only visited again in the years 1986 to 1990. The remaining area sample plots of the years 1981 to 1985 are surveyed no more.

Tract of inventory period 1986/90



2.2.1 Inventory of volume felled

It is possible by the sample plots established in permanent form to register the sample trees, which had been felled or which have died in the past five years, very exactly. Therefore the calculation of the volume of the stems felled is possible. Because of the lower number of sample plots the standard error will increase a little bit, but that systematic survey error is eliminated, which resulted by the uncertain delimitation of the vegetation period. For bigger geographic units and for five- to ten-year periods one can probably expect good results.

2.2.2 Road inventory

In the commercial forests at the points of intersection of the survey line with the axis of a skid road or a forest road a classification of the roads was carried out. The calculations of the road-lengths is based on the classic geometric problem of probabilities, published by the French natural scientist Buffon already in 1777 ("Buffon's Needle Problem").

2.2.3 Logging distances

For the determination of the logging distances additional surveys are made. Taking the cardinal point of the tract ("00") as reference point and irrespective of the land use the distance to the skid road, the length of the skid road to the forest road, where trucks can be used, and the length of the road to the major road are to be recorded.

2.2.4 Temporary sample plots

In addition to the permanent tracts established in the period 1981/85 for continuous surveys from 1986 onwards also temporary tracts are surveyed. The result of the survey of these temporary tracts should give information about a potential systematic influence for the permanent tracts by eventual knowledge of the situation of the continuous sample plots. For this reason since 1986 not only the first continuous survey of the permanent established tracts respectively sample plots was started, but also in addition the same number of temporary surveyed tracts included. The size of the tracts and the number of sample plots are the same as in the permanent inventory. These temporary tracts should show systematically conditioned errors, like e.g. increased harvesting of sample trees damaged by game (bark-peeling), uneven thinning etc. on permanent sample plots, and improve the accuracy of the estimated values of the recorded characteristics in the evaluation of 1990. At the end of the five-years inventory period 5,500 permanent tracts with approximately 22,000 sample plots and 70,000 sample trees will be surveyed a second time and also the same number of temporary tracts with their sample plots and sample trees will be available for the calculation of the estimates and the control of the permanent sample plots. The evaluation of the permanent tracts together with the temporary tracts should permit an optimal view over the situation and the development of the Austrian forests, also for smaller units.

3. I n n o v a t i o n s in the inventory since 1981

Changes of characteristics have been avoided to a great extent, but could not be excluded entirely because of new perceptions and requirements to be comprised in the survey. In this case it was tried by parallel evaluations to permit a comparison with the results of the inventory periods 1961/70 and 1971/80.

3.1 Limit in diameter measuring

The diameter limit for sample trees was reduced since 1981 for the management classes high forest/commercial forest, high forest/protection forest with yield and for standards im coppices from 105 mm to 50 mm diameter in breast height. In this way the diameter limit is decreased uniformly in all management classes to 50 mm d.b.h. Certainly trends of development will be better recognizable in this way in the future.

3.2 Volume ascertainment and volume increment

It was not possible to determine increments for the period 1981/85 since there were not taken increment cores from sample trees on permanent sample plots to avoid systematical errors. Therefore there were no increment calculations carried out in the evaluations 1981/85, but for the possibility of comparison with the period of inventory 1971/80 also calculated the volumes from 105 mm d.b.h. on. From 1990 on calculations of increment will be carried out in evaluation.

3.3 Improvement of the area of tree species

To improve the accuracy of the percentage of area for the tree species in the age-classes the survey of the areas of tree species was modified. While until 1980 each sample plot was divided into shares of age-classes as well as into shares of tree species separately, since 1981 the shares of the area of tree species were estimated in the existing age-classes. By this the allotment of tree species to age-classes in two- or many-storied stands is possible with greater precision. The increase or decrease of the area of tree species can be better recognized.

3.4 Browsing of isolated young growth up to 1.30 height

To find out the browsing of isolated young growth (up to a height of 1.30 m) with greater precision it is possible since 1981 to specify five kinds of browsing and their percentage for each tree species recorded. Also the damage by rubbing and striking are recorded separately for tree species. The results should give the authorities hints about spreading and density of game populations.

3.5 Damages of stands on areas of different size

In surveying damages of stands besides the registration of bark-peeling also the damages by felling, logging and rockfall with their grades of intensity were included. In evaluations there are calculated also the volumes in the intensity grades belonging to the areas.

3.6 Food of deer

In the commercial forests the food for cloven hoofed game (without wild boar) within its reach is surveyed. Scientific analysis on the stress on vegetation by grazing of game is

possible by this. Also the area of mast and shedding of leaves, which also may be food for game, are surveyed.

3.7 Damages of stems

For the sample trees the survey had to be modified on the permanent sample plots. Until 1980 the damages of stems had only been surveyed in case the yield in lumber or the development of trees was restrained. Only the most important damage could be registered.

Since 1981 eight different criterions were distinguished for sample trees, and it was possible to specify three different damages per tree. Additional for peeling damages the number of damages is surveyed, without respect to the size, but only if the cambium is hurt. These exact survey is necessary, because otherwise also on the permanent sample plots an alternation of the peeling damages is not clearly recognizable and a calculation would not be possible. By recognizing a new peeling damage the results are becomig more reliable.

3.8 Inventory of forest conditions

Since 1984 also the characteristics of the (until now) from the forest inventory separated inventory of forest conditions are included in the forest inventory. The inventory of forest conditions surveys only predominant an dominant sample trees with an age of more than 50 years and a growth-class above pole-wood. From the first comparisons with the inventory of forest conditions are problematic by reasons of the survey technique, because at the forest inventory the survey is carried out from spring to autumn continuously, on the other hand the surveys at the inventory of forest conditions take place only in July and August. Already by this reason the appraisement of the conditions of the tree crowns can be substantially different. Besides the Austrian Forest Inventory visites the same sample plots only every fifth year. For long-term observations of the conditions of the tree crowns the permanent sample plots of the forest inventory certainly are qualified at the best. Therefore the two networks of sample plots are combined in the future to a great extent.

4. E s t a b l i s h m e n t of the basic material for survey and e q u i p m e n t of the survey groups (use of computers)

4.1 Preparatory works - network of tracts

a. Fixing the network of tracts with distances between tracts and calculation of the coordinates for the network of tracts.

b. Calculation of the south-eastern cardinal points of the tracts, partially transforming the coordinates into neighbouring geodetic systems (Gauss-Krueger M 31 to M 28 respectively M 34) respectively to local systems.

c. Drawing the network of tracts on the Austrian map, scale 1 : 50,000.

d. Transmission to the Austrian map, scale 1 : 50,000, with imprinted roads for field use.

e. Drawing the single tracts with coordinates in the cadastral maps, respectively in the reduced maps, scale 1 : 10,000.

f. Determination of ownership.

g. Transmission of the tracts in aerial photographs respectively aerial photo-maps, scale 1 : 10,000.

4.2 Equipment of the survey groups

4.2.1 Permanent tracts

For control of a permanently established tract a survey group is composed of one university graduate (University of Agriculture and Forestry), one forest technician (forest technical school) and one surveyor's assistant. At present seven groups are occupied in field work from April to the end of October; they are employed during winter time at the Institute for Forest Inventory with works of publication, evaluation and preparatory works. The surveyor's assistants are only engaged for field work.

Objects of equipment:

2 Bitterlich Mirror Relascopes (for the choice of sample trees and height measuring respectively measuring of diameter in 0.3 of the height of tree)
Suunto Surveyor's Compass
Steel measuring tape and steel calipers
Basis data for the tract
Printed forms
Other small equipment

Relascopes are permitted to be used only with tripod.

During the establishment and for each second control instead of the mirror relascope because of the higher precision the tele-relascop with eight-fold enlargement should be used for choice of the sample trees, measuring of the diameter in 0.3 of the height and the height itself, if necessary.

After the survey the data are acquired for electronic data processing, verified and released for evaluation. The program instructions for the calculations are written by members of the Institute for Forest Inventory and handed over to the EDP section for programming and evaluation.

4.2.2 Temporary tracts

The survey groups for temporary tracts are composed of one university graduate and one forest technician. From April to June and from September to the end of October five groups are engaged in this work of the forest inventory; in July

and August they are occupied with the inventory of the forest's conditions. The equipment of these survey groups is identically to those groups, which survey the permanent tracts.

4.2.3 Staff of the Institute for Forest Inventory

In the average 30 employees are members of the Institute for Forest Inventory. 12 of them are university graduates, 12 are forest technicians ore high school graduates and six are assistants. Moreover the permanent staff of the Forest Inventory is enlarged by five university graduates and five forest technicians for the survey of the temporary sample plots for the periods as mentioned in item 4.2.2. The groups which survey the permanent tracts are increased by one assistant. In the mentioned staff the EDP-employees, which are used for forest inventory, are not included.

4.2.4 Use of computers

The recorded data of forest inventory are evaluated after the data acquisition on magnetic discs and tapes with EDP-programs and after the acquisition on COM (Computer Output on Microfiche) issued on microfiches. The Federal Forest Research Institute has installed for electronic data processing work a DAC VAX 750 Computer, which is connected with a SIEMENS-Computer 7570/C in the Agriculture and Forestry Computing Center with permanent telephone connection. The production of microfiches is carried out directly from the magnetic tapes.

5. Period after 1991

5.1 Network of tracts

The network of tracts used at present in the actual arrangement should probably also be used - but shifted - for the temporary surveys in the period 1991 to 2000, if they are necessary by systematic reasons. The permanent tracts from 1981/85 should be kept further in order for the possibility of furnishing sample plots distributed over the whole area of Austria for forest yield science. By using the temporary and permanent sample plots every five years 11,000 tracts with 44,000 sample plots are available for evaluation, so that also for small units results can be given and their changes can be shown.

5.2 Recording of data at the surveys

Until 1980 survey data had been recorded in the field in different printed forms and acquired for EDP subsequently. For some years portable hand-terminals with sufficient storage capacity are available, which could also be used by forest inventory in field work. For the proposed change to hand-terminals a preparatory period of two to three years is to be included.

6. Present position and future of the Austrian Forest Inventory

The change from temporary to permanent sample plots in 1981 certainly meant a step to the future. By this modification essential preconditions had been created to get new perceptions for forest yield science, for inventory of forest's conditions and last not least also for forest politics. By the additional inclusion of the temporary sample plots certainly it is also possible to avoid systematic errors from the first or to recognize them at least. It is our opinion that the results of the forest inventory are worth the money that is spent. No other institution is able to supply informations of such a variety and importance, which have full validity for all the forests of Austria. They are a certain base for the judgement of the further development of the forests (trend-inquiries) respectively for long-term outlooks on wood raw material supply.

The present annual costs of the forest inventory amount, not including the costs for new vehicles and the costs for EDP, but including the whole personal costs, about 13 millions AS. The sum is expressed best in proportion to the price of the total annual cut of Austria. For every cubic meter of the total annual cut only 0.90 AS are spent for inventory costs. This is about one pars pro mille of the average price of one cubic meter.

Suggestions for modifications which are expressed by users of the results are immediately taken into consideration or in the next inventory period.

In evaluating the inventory data first of all those tables or programs are taken in consideration which are known as to have given the most important results during the preceding evaluations. But in addition all the evaluations (which have actual interest) are carried out as fast as possible.

7. Presentation of the results

7.1 Who uses the results?

First of all the results of the forest inventory are used for help in taking decisions for measures of forest policy and forestry promotion. Many results of the forest inventory influenced the new Forest Act of 1975. They also shape the base of expertises for the establishment of new plants in timber and wood chemical industry. In other spheres of action they are used by the Provincial Forest Technical Departments, the District Forest Authorities, the Forest Departments of the Chambers of Agriculture, the Austrian Federal Forests, but also by private economy and the wood processing industry. Last not least the results of the forest inventory are used by scientific institutions (University of Agriculture and Forestry, Federal Forest Research Institute etc.) for their tasks.

7.2 Form of presentation

The form of presentation of the results is very different and depends from the purpose.

a. For the ten-year-results for 1961/70 and 1971/80 reductions were made from the original computer output and 70,000 tables for 177 units submitted to the diverse agencies. The main results of the Austrian Forest Inventory have been reduced to microfiches and issued for 103 geographic units with 655 pages on four microfiches for each unit, altogether 67,500 pages. These results can be bought by interested agencies.

b. Organizing of seminars of the Federal Ministry of Agriculture and Forestry for the users of the original tables.

c. Publication of partial results in technical journals.

d. Guiding lectures or publications about important results with conclusions for forest policy.

e. Publication of results in the "Mitteilungen der Forstlichen Bundesversuchsanstalt" (Informations of the Federal Forest Research Institute), with diagrams, are given to public agencies free of charge and also sold to private persons interested in the results. Every five years main results are calculated at the present.

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NATIONAL REPORT: BRAZIL

by
Marcio A.R. Nahuz

The latest forest resources assessment on a national scale in Brazil consisted of the Programme for Monitoring the Brazilian Forest Cover (PMCFB), sponsored by the Brazilian Institute of Forest Development (IBDF). This Programme was developed in 1981 and 82, and covered an area of 500 million hectares of tropical forests in the Amazon Region, in addition to the native and planted forests of the south, southeastern, centre-west and northeastern regions.

The Programme included four projects:

1. Assessment of Deforestation in the Amazon Region, aiming to identify, evaluate and monitor critical areas of deforestation in the region. By comparing satellite images taken in 1975,1978 and 1980, forest alteration rates of 1.6 to 2.3 million hectares per year were detected. From a total area of 506 million hectares, 12.1 million hectares (2.42%) were found to be altered.
2. Assessment of Forest Plantations, which mapped all planted forest established with tax incentives, detecting eventual problems related to planting chronograms and densities. A project area of 5.6 million hectares of forest plantations was covered.
3. National Parks, which mapped the major part of the 26 National Parks and 14 Biological Reserves, covering an area of 10.6 million hectares, and helped to detect landuse changes in the neighbouring areas.
4. National Forests, mapping and assessing the forest cover of areas recommended to constitute National Forests, in addition to the existing 14 units which cover 1 million hectares.

In cooperation with INPE - the National Institute for Space Research, and various Universities, IBDF carried out the Continuous Forest Inventory, aiming at the assessment of forested areas and growing stock in both native and planted forests in Centre-South Brazil.

The native forests were assessed in terms of different strata, types and growing stock; these covered 25.6 million hectares, stocking 4008 million m^3.

Forest plantations of Eucalypts, Pine and Araucaria effectively established covered an area of 2.9 million hectares by the end of 1982, with a growing stock of 276 milliom m^3.

The Continuous Forest Inventory provisions are for a regional re-assessment every two years; for this purpose permanent plots have been established and allegedly new information is being fed into the system. Updated results however have not been publicized yet.

New information needs and the technology currently available are changing the methodology used in regional re-assessments to include data collection on forest biomass for energy purposes and the occurrence and intensity of natural regeneration in virgin and logged -over forests.

Users of forest inventory data are many and varied. In addition to the situations already described, typical cases include:

- the single owner of a sawmill trying to assess his raw material supplies;
- owner groups of large tracts of forested land aiming at establishing new forest-based ventures, or assessing marketable timber prior to land clearance;
- companies evaluating potencial gains or losses of wood in areas to be flooded for hydropower plant construction;
- government agencies planning and establishing settlement projects, or evaluating timber losses by fire or insect attack, or assessing potential locations for forest industries.

These are some of the most frequent situations which may occur isolatedly or in any number of combinations. Most inventories, particularly those of large areas, of which the results are widely disseminated, are multi-purpose and have many users.

Forest inventory methodologies and equipment vary widely, according to the objectives, area covered, precision level required and funds available in each operation

Simple inventories of marketable tropical timber would require no more than a systematic sampling design, with ground measurements taken by tape and hipsometer. Existing volume tables are used or these are calculated based on equations or with an average form factor.

Assessment of forest cover in large areas many require the use of satellite imagery (MSS/LANDSAT), with combinations of different spectral bands to enhance specific aspects, visually and automatically decoded, and thematic mapping (TM). Ground to image correlations are obtained via extensive groundwork. Timber class identification and volume estimation have been successfully carried out with multistage sampling techniques in forest plantations, with measurements taken by relascope. For data processing and storage, any number and type of microcomputers are used, with the larger amounts of inventory data being processed by B 6800 or Cyber 750 mainframes and stored in computer compatible tapes (CCT's).

Emerging needs for inventory and remote sensing information include the monitoring and control of areas in which tendency to desertification is detected, e.g. caatinga areas in northeastern Brazil; classification of different forest covers relating to density and forest alteration; forest classification and characterization in regions of broken topography; and degradation of forest cover due to pollution. Most of these needs are being met by techniques which are newly developed or in the process of development.

Techniques for assessment of the total forest biomass or phytomass for energy purposes are being developed, based on the determination of the "vegetative index", obtained through interaction of bands 5 and 7 from MSS images. This is being developed in areas of wooded savannahs.

In forest plantations of Pine, Eucalypts and Araucaria, major parameters detected are the area effectively planted, age , growth, density via the terrain exposure index, in addition to the differentiation among genera and soon, among species.

Forest inventories and remote sensing in Brazil are definitely interlocked, the latter providing the best techniques available for maximum coverage at the lowest cost. Features of forest areas of major interest are detectable in time for corrective measures. Expansion of shifting agriculture and encroachment of national parks and forests, burned range and forestland, forest damage by fungal and insect attack have been detected rapidly and in some cases, corrected or controlled.

Forest inventory results are publicized in various ways. The sponsoring agency may publish the complete report with information such as objectives,methodology, results and maps, sometimes in several volumes. Results of the Continuous Forest Inventory for example, were published in 8 volumes. A summary booklet was printed and widely distributed.

Concise inventory results and information from remote sensing are frequently published by specialized journals, and if the information has potential audience impact, this is widely disseminated through magazines, newspapers and other media including commercial TV.

Forest inventory continues to be a very costly activity in which only government agencies, large companies or owner-groups are likely to incur. In spite of the growing needs and availability of technology, a simple inventory requires costly aerophotogrammetric and photointerpretation work at least, and these are still too expensive for the small landowner. Until inventory results of large areas are made available from which the user can extract the information he needs, simple timber cruising will have to suffice.

NATIONAL REPORT: BURMA

by
U.S. Kyaw

1. Background

Burma, with a total area of 676,580 km^2 and a population of 37 million in 1985, is among the countries of South East Asia that are still rich in forest resources. A major earner of foreign exchange and widely spread over the country, Burma's forests are not only of economic importance but also of social and environmental significance.

Forest inventory in Burma dates back to the 1850s, when D. Brandis inventoried the teak forests of the Pegu Ranges to obtain data for compiling working plans. Later, subjective sampling and complete enumerations of valuable species over a certain size were carried out to get information for management planning. From 1963 to 1975, forest inventories were carried out in selected areas using mathematical-statistical methods of sampling.

2. National Forest Inventory

2.1 Nature and scope

Under a UNDP/FAO assisted project, the Socialist Republic of the Union of Burma has been conducting large scale forest inventories since early 1982.

The main objectives of this project are:

(a) To carry out forest inventories in western Burma as a basis for planning and development of the forestry sector;

(b) To provide forest type maps as a tool for forest management planning;

(c) To design and initiate a continuous forest monitoring system;

(d) To develop medium and long term forestry plans at various levels by using the inventory data.

The first phase of the project which terminated in May 1986 has established the basis for a continuous forest inventory system and succeeded in installing well-equiped inventory, mapping and computer sections within the Forest Department. The second phase will strengthen the established sections of the first phase and emphasize on the development of institutional capabilities in the Forest Department for improved forest management and utilization planning. The second phase will end in 1991.

2.2 Project implementation

2.2.1 Aerial photography

Panchromatic aerial photographs have been flown since late 1981 for some 329,900 km^2 at 1:25,000 scale and 129,500 km^2 at 1:50,000 scale covering 68% of the country. The remaining areas of the country will be covered in the remaining flying seasons of the project.

2.2.2 Forest land use mapping

The work consists of interpreting the situation at the date of existing satellite imagery and up-dating the situation to the date of aerial photography, or alternatively, the interpretation of newly acquired imagery. It was estimated from aerial photographs, taken between 1953 and 1962, that about 57 percent of the country's area was then covered by closed forest. The FAO/UNEP Tropical Forest Resources Assessment Project reported a forest cover of 48 percent basing its assessment on 1972-75 Landsat satellite imagery. The present project, using 1979-81 Landsat satellite imagery estimated that the area of closed forest had reduced to 42 percent. When this trend of forest depletion is extrapolated, it seems likely that the 40 percent has now been reached which is equivalent to about 27 million ha. The above assessments did not include forests affected by shifting cultivation, which was about 26 and 28 percent of the country in the first and second satellite assessment respectively. Forest land use maps at a scale of 1:250,000 and based on available Landsat imageries will be developed soon with the arrival of a consultant.

2.2.3 Forest type mapping

Forest type maps at 1:50,000 scale are being prepared from the newly acquired aerial photographs for the western half of Burma which encompasses more than 40 percent of the country's forest. Photo interpretation and

transfer onto base maps are done by Forestry graduates. Relevant information of the base maps is updated and plates for printing prepared by the cartographic section of the project. Lettering of the maps is in Burmese with the aid of NC scribers.

Todate, over 90 forest type maps have been prepared. About half of these have so far been printed in copies of 500 each, partly by the project and partly by the Survey Department.

2.2.4 Forest inventory

The activities of the project include forest inventories at pre-investment level in those regions of Western Burma that are of great commercial importance and at reconnaissance level in regions that are of lesser commercial importance. Supported by market analysis and related studies, the data will be used by the project for a forestry development and utilization plan of a selected region, with working plans for smaller units that will require further more detailed inventories.

Field work of the forest inventory at pre-investment level is now completed. In 5½ seasons since early 1982, nearly 11 million ha of forest have been covered, at a cost of Kyat 0.63 per ha, employing 80 field crews every year except in the last season of 1986/87 when the number was 40. As inventory work is impossible during the monsoon and difficult at the end of the dry season, field work was confined to the period from November to March.

The inventory was designed to yield a precision of ±20 percent at 95% probability for the net volume of trees 20 cm and more in diameter of all at present utilized species within a forest area of 50,000 ha. As the first phase of a continuous forest inventory, sampling units of 1.05 ha were measured on a 3,300 yard, or approximately 3 km, square grid using the reference system of existing 1":1 mi maps for distribution. The sampling units had the form of 30 m wide strips running 175 m west-east and 175 m north-south so as to register possible trends in both directions. Trees of 20 cm and more in diameter were recorded of the whole sampling unit, trees of 10-19 cm at the three corners of the sampling unit on circular plots of 15 m radius and trees of 5-9 cm as well as bamboo on the same plots but with a radius of 10 m.

One quarter of the sampling units, on a 6,600 yard square grid, were marked on the ground as permanent plots for re-measurement on successive occasions. Some 2,900 plots have thus been established in the commercially most important regions of Burma as the basis for future sampling with partial replacement, probably the most extensive one of its kind in a tropical country. Maintenance work on these plots and re-measurement have now started five years after their establishment. The second phase of the continuous forest inventory is to start in again another five years time.

Volume data of some 35,000 trees were collected by assessing on three trees per plot the bole height and stem diameters at quarter height intervals with the aid of wide scale relaskops. About four percent of these trees, when on temporary plots, were felled by control crews so as to determine the correction factor for volume measurements and obtain data on bark and branch volume. Volume equations are being developed by zones of approximately equal growth conditions for individual tree species or groups of species as defined by regression analysis.

Refresher courses of two weeks with tests in tree identification were held before the start of each field season. In the field, a group of four enumeration crews and one control crew was supervised by a forest officer. Control crews re-measured about five percent of the plots to ensure that field work was of acceptable accuracy. These measurements and additional inspection surveys indicate that field work was indeed of good quality and the accuracy of measurements and assessments well in line with that of good inventories elsewhere. It appears that tree identification was subject to about 10 percent uncertainty for species that are utilized today, and to about 20 percent for the lesser known species.

2.2.5 Data processing

The project has commissioned a Digital VAX-11/750 computer system in February 1986. The central processing unit has at present a memory of 3 MB; there are six terminals, a hard disk drive (124 MB), one exchangeable disk drive (67 MB), one magnetic tape unit and two line printers. It is planned to expand the main memory to 4 MB and obtain two more disk drives, one more tape units and a number of additional terminals.

The inventory data is processed within a broad overall Forest Management System. Sub-programs allow the compilation of stand, stock and bamboo tables for any required reporting unit and forest type, both, in metric and imperial units. Increment cores from teak trees will allow a direct estimate of the current annual increment of this species. Successive re-measurements of the permanent sample plots are expected to provide in future growth estimates of the whole forest which will improve with the number of measurements available.

2.2.6 Main users of the inventory data

The main users of the forest inventory data are the Forest Department and the Timber Corporation which are responsible for the management of all forests and the extraction, milling and marketing of timber. During the project period, one extensive regional forest management plan and three more intensive working plans for smaller units will be prepared using the inventory data. The Forest Department will continue to develop such plans in cooperation with the Timber Corporation.

The Forest Inventory Section and the Forest Research Institute will utilize inventory data for mutually initiating studies on future silvicultural methods and related growth and yield.

The project has supplied a number of agencies with forest resources data, especially the Ministry of Industry, for the planning of industry and trade development.

2.2.7 Publication of National Forest Inventory

Data books, containing stand, stock and bamboo tables have so far been produced for 19 townships, each between 50,000 - 150,000 ha. Inventory data for the Pegu Yoma region will soon be available.

As routine publishing of inventory data in rigid form puts considerable strain on time and resources of the project, serious consideration is given to providing in future information only on request, catering in these cases to the special needs of the individual user.

3. Future Forest Inventory in Burma

Now that the inventory at pre-investment level is completed, the Inventory Section of the Forest Department has to attend to other tasks, apart from processing the inventory data and from maintaining and re-measuring the established permanent sample plots. These tasks are:

(a) Management inventories in the region selected for management and utilization planning by the project, and studies on decay, defect and log recovery from logging operations;

(b) The establishment of permanent sample plots and collection of data on growth and yield in forest plantations for a variety of possible silvicultural strategies;

(c) Forest inventories at reconnaissance level in the remaining regions of Western Burma; and

(d) Assistance in studies on silvicultural systems for the various types of the natural forest.

The second phase of a Continuous Forest Inventory of the commercially important forests of Western Burma is intended to start in the season of 1991/92, that is ten years after the first phase was initiated. This continuous forest inventory is envisaged to provide overall information on the change of forest area and stocking as well as on growth, removal and mortality.

NATIONAL REPORT: CANADA

by
J.J. Lowe

1. Introduction

To understand Canada's national forest inventory it is necessary to recognize several key factors.

a) The country is very large and diverse, with low population densities in the forested areas.

b) There is a preponderance of Crown (i.e. state) owned forest, especially away from the centres of settlement. (The Crown may be Federal or Provincial).

c) Most commercially attractive forest is controlled by the Provinces (cf. Federal or Private). The provinces are autonomous for resource management and inventory purposes.

d) There are major gradients of forest type, productivity, accessibility and value from south to north and away from the west coast.

e) Canadian forest management is evolving from an era of exploration and timber development to one of increasing integration, economic awareness, intensity and long range planning.

f) Canadian forest inventory relies heavily on remote sensing and forest cover maps; these vary considerably as to intensity, specifications, and age.

g) Canada has elected to develop its national forest inventory by aggregation of provincial inventories rather than by independent, simultaneous and statistically objective sampling.

h) The national inventory is on a 5-year cycle, and since 1981 has been reported to the Canadian Forest Resource Data System (CFRDS) at the Petawawa National Forestry Institute (PNFI) of the Canadian Forestry Service (CFS). Data is reported by cell (about 44 000) rather than by province or territory (12). The preferred cell is 100 km^2 (UTM grid), but in practice it is the provincial or territorial unit of data aggregation (generally a 1:15 000 ± map sheet).

i) The national inventory agrees with the data of the provinces. It allows map presentation and geographic analysis and overlay (suggested scales $1:15 \times 10^6$ to $1:30 \times 10^6$). It is not designed to estimate change in the forest.

j) The Canadian Forest Inventory Committee (CFIC) has been very helpful in developing standard national terminology and specifications, and in transferring data from provincial to national inventories.

2. Canada's Forest Inventory 1986

The 1981 Inventory was the first to be reported at the cell level within a geographic information system (GIS). It is the existing data base to answer client requests, and was described by Bonnor (1982). The poster Tree Distribution in Canada illustrates what this inventory can produce geographically.

The 1986 Inventory improved and extended the specifications and attributes (see Appendix 1), requiring collection again of source inventories which had not themselves changed since 1981.

Significant new attributes include: age class; predominant genus in the cover type; saw volume as well as pulp volume.

The use of a GIS allows the overlay of broader "auxiliary information" where it is available. Perhaps the most significant of these are:

- policy constraint (i.e. % of area constrained from timber harvest in nominally 'unreserved' forest),
- stocking (to quantify areas of 'unproven' stocking such as 'cutover' and 'burn' by stocking level),
- productivity (mean annual increment under existing levels of stocking and management),

The 1986 data is now in the last stages of preparation. It will replace the 1981 data for client service by the end of 1987, and Canada's Forest Inventory 1986 will be published early in 1988.

The 1986 inventory provides estimates, for the first time, of all significant areas of productive forest in Canada.

The 1986 reporting cells are not all exactly the same as in 1981, and in several places are closer to the preferred resolution of 100 km^2.

Procedures for analysis and reporting have improved enormously since 1981.

3. Canada's Forest Inventory 1991

It has been decided that 1991 specifications will not differ from 1986. This means that only new panels of source inventory need be collected; these will be much 'cleaner' than the old inventories collected in 1981 and 1986. This, plus the ability to reuse the aggregation, quality check and processing software of 1986, will make the exercise much faster and more convenient than it was in 1981 and 1986.

The specifications will be reviewed not less than 2 years after the 1986 Inventory comes on stream, and not later than the deadline for planning of the 1996 Inventory. The onus will be on users to justify changes to the specifications.

4. Users of the Inventory

It is always difficult to identify users of national inventories, maps and statistics. Certain levels of renewable resource infor-

mation are essential in any forested country for strategic, professional, industrial and public reference. The clients are often unknown, and rarely identify their needs in advance. However, the improving quality of data and responsiveness to requests leads us to expect considerable expansion in client requests as well as in general product.

Users may be separated into certain broad classes
a) General - served by reports and maps illustrating the size, structure and distribution of Canada's forests. These may be approached through direct delivery of product (reports, posters, etc.), or via information institutions (eg. libraries, Canada's National Atlas, Statistics Canada, Canadian Forestry Statistics, professional journals).

b) Specific national level - client requests for strategic or other purposes (eg. FAO/ECE; national studies of forest pests, economic wood supply or acid precipitation; input to policy decisions).

c) Specific regional or local level - client requests that would better use the source inventories but where the provinces or territories can not yet provide the service. There remains a major gap between the national levels of resolution (eg. 1:20 000 000 ±) and provincial levels (1:20 000 ±). As provinces complete the enormous task of loading their inventories to modern GIS and data base management systems their abilities to analyze, aggregate and report data in statistical or map form will greatly improve. Until then the national inventory is sometimes called upon as the best available surrogate. This is never done without provincial approval.

5. Methodology and Equipment

This report can not enter into descriptions of the source inventories, or how their stand level detail is reported to CFRDS. Suffice to say that their stand maps are generally based on air photo interpretation with some ground verification, that representative volume sampling takes place, and that a wide variety of computer processing has developed since the late 1950s. Most provinces are now making rapid progress in the computerization of map information.

Specifications of the source inventories are related to the standard national specifications with 'conversion tables', and these are used to guide recoding into a standard 'exchange format'. The recoded data is collapsed to the cell level, with separate entries for each unique combination of descriptive attributes. Each entry carries its own statistical attributes (ha; m^3/ha by species group for pulp and saw utilizations). This becomes the 'attribute data base'. (See Appendix for details). Not all attributes are universally available.

The cell grid is digitized to form the picture quality spacial data base, which can be linked to the 'attribute data base' in a geographic information system.

All data is subject to rigorous quality checks before being accepted into CFRDS, and results are checked by the contributing agencies.

Certain 'auxiliary information' is loaded into CFRDS, and can be combined with the inventory using GIS techniques -- this information generally relates to polygons of provincial, or sub-provincial size.

Other themes can be combined in similar ways.

Products can be put out as statistical tables, business graphics, or choropleth maps.

The computer used at PNFI for CFRDS is a VAX-VMS 11/780 minicomputer, with peripherals that include 2 tape drives and 4 disk drives (3 RA81, 1 RM05), digitizing table, Calcomp plotter, Matrix Instruments Colour Graphic Recorder, and graphics terminals. At Statistics Canada we have access to a Matrix Gerber 4442 photohead plotter.

Software used is INFO, ARC/INFO, GIMMS, INGRES, SAS, SAS/GRAPH and FORTRAN.

Attempts are presently under way to provide user-friendly routines which will allow the forest inventory specialists at the client desk to satisfy quickly a high proportion of user requests without having to call on computer specialists.

6. Newly Emerging Data Needs

Several clients have already expressed a need for better information on attributes that relate to such things as forest pests (eg. species composition), economic wood supply (eg. species, size, defect, growth), forest change and inventory update, forest land use and its change, and management intensity.

Client use of the 1986 Inventory is expected to trigger other expressions of need. These requests may be very hard to satisfy without independent surveys for several reasons:

- the source agencies may not yet be collecting the data in a comprehensive and reportable manner;
- the clients may be attempting to use national inventories improperly in the absence of suitably accessible local or regional inventories;
- the analyses are infringing on provincial areas of jurisdiction;
- cost;
- differences between successive national inventories can rarely be taken as statements of real change with existing Canadian procedures.

7. Publications

Reports describing Canada's Forest Inventory 1986 will be produced beginning in 1988.

The third edition of Forest Inventory Terms in Canada will also be published in 1988.

Existing publications of interest include:

Canada's Forest Inventory 1981 (Bonnor 1982)
Inventory of Forest Biomass in Canada (Bonnor 1985)
Selected Forestry Statistics Canada 1986 (Anon. 1987)

8. Other Aspects

Canada's Biomass Inventory 1984 was reported by Bonnor in 1985. It was developed in cooperation with the provinces as part of Canada's ENFOR program, and is presently available as a CFRDS component for client requests. It is very like the 1981 Inventory, but instead of gross merchantable timber volume (m^3/ha) it reports 8 components of aboveground forest biomass (t/ha for merchantable stem wood, associated bark, stump wood, associated bark, etc.).

Other national forest resource statistics are reported, but not usually below the provincial level of detail. These include forest fire losses, insect and disease statistics, silvicultural activities, harvest, and allowable cut.

The relationships between conventional forest inventory and other disciplines of forest resource interest (eg. wildlife habitat) are generally at a very early stage in a few provinces, and non-existent at the national level.

There are national map studies of soil, climate and ecological region. These could be linked to the national inventory, but that has not yet been done except for Canada's Forest Regions.

The increasing use of GIS technology will make information exchange and overlay more convenient in the long run, but much remains to be done concerning compatibility. Compatibility problems relate to geographic positioning, to the GISs themselves, and to attributes. It is interesting to realize that even in a country as advanced as Canada in mapping and GIS technology there are still problems relating to basic coordinate systems and to planimetric and topographical detail. The fact that thematic resource surveys have classically used lower levels of geographic accuracy, and many local classification schemes, suggests that problems of integration and overlay will not be trivial.

As a new national inventory comes on stream, with specifications which are unlikely to change significantly for at least 10 years, it is important to renegotiate 'equivalence' arrangements with prime clients such as FAO/ECE. The closest possible equivalences will be sought out between the national and international specifications. It may not be possible to match all FAO/ECE classes, and the inventory situation described above suggests it is unlikely that such omissions can be filled in the next 10 years.

For more on this topic, see my report under Agenda Subject 3.

9. Appendix

Attributes in Canada's Forest Inventory 1986

Location Codes

Province or Territory
Cell Reference

Classification Attributes

Data Source
Ownership
Status
Land Class
Site Quality
Stocking Class
Cause of Disturbance
Age Class
'Maturity' Class
Forest type
Predominant Genus

Numerical Attributes

Year of Information
Area
Volume (pulp and saw m^3/ha by species group)

NATIONAL REPORT: CHINA

by
Liu Longhui

China has a vast expanse of land and a large population, but lacks forest resources. Forest resources are one of the most important natural resources in China. Along with the development of China's forestry, the forest resources survey and assessment work have also been carried out step by step.

Since the 1960's, three nation-wide inventory on forest resources have been conducted. From 1977 to 1983, the Third National Forest Inventory had been conducted. The result showed that the total area of forests in China was 115 million hectares amounting to 10.26 billion cubic meters in growing stock, with the forest coverage of 12% .
More detailed information is presented in the following table.

Since the 1970's, two publications containing results of national forest inventory work have been conducted in 1977 and 1982, i.e. National Forest Resources Statistics 1973 to 1976 and 1977 to 1981.
In China, the Major Technical Provisions For Forest Resources Inventory, published by the Ministry of Forestry of the P.R.C. in 1982 is the criterion of the latest national forest resources assessment and classification, e.g. land type is defined by the following criteria:
1, Forest land : Forest land may be classifiedaccording to its current primary use or capability, it is subdivided into Shelter (Protective) Forests, Commercial (Timber) Forest (including bamboo forests), Fuel Forests, Special use Forests and Economic Forests. Forest land may also be classified according to the origin, it is further subdivided into Natural Forests and Plantations;

2, Sparse-forest (Open forest) land;

3, Immature-plantation land ;

4, Shrub-forest land;

5, Nursery land;

6, Non-forest land; Non-forest land is further subdivided into Barren hills and wastelands suitable for afforestation, Cutovers, Fire-slashes and Sandy wastelands suitable for afforestation;

7, Non-forestry land, it comprise Farm land, Pasture land, Water bodies, Unutilized land and Other.

In order to systematize the task of forest inventory in our country according to different objectives,purpose and users, the forest resources survey was divided into three types. Type one is called nation-wide inventory for predicating the forest resources existing and the general dynamic tend in forest resources; Type two is called forest management inventory for formulating the forest management plan for the forest administrative offices or forest farms; Type three is called operational inventory for constructing the particular design of harvest or silviculture treatment. So the process of formulating the result of forest inventory must start by identifying the users' need of information, e.g. the users of the nation-wide inventory are high-ranking leaders of the goverment or forestry authorities and leaders of the provinces. The nation-wide forest resources assessment is an adequate information base for national or provincial policy makers.

The developing trend of the approach to forest inventory techniques in China is similar to that in many other countries of the world. From 1949 to 1953, the strip plot cruising method and simple ground surveying were used by Chinese forest inventory teams. Since 1954, we began to adopt aerial photography to delineate the boundaries of stands and working units such as subcompartment and then to record the stand variables by ocular estimations. In 1957, the angle-gauge was used for improving the ocular estimation technique. Stratified sampling was first tried in 1963 and popularized after then. Ever since, the forest inventory technique was progressively tranformed from ocular estimation systems into mathematical sampling methods systems. Mean while research and experiment were conducted on different inventory methods suitable for different areas, conditions and management levels developed

Table

National Totals of Forest's Areas and Volumes

	Area (million hectares)	Volume (million cubic meters)
Area of Forest land	115.28	
Arbor Forest	100.69	
Economic Forest	11.28	
Bamboo Forest	3.31	
Area of Open-forest land	@ 17.20	
Area of Shrub-forest land	@ 26.80	
Area of Non-forest land	@ 101.30	
Afforestable Barren Hill and Waste land	@ 85.39	
Natural Forests	87.47	8754.46
Plantations	27.81	273.49
Coniferous Forests	52.63	5173.49
Deciduous Forests	48.05	3854.46
Growing-stock volume		10260.60
Volume of Forest land		9027.95
Volume of Open-forest		@ 542.07
Volume of Scattered Trees		@ 544.51
Volume of Bordering Trees		@ 146.07

@ Taiwan excluded.

and experimented, such as two-stage and multistage sampling inventory, double sampling with regression, quantitative inventory, sampling point with fixed number of measuring trees, regressional survey with visual estimation and field mensuration, etc. And most of these methods have already been put into practice.

In order to monitor dynamic changes of national forest resources, an CFI system has now been set up in all the provinces and municipalities through-out the whole country (except the municipality of Shanghai, Taiwan and Tibet Autonomous Region) with permanent sampling plot as the chief component for the survey of forest resources. There are altogether 160,000 permanent sampling plots in the whole country. Since 1986, 15 provinces and municipalities have remeasured and satisfactory results have been achieved. In addition, the nation-wide depletion and consumptive structure of forest resources investigation have also been conducted in 1986.

Aviation and aerial photography have been the important means of the resources survey in China. As to the application of the aerial photo, in the begining, we only use the photo to delineate compartment and subcompartment units or to make photo maps by photogrametic process on the basis of ground control survey. These maps were used as base maps for transfer of working units, to calculate area and for plotting forest type maps. However, with the improvement of the technique, aerial photography was not only used to interpret forest stratification, stand measuration and site factors, but also used to interpret stand volume tables or aerial photo digitized volumetric table. The above mentioned efferts have helped exploit the potential utilization of aerial photography and increased the speed of our forst inventory. As to the application of satellite imagery. We carried out the forest inventory of the Tibet Autonomous Regin by using lansat imageries in 1977 for the first time. Following that, gratifying results were also achieved in use of satellite remote sensing in integrating agricultural regionalization of the Three North Shelterbelt Region and the nationwide prevention of forest fire. Ever since 1980, in order to bring forward the application of remote sensing techniques in forest inventory and planning, we have established two remote sensing experimental stations at Nankunshan of Guangtung Province and Jiangshanjiao of Heilongjiang Province with an objective

to carry out spectral photometry, phenological observetion and experiment on aerial photography with different type of films, etc.

Since 1972, we have begun to use electronic computers in forest inventory to improve the data processing. The computer techniques of forest inventory have developed repidly in recent years. Now, forest inventory units in each province are equiped with microcomputer system. Application of computer for data capture, check, transmission, processing, storage and mapping has been carried out. In 1982, we also carried out a series of development projects of science and technology such as the establishment of the first nationwide forest resources data base called the " 4.5 " Forest Resources Data Base. At present, we are engaged in the research and preparation of the " 5.5 " data bank designed for CFI and data bank for the type two forest inventory. Efforts are also being made for the development of computer predictive models of forest volumes and yield, data updating models and for the forest resources management information systems, etc.

NATIONAL REPORT: COLOMBIA

by
Luis Carlos Molina

INTRODUCTION

The information presented in this report is a synthesis obtained from work carried out by different organisms over the last few years and includes some studies that are still underway and have yet to be published.

The concepts expressed may be wholly credited to the author, and do not represent the official viewpoint of any of the organisms involved. This report has been prepared in accordance with the guidelines indicated by the organizers of this meeting, in order to provide a general idea of the current situation and at the same time indicate future tendencies in the field of forest assessment in Colombia.

Final results, compatible with the different studies, require a more detailed analysis.

1. A BRIEF DESCRIPTION OF THE SCOPE OF THE LATEST NATIONAL FOREST RESOURCE ASSESSMENT

1.1. Forest Map of Colombia

The "Augustin Codazzi" Geographic Institute, IGAC, in cooperation with CONIF and INDERENA, prepared a forest map of Colombia in 1984 with the principal objectives of:

- locating the distribution of forests in the country
- determing the surface are presently covered and the economic value of it in order to formulate development policies for the forest sector.

This map was drawn up on a 1:500,000 scale and published at 1:1,500,000. It was achieved using different images: side looking airborne radar (Westinghouse) on a 1:250,000 scale,

(Goodyear) on a 1:200,000 scale and Landsat MSS satellite images on a 1:250,000 scale (1979/1982) complemented by aerial photographs on scales varying from 1:30,000 to 1:60,000.

Interpretation of these data was controlled on the ground by means of a pilot area reconnaissance type inventory according to the following criteria:

- Natural virgin forest areas
- Previously unstudied areas
- Relatively accessible areas
- Areas representative of photo-intepreted physiographic landscapes.

The field sampling was of the eco-floristic type using one hectare parcels from which the following information was gathered:

- DBH as of 15 and 25 cms
- Botanical identification on all species.

Furthermore, information referring to phenology, succession, natural regeneration and other ecological aspects was taken into account.

Classification system for types of forests:

- First level: altitudinal levels
  I - 0 - 1,000 (Base level)
  II - 1,000 - 200 m.s.n.m. (sub-Andean level)
  III - 2,000 - and above (Andean level)

- Second level: Potential
  P - Commercial and lumber
  p - Not commercial for physical reasons. here we classify areas, occupied by lumber wood or not, that have slopes greater than 75 %

- Third level: Degree of intervention
  1: No intervention
  2: Intervened

- Fourth level: Physiographic landscape
  Cartographic units are identified by letters according to physiography:
  A: Alluvial plains, B: Terraces, C: Hills, S: Mountains, Q: Cordillera

Forest inventory data were processed electronically. Trees were classified into three groups: commercial species, potential, and unknown. The program provided information on the number of trees, basal area, and volume per hectare, for each type of forest; frequencies and index of importance value for each species, and the diammetrical distribution for volume, basal area and number of trees expressed per hectare.

1.2. Forest Area Zonification Map

This cartographic document is being prepared at IGAC for INDERENA with the following objectives:

- To set nationwide policies for adequate forest resource management
- To define the jurisdiction of the various agrarian and forestry organisms
- To apply the national code on renewable natural resources and protection of the environment (INDERENA, 1975).

Maps on a 1:500,000 were compiled for this study. Methodology was based on the application of the following factors:

- Climate, combining altitudinal level biotemperature and average annual rainfall
- Slope, including grade of the slope expressed in 25 % percentage classes combined with longitude of the slope taken every 100 meters
- Soil erosion and fertility, taking into account ecological, economic and social aspects
- Removal factor; legal and institutional aspects affecting the zone, including national parks, colonization areas, Indian reservations and hydroelectric project flood areas.

1.3. Map of Current Land Use in Colombia 1987

The "Agustin Codazzi" Geographic Institute, IGAC, prepared a map of current land use with the cooperation of the Agricultural and Livestock Institute; ICA. This map was compiled on a 1:500,000 scale, interpreting 18 Thematic Mapper (TM) images (1985-86); 6 Multispectrical Scanner System (MSS) images (1985-86) and 11 MSS images (1973/84) in visual form. Information for the Amazon, Pacific and part of the Orinoco regions was taken from a forest map published in 1984. The principal objective was to obtain an inventory of current land use, its distribution and extension, to define agricultural and livestock programs and development. Map labelling used International Geographic Union terminology as a guide by which the following usage classifications were determined:

Agricultural lands:	Temporary crops, semi-perennial and perennial
Grasslands:	Natural grasses, managed and introduced with dense or open cover, scrub grasses
Forest lands:	Primary, intervened, planted, shrub savanna xerophytic vegetation
Lands unused for agriculture and forestry:	Swamps and marshes, drylands and/or zones with no vegetation, forest fallow, paramos and perpetual snow.

This study defined 21 types of land use, which are listed in Table 3 together with their respective areas. Upon comparing this information with potential land use, the following conclusions were obtained (See figure 1).

- Agrcultural lands occupy 4.66%, but according to Agro-ecological zoning map (IGAC-ICA, 1985) 12.7% of Colombian land area are devoted to agriculture.

- Grasslands occupy 35% it is estimated that potential grasslands constitute 16.8% (IGAC-ICA, 1985), indicating that large areas are located in zones not suitable for this activity. Of those areas devoted to grasses only 4.54 % correspond to managed grasses, however potentially suitable lands equal 7.3 %. This shows a significant deficit in this activity, as occurs with agriculturally suitable land, those apt for cattle are also under-utilized by more than 3 million hectares.

- Land devoted to primary forests occupy 44.87 % of the surface showing an approximate degree of deforestation equal to 600,000 hectares/year.

- Lands with planted forests cover 0.12 %, indicating that the rate of reforestation is very low compared to the accelerated rhythm of deforestation.

- It is estimated that forestable land in Colombia is equal to 68.5 % of the territory, (IGAC-ICA, 1985). Upon comparing this figure with the current 49 % we deduce that there is a great difference, surely caused by deforestation.

- Of lands unused for agriculture or forestry (7.44 %) of the country's surface, 4.7 % are classified as forest fallow (3,998,311 hectares).

1.4. Map pf Potential Forest Use in Colombia

The "Agustin Codazzi" Geographic Institute, IGAC, is preparing this map on a 1:500,000 scale to be published at 1:500,000 with the following objectives:

- To indicate forest potential in a preliminary way in order to aim at better utilization.
- To provide bases for carrying out more detailed studies and to serve as a general consultant reference for the forestry sector institutions.

In order to evaluate forest types, according to suitable uses, intrinsic characteristics were taken into account such as, density, floristic composition and available wood, as well as extrinsic characteristics which have a close relation to external forest conditions such as, relief, accessibility and ecological impact.

In this study, suitable forest use has been taken to mean broad ecological and utilization criteria in order to obtain maximum

yield from the forest with a minimum effect on environmental equilibrium. Six classes or hierarchical levels were established:

Class 1: Dense, exuberant natural forests with a tendency toward homogeneity of some commercially valuable species with a total volume of approximately 120 m^3/ha,; these forests grow on level or almost level land with easy access.

Suitable use: Multiple. Forest products may be obtained (wood or non-wood) and it provides protection and recreation.

Class II: Dense, exuberant forests with a tendency toward homogeneity and an approximate volume between 120-80 m^3/ha. They develop on flat or undulationg terrain with easy to limited access. Ecological effects on the ecosystem are low to middle range when use occurs under rational conditions.

Suitable use: Multiple, but limited by terrain and access.

Class III: Mangroves of lower density, with a tendency toward homogeneity of species. Total lumber volume 120 m^3/ha, growing on almost flat terrain under seawater flood conditions with easy access. Middle range effect on the ecosystem.

Suitable use: Restricted. Limited to utilization of lumber species. This type of vegetation is important for the preservation of ecological conditions.

Class IV: Dense, exuberant forests with heterogeneous species and a total lumber volume over 120 m^3/ha found on very hilly terrain and show access limitations. Middle range effect on the ecosystem.

Suitable use: Restricted, limited exploitation due to terrain; should be taken into consideration as soil, water and wildlife forests.

Class V: Dense, exuberant natural forests with heterogeneous species and total volume between 120-80 m^3/ha on uneven to very hilly terrain with limited access. High ecological impact.

Suitable use: Restricted, limited to forest sub-products and to a lesser extent lumber.

Class VI: Dense, exuberant natural forests with heterogeneous species and a total lumber volume over 120 m^3/ha found on rough to steep slopes with limited access. High ecological impact.

Suitable use: Restricted, limited to forest sub-products.

2. FUTURE PLANS

2.1. Assessment and Monitoring of Tropical Forests

The assistant directorship of Instruction and Research of IGAC, with INDERENA, has initiated the assessment and monitoring of

tropical forests and other resources by means of TM and SPOT satellite images in the National Rehabilitation Plan zones (PNR). Evaluation will begin with an area of 20 million hectares in economically affected zones, but the first phase will cover about 10,000,000 million hectares.

Objectives are the following:
- To evaluate forest cover, associated vegetation and current land use in natural regions by means of visual and digital interpretation of TM and SPOT satellite images.
- To establish potential use of land in specific PNR sectors by zoning homogeneous areas.
- To carry out, follow-up and monitor the condition of forest cover in the country, emphasizing areas where there are more intensive colonization processes.
- Form a geographic data bank to support the monitoring program for Colombian forests and resources.

Mapping will be done to a 1:100,000 scale and map publication on a 1:200,000 scale. Methodology for this project is being formulated.

3. PRINCIPAL USERS

- INDERENA (NATIONAL INSTITUTE ON NATURAL RESOURCES AND ENVIRONMENT), a state organization in charge of the administration of renewable natural resources in Colombia. It controls and enforces environmental policies, regulates the use, exploitation, commercialization, mobilization and general management of renewable natural resources.

- INCORA (NATIONAL INSTITUTE FOR AGRARIAN REFORM), a state organization in charge of establishing colonization plans and reserves for the protection, sponsoring and performance of natural resource projects.

- Regional corporations such as the CVC (Autonomous Regional Corporation of Cauca), CVS (Autonomous Corporation of the Sinu and San Jorge Valleys), CAR (Autonomous Regional Corporation of the Ubate and Chiquinquira Valleys), CARDER (Autonomous Corporation of Risaralda), etc., entities that have been delegated the administration of renewable natural resources.

- Colombian Association of Reforesters in order to propitiate a concrete stand, both by government and the private sector on the future of forest planting, and industrialization and marketing of its products.

- PROEXPO (EXPORT PROMOTION FUND), NATIONAL PLANNING DEPARTMENT, AGRICULTURAL FINANCE FUND, INCOMEX (NATIONAL INSTITUTE OF FOREIGN TRADE), state organizations in charge of establishing policies on development, planning, marketing and export of resources.

- Lumber industries (329 mechanized lumber companies)

- Pulp, cardboard and paper industries (30 companies)

- CONIF (NATIONAL FOREST DEVELOPMENT AND RESEARCH CORPORATION) an organization devoted to forest research in the areas of agro-forestry, natural forests and plantations.

- HIMAT (COLOMBIAN HYDROLOGY, METEOROLOGY AND LAND USE INSTITUTE), an organism in charge of acquiring better knowledge on meteorology and hydrology, regulating rivers and other bodies of water, developing conservation programs, recovering and adapting land.

In the future according to the current administrative decentralization program of the government, principal users of this information could be the municipalities and Regional Development Corporations, who will attempt to detect needs through contact with the communities affected.

4. IDENTIFICATION OF NEWLY-EMERGING NEEDS FOR INVENTORY INFORMATION

These needs have been identified by consulting with regional development corporations, Colciencias, INDERENA, lumber comnpanies and CONIF, by reviewing research objectives of projects being undertaken.

In summary the needs identified are the following:

- To manage forests based on environmental demand, that is to develop different management techniques based on the overall functioning of the ecosystem, especially in low exploitation areas.

- To carry out studies to intensify production of the tropical rain forest lands, for example, by integrating agricultural, silvicultural and sheep production, especially where large forest plantations have been established, giving priority to reforesting degraded areas, establishing a balance between forestry use and other land uses, in order to avoid erosion or other types of ecological degradation.

- To define legal, physical and economic aspects in regards to forest utilization.

- To emphasize studies on the following topics:

    - Numeric analyses of forest parameters to determine: degree of species aggregation, value of importance index, complexity, presence, etc.

    - Structure and dynamic functioning of the tropical rain forest ecosystem.

- Optimize utilization of forest products, forming a more efficient lumber industry, with less waste of lumber, using it for fuel or others

- Increase studies of flora especially in intervened areas

- Perform technological studies of unknown forest species in order to offer them for local consumption

- Geo-referenced information systems. Perform forestry resource surveyances within the framework of land assessment, so that an integrated assessment of resources can be made to facilitate planning and administration

- Monitoring of forest resources. This new need, together with the geo-referenced information system will allow efficient and rapid:

  - Dynamic definition and evaluation of forest cover and land use

  - Analysis and quantification of forest cover and linked vegetation (plains, highlands, swamps, gallery forests, etc.)

  - Definition of exploitation tendencies in commercial forests, colonization movement and rational utilization of this resource for self-consumption (fuels, fences, housing).

4.1 Steps being taken to meet those needs

During the last decade defferent governmental organisms devoted to the administration and conservation of natural resources, have been developing a series of research projects related to studies of environment oriented toward the development, rational use and conservation of tropical rain forests.

CONIF initiated a series of studies that offer users of the sector scientifically based solutions to their forest development needs, for example, improved agro-forestry techniques, silvicultural enrichment and the management of tropical rain forests, experiments on species adaptation, fertilization, mycorrhiza and vegetational propagation among others.

The objectives of the TROPENBOS program are to provide knowledge about forests as a basis for conservation and development. It intends to design and carry out plans in each locality, region and country.

INDERENA has a monitoring program for forest resources to determine and evaluate the condition of the forest cover and other types of vegetation, in order to maintain supervision of these resources.

IGAC, through the assistant directorship of Instruction and Research, CIAF, has initiated a five year project for the purpose

of setting up a geographic information system for natural resources. This system would allow a methodology to be established for periodic assessment of forest resources, in addition to determining the efficiency and utility of digital processing of images.

IGAC, through the Agrological Assistant Directorship has prepared three studies pertinent to the development and conservation of tropical rain forests and for regulation of rational use of natural resources.

INVENTORY PUBLICATIONS

IGAC-INDERENA-CONIF, Bosques de Colombia, Bogota, 1984.

-------, "AGUSTIN CODAZZI" GEOGRAPHIC INSTITUTE -ICA, COLOMBIAN AGRICULTURAL AND FISHING INSTITUTE, Mapa de Uso Acutal de la Tierra en Colombia, Bogota, 1987.

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TABLA 3.

ACTUAL LAND USE IN COLOMBIA 1987

	AREA	PERCENTAGE %
Agricultural land		
- Temporary crops	1.163.532	1.02
- Semi-perennial		
- Sugar cane	278.213	0.24
- Banana plantation	38.505	0.03
- Perennial crops		
- Coffee	1.370.695	1.20
- African palm	80.650	0.07
- Orchard fruit	3.994	0.003
- Others	2.382.290	2.09
Grasslands		
- Managed	5.187.603	4.54
- Natural or introduced with dense cover	21.517.280	18.84
- Natural or introduced with open cover	4.864.103	4.26
- Scrub grasses	8.514.185	7.46
Forest land		
- Natural	51.221.802	44.87
- Intervened	4.584.096	4.01
- Plantation	133.635	0.12
- Shrub savanna	1.458.800	1.28
- Xerophytic vegetation	1.455.728	1.27
Land unused for agriculture or forestry		
- Swamps and marshes	1.854.355	1.62
- Drylands and/or zones with no vegetation	1.480.900	1.30
- Forest Fallow	3.998.311	3.50
- Paramos and perpetual snow	1.156.328	1.01
Others use		
- Water and urban zones	1.429.812	1.27
T O T A L	114.174.800.	100.00

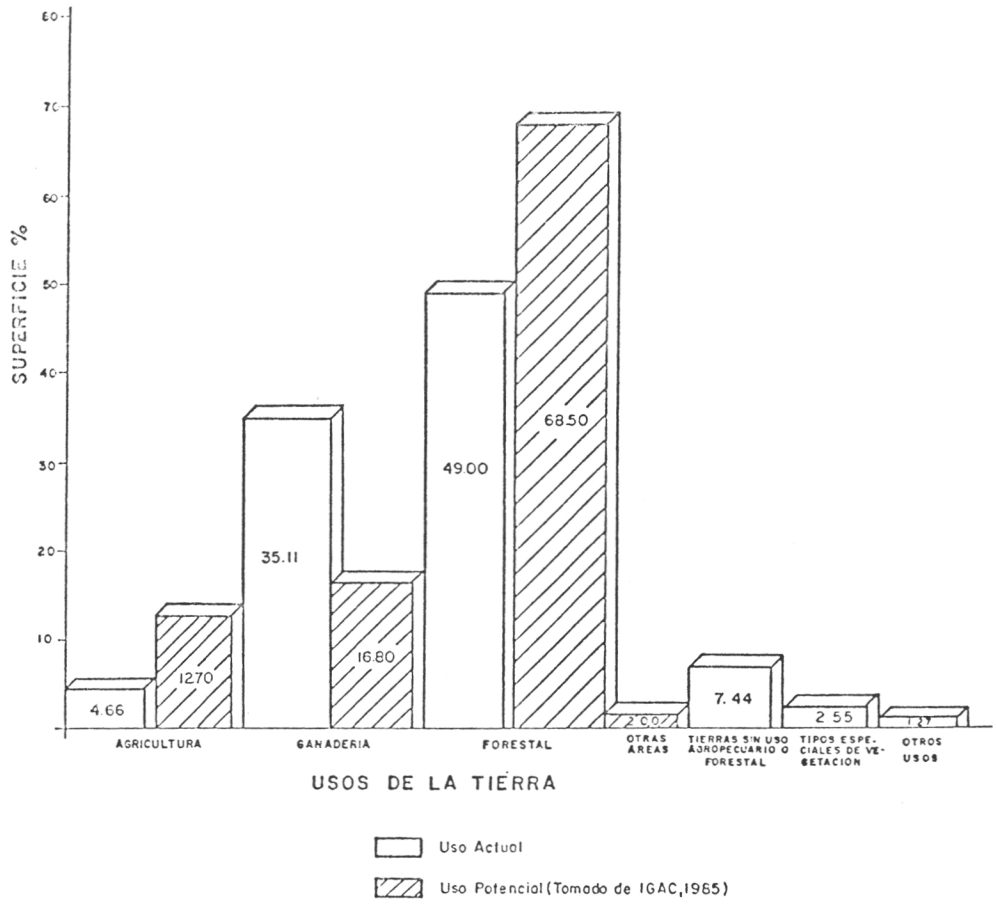

FIGURA 1. Comparación entre el Uso Actual y el Uso Potencial de las tierras en Colombia.

NATIONAL REPORT: CZECHOSLOVAKIA

by
Viliam Matusky & Zoltán Koči

Forest regulation which has a long-standing tradition in Czechoslovakia also includes forest stock-taking (inventory) The outcomes of forest regulation are primarily forest management plans, drafted in ten-year cycles for forest management districts identical with organisational units of the State forest administration - forest plants or forest managements. Forest management plans contain a detailed picture of the forest situation.

Forest management plans are drafted annually for one tenth of forest management districts. This means that information they contain dates, on the average, from the period of five years ago. This system is adequate in normally growing forests where the felling more or less equals the increment. In the forests afflicted with extensive devastations and those suffering the impact of industrial emissions, the inventory cycle is reduced, as the need may be, to five and less years. This provides for the topicality of information also on those forests where rapid changes occur in the volume (especially of reserves).

Comprehensive forest management plans (CFMP) are drafted by means of aggregation of data from valid forest management plans. Special field surveys are not conducted for the purposes of CFMP drafting, as there are sufficient data on the actual condition of the forest provided by in-depth examination. CFMP are elaborated at the level of each forest user and also for the country as a whole.

The comprehensive forest management plans contain especially the following tabular information:

- basic data on forest situation according to the type of management unit and exploitation
- basic data on forest situation according to the categories, forest shape and cutting periods
- basic data classified by forest categories and age classes,
- forest categories
- basic data classified by wood species
- spatial representation of wood species in age classes
- assortment of planned harvesting
- breakdown of management tasks into five-year national economy plans.

The main CFMP user is the supreme body of the branch - Ministry of Forest and Water Management for which it serves as the working material for the formulation of the outlook of the development of forest management and other national economy branches and for the regulation of basic decisions concerning forest management and to which it provides data on forest situation.

Other branch users are research institutes of forest management, individual State forest plants. Partial CFMP users include especially those from the sphere of the ministry of culture, education, industry, planning commissions and commissions for scientific and technological development and investments. In recent years, requirements are growing for data concerning the state and the development of forests especially from the part of organisations in the field of ecology and land-use planning.

The detailed identification of forest condition is carried out separately for each unit of spatial arrangement of the forest. One unit of spatial arrangement of the forest is represented by a specified area of forest stand with identical composition, density and class and it serves for a detailed identification of the actual forest condition and for the elaboration of economic measures. Survey and measurement data are recorded in the field record book.

The examination of forest condition includes:

- identification of the areas of forest arrangement units
- determination of stand characteristics, forest and terrain type, endangered zones
- examination of taxation variables - age, stocking, wood species representation, height, thickness $d_{1,3}$ and class
- determination of the genetic classification
- examination of health condition
- identification of stand reserves of wood substance
- derivation of increments.

Besides data on felling, thinning and afforestation obligations, the plan of economic measures (detailed operational plan) specifies: cutting cycle, reproduction composition of wood species, form of economic use, distance between cutting areas, direction of reproduction, width of cutting area and number of starting points. These data are presented in a schematic form in the operating-technological map with the scale of 1:10000.

The reserves are examined and calculated in m^3 without bark on the stem. Tallying of trees is used to ascertain stand reserves in high forests under exploitation; it is done in those parts where the harvest cutting is considered. Statistical representative methods are mainly used in the stands of the last two age classes (61 years) and older stands, unless harvest cutting is prescribed in them.

In tree tallying, stand reserves are established with the accuracy of $\pm$ 5 %, in the statistical representative methods with the accuracy of $\pm$ 10 %.

Different types of aerial photography are extensively used in the determination of forest condition. Possibilities for their further expansion also to the study of the health condition of forests are presently verified.

The determination of forest condition also includes forest mapping. The drawing of forest maps is done on the basis of the State map derived at the scale of 1:5000, into which is plotted the basic forestry situation and variable detail. A so-called economic map is thus created which, at the same time, is also a working map in the field surveys.

The maps are drawn on the basis of the evaluation of aerial photographs and field measurements. The use of orthophotographs and orthophotomaps is also tested. Since 1990, map digitalization is assumed.

The users of the detailed data on forest condition are especially the State forest administrations which, in addition to numerical surveys, also receive sets of forestry maps: contour map, stand map and operating-technological map at the 1:10000 scale, organisational map at the scale of 1:20000 or 1:25000.

The set of data on the condition of the forest, ascertained on the basis of detailed surveying, is very extensive and, in many directions (technologies, other than productive functions),not yet quite sufficiently used. Nevertheless, needs arise for certain other data resulting from the actual economic situation of the forest or for data required by the society, such as refining of data on insufficiently productive young stands (reconstructions), more accurate data on the 1st age class, data on wood species intrusions in the case of species which are of low forestry value, but highly valued by the wood-working industry, etc.

The costs of field operations including computer processing are 100 to 130 Czechoslovak crowns/ha.

Forest management plans and comprehensive forest management plans are drafted on the basis of computer technology. This process is fully automated and takes place with the aid of data base in the data bank. Comprehensive forest management plans do not provide updated data at a certain date, but they contain summarized data derived from valid one to ten-year forest management plans.

In the future (in 1991 at the earliest), the large-scale forest inventory is anticipated to serve for the determination of forest situation. This is the result of the growing requirements of the Ministry of Forest and Water Management and plan-

ning bodies for a high degree of updating of data on the forest stand fund and exploitation possibilities, as well as the need for its regular and systematic reproduction during relatively short time cycles. The provision of such data by means of updating forest management plans and forest record-keeping presently encounters certain problems. The possibility of using large-scale forest inventory is therefore considered for this purpose, especially as concerns the determination of reserves, increments, assortment and health condition of the forest. The main objective of the large-scale forest inventory-taking will be the permanent monitoring of forest condition and development, especially with regard to the changing ecological and economic conditions. Data obtained by large-scale forest inventory will be processed on the computer.

The data from forest inventories and comprehensive forest management plans are given in independent materials and are only designed for internal use of the bodies concerned.

NATIONAL REPORT: FRG

by
K. Schwenke

a) Description of the scope and coverage of the latest national forest inventory

Scope

A national forest inventory on a random basis is being taken in the Federal Republic of Germany for the first time together with the federal forest inventory for 1986 to 1989. It was preceded by socalled forest surveys. The last of that kind took place in 1961 and was based on an inquiry among forestry enterprises.

The aim of the federal forest inventory is to get a general idea of the present large-scale forest conditions and forest production possibilities. As it is the first forest inventory on a random basis at federal level, the federal forest inventory has been conceived as a starting inventory. That means, the federal forest inventory is restricted to the assessment of the forest conditions. The assessment is based on the most important criteria (tree species, age, standing volume, type of ownership and forest road density). It has, however, been conceived at the same time in such a way as to assess in a follow-up inventory the forest development, in particular increment, in an optimum way. A timber forecast should, however, immediately follow the federal forest inventory. Owing to a lack of increment data it will be necessary to use the field tables available for the model calculations.

Concept

The federal forest inventory is based on a sampling procedure with a systematic sample. The sampling distance is 4 x 4 km.

In some Laender (states) the density of the sampling grid is increased to 2.83 x 2.83 km and/or 2 x 2 km in order to obtain reliable data for those Laender having a low forest percentage. In the case of a sampling distance of 4 x 4 km an error of under 1 % is expected for the standing volume/ha and the total standing volume. At each sample point which is in a forest area the forest structure is surveyed. The basis is a square tract with a side length of 150 m. The forest structures (type of ownership, types of stands) and the forest roads are recorded on the tract line. The standing volume survey is taken at the tract edges within the framework of angle count samples and sample areas. The most important criteria for the angle count sample are tree species, diameter breast height, age, tree height, diameter of stem in 7 m height as well as damage to the stem. Moreover, azimuth and distance from the angle count sample central point are registered for each stem recorded in order to ensure a reliable identification for a follow-up inventory. A simplified survey with fixed sample areas is taken in regenerations and young stands (up to 10 cm d. b. h.).

To ensure that the tracts are found again for a follow-up inventory, the tract edges located in the forest are marked by iron pipes driven into the ground being at the same level with the ground.

An important aspect of the federal forest inventory is its decentralized conduct. Under the Basic Law of the Federal Republic of Germany forestry is within the competence of the Laender, while the Federal Government mainly has only competences under skeleton law. Accordingly, the tasks of the federal forest inventory are assigned as follows: The Laender are responsible for data collection in the field. The Federal Government compiles and analyses the data. As far as this task requires it, the Federal Government has a limited coordination competence. As there is no central inventory management with far-reaching competences, problems arise in connection with ensuring a standardized surveying. Close and intensive contacts between the Federal Government and the competent authorities of the Laender (Land inventory management) have to solve this problem.

b) Plans for a follow-up inventory

There are no concrete plans yet for a follow-up inventory. The outcome of the current federal forest inventory remains to be seen before deciding on the concept for a follow-up inventory on the basis of the experience gained. According to the present ideas which are, however, not yet binding it is intended to take a follow-up inventory in about 10 years. Its focus will undoubtedly be on the assessment of the changes in forest conditions. In this respect, increment will be the most important criterion. Moreover, the inclusion of the new type of forest damage will be of greatest importance. Other aspects relate to an assessment of the soil conditions and possibly of criteria relating to the social functions. With regard to the inventory methodology the possibilities of aeral mapping have to be examined. Concrete ideas and/or concepts, however, do not yet exist for an extension.

c) Users of the inventory data

The results of the federal forest inventory will primarily be used by the forest administrations of the Federal Government and the Laender for forest policy formulation. The second large group of users will be the enterprises of forestry and forest industries which will also develop their forest and market policy ideas and requests from these data. Moreover, these users will also use the data for their decisions at enterprise level (e. g. investment in forest industries). The data material collected will also be made available to scientists for their studies.

The Laender will receive the data material which are of interest to them as well as the evaluation programmes enabling them to conduct their own special evaluations.

d) Description of the methodology and equipment

Inventory

The federal forest inventory is a purely terrestric sample inventory. The sample is systematic according to a 4 x 4 km grid; regionally the density of the sampling grid is increased to

2.83 x 2.83 km and/or 2 x 2 km. The sample grid is oriented at the Gauß-Krüger map coordinates. The sample points are defined by their coordination and are accordingly entered on the topographic map 1 : 25,000. Each of these sample points is the starting point for a square tract with a side length of 150 m strictly oriented towards north and east. With the aid of the local forest authorities it is examined on the basis of the map material and - as far as available - updated aeral photographs whether the tract line touches forest areas. In the case of uncertainties an examination in the field is effected. All tracts touching forest are surveyed by inventory teams consisting of two graduate foresters. Apart from the map material (topographic map 1 : 25,000, German basic map 1 : 50,000) they avail themselves of the preliminary surveys of ownership types, borders and size groups taken by the local forest authorities. The tract is measured in the field on the basis of the map with compass and ultra-set (rangefinder with ultrasound) or tape measure.

A line appraisal is carried out on the tract line involving ownership borders and stand borders. The stands in question are shortly described and documented with the length of the line section. The measuring of the appraisal line takes places again with compass and ultra-set.

To ascertain the standing volume the individual trees are measured on the edge points of the tract and described. Up to a d. b. h. of 9.9 cm of young growth, graded by size, is relatively summarily recorded in three concentric sample circles.

The trees with a d. b. h. of at least 10 cm are selected with the mirror relascope by means of an angle count sample. Each tree in the angle count sample is assessed in relation to the tree species and measured.

The following equipment is used:

- diameter tape
- Finish parabolic caliper 7 m and mirror relascope

Measured are: d. b. h., diameter in 7 m height, tree height and stem height for broadleaves.

The age is ascertained as far as available from existing data (forest management planning), counted or estimated on whorls or poles. Core for estimation of age is not taken. Each tree is determined for identification for a follow-up inventory by means of azimuth and distance from the central point of the angle count sample (tract edge). The tract edge is marked by an iron pipe driven into the ground being at the same level with the ground to allow an identification with metal detectors.

Subsequently, damages to the stem (wood damage) are assessed. New types of forest damage are not recorded in this respect.

Data collection and storage

The inventory teams enter the data in forms according to clearly defined keys. A preliminary examination of these data sheets is made by the Land own inventory management who also select at least 5 % of the tracts which are subject to a control. The data sheets examined are passed on to the federal inventory management, where a second examination takes place with regard to completeness. Subsequently, the data are fed into a computer and checked for plausibility. Faulty data sets are clarified together with the inventory management of the Land. This work is carried out at the Federal Research Centre for Forestry and Forest Products, Hamburg, where the evaluation programmes are also drawn up. For this purpose a working group consisting of 5 persons was set up.

Data processing is carried out on a VAX 750 VMS system. Pascal and C are available as programming languages. Moreover, use can also be made of the SAS programme.

Mapping

At present not much can be reported on the mapping of the inventory results, as it is still being developed within the framework of the evaluation concept. Mapping on microfiche is being favoured, as it is done in Austria. Moreover, the most important tables will undoubtedly be published also in the form of brochures.

e) Identification of newly-emerging needs for inventory information and steps being taken to meet those needs

As already mentioned above the federal forest inventory is the first inventory of its kind in the Federal Republic of Germany. Only if or when the results are available, the additional information needs will be identifiable. Some ideas have already been outlined in this respect under item b).

f) Publications

The following publications are available on the federal forest inventory:

- Instruktion für die Traktaufnahme

  Bundesminister für Ernährung,
  Landwirtschaft und Forsten,
  Selbstverlag 1986

- Sonderheft Bundeswaldinventur

  Allgemeine Forstzeitschrift Nr. 32
  vom 9. August 1986

- Forderungen an eine Bundeswaldinventur aus der Sicht von Forst- und Holzwirtschaft, Kolloquiumsbeiträge
  Forstliche Forschungsberichte München Nr. 66/1985

g) Other aspects

Costs

The costs of the federal forest inventory are expected to amount to about DM 15 million, of which about DM 12 million account for data collection in the forest to be borne by the Laender. The remainder of DM 3 million to be borne by the Federal Government is estimated for the compilation and analysis of the data.

Manpower requirements

Up to 100 persons are involved at times in the federal forest inventory, of whom

- 5 persons for central coordination and analysis
- 8 persons as inventory managers in the Laender (excl. city states) (how many persons are employed only temporarily is not known)

- 80 to 90 persons as inventory teams depending on the progress of work in the individual Laender.

The manpower employed are mainly graduate foresters.

The experience so far gained in connection with the conduct of the inventory has shown that the estimated performance of 1 tract per day and inventory team is largely achieved.

For about 14,000 tracts to be surveyed the requirements amount to a total of 2,100 man/months for the tract survey; this corresponds to an average need for 30 inventory teams for a 3-year inventory and 160 day per year.

Relationship between forest inventory and other surveys

There is no direct relationship between the federal forest inventory and other surveys. As, however, the sample points (tracts) are defined by their coordinates in terms of space, it is possible to carry out evaluations for any delimited region and to compare those with the results of other surveys made for that region. It is, for example, intended to compare the results of the federal forest inventory with those of the forest damage survey as far as forest growth areas are concerned. Nothing can be said yet about relationships between the federal forest inventory and geographic information systems.

NATIONAL REPORT: FINLAND

by
Kullervo Kuusela

HISTORY AND OBJECTIVES OF THE INVENTORY

The regular inventory of forests on the basis of statistical sampling was commenced in Finland in 1921. The objective was to gather information concerning the quantity and quality of forest resources in conditions where the use of wood for fuel and other household purposes was great, the use of industrial timber was increasing rapidly, and it was generally feared that forest resources were decreasing. The need for a reliable basis for forest income and property taxation also existed.

Inventories have been carried out 7 times. The years of field work were: 1921-24, 1936-39, 1951-53, 1960-63, 1964-70, 1971-76 and 1977-84.

The inventory is carried out by the Finnish Forest Research Institute which is a state institution under the Ministry of Agriculture and Forestry. The first four inventories were accomplished at intervals of years then considered desirable. More recently, field work became a continuous (annual) process.

The continuous inventory proceeds by regions. The length of each cycle comprising one complete inventory is dependent on the funds granted by the state budget, the smallesta area unit for which results are required, and the statistical precision of the estimates considered desirable.

For the purpose of general planning activities in forestry the principal estimates are needed for units with a minimum area of approx. 200 000 ha. The standard error of the growing stock volume estimate is required to be ±5-8 per cent in South Finland and ±10 per cent in North Finland for these units.

The most important administrational unit is the Forestry Board Districts (Fig. 4). These are commonly 0,5-1,0 mill. ha in area. There are 20 districts. The standard error of the growing stock volume estimate for these districts is ±2-4 per cent.

The 7th inventory lasted 8 years (1977-84). The area of the forest land was estimated at 20,1 mill. ha with a standard error of ±0,5 per cent. The growing stock volume was estimated at 1664 mill. m^3 with a standard error of ±0,7 per cent.

The annual costs, including research personnel, was 2,5 mill. Fmk in 1984.

On the financial basis, area units and precision requirements described above, the average inventory rotation, i.e. time between 6th and 7th inventory, was 6,9 years for Forestry Board Districts. The corresponding costs per hectare per year are approx. 1 Fmk. Calculated against the total forest land area the annual costs are 0,12 Fmk per hectare.

The results of forest inventories are the informational basis for utilizing and developing forest resources in such a way that the utilization and improvement of forests as a renewable natural resource are efficient and economically sound. Sustained yield and ecological principles can then be followed.

The important characteristics of forest resources are area and quality of sites, volume, structure, quality and increment of the growing stock, greatest possible drain and removals by timber assortments on the sustained yield basis, silvicultural condition of tree stands, and the required silvicultural and forest improvement works. Some characteristics are estimated for planning the multiple use of forests.

Because the products of forestry and forest industries comprise 40-45 per cent of the total value of Finland's exports, forest resource information are of great importance in planning and developing forest industries and the uses of timber. Estimates of the greatest possible drain on the basis of sustained yield have been the basis of planning and regulating the increase of timber using industries.

Information concerning the timber cut and utilized are also needed for forest balance estimates. These are achieved by separate timber utilization and drain investigations. Stumps of the cut trees are also measured in the inventory and the results describe the quality of the trees harvested and the cutting methods.

The principal users of the forest resource information are the Ministry of Agriculture and Forestry, the National Board of Forestry, Central and District Forestry Boards, Forest Improvement Districts and economic planning organizations on the national and regional level. Besides these public agencies, the organizations of forest industries and industrial companies use forest resource information. The results of forest inventories are also used in planning other forest research activities.

SAMPLING DESIGN

The inventory is based on a systematic sample which covers the total land and inland water area.

A sample of parallel lines and sample plots measured on the line was used until the year 1963. The area of site and stand classes was estimated by line measurements. The direction of lines was from south-west to north-east and the distance between the lines was 15 km in most cases (Part 1 in Fig. 1). Growing stock characteristics were estimated by sample plots.

A tractwise line-plot inventory has been used since 1964. At first, the inventory line had the form of a square in the middle of each tract (Part 2 in Fig. 1). Later the form was changed into a half square (Part 3 in Fig. 1).

Reasons for changing the line design have been:

- At the time of the first inventories the road net was sparse and the means of transportation were poor. Sampling by parallel lines was cheap in flat and comparatively assessible terrain.

- The road net improved rapidly after the Second World War, motorvehicles became common and the willingness of field crew members to walk trough the country decreased.

- From the point of view of the sampling efficiency the measurements on parallel lines have great neighbour correlation and there are no measurements in a large area between the lines. If the forest characteristics form an oblong figure parallel with the lines, the statistical error of line estimates can be great.

- When the form of the line unit is a half square, the sampling efficiency improves in such a way that when using the same total length of lines the statistical precision is better than using the square form. If the aim is a predetermined precision, the sampling design with halves of squares is faster and cheaper to measure than the design with squares.

The tract size in the 7th inventory started in 1977 is 8*8 km. Line design 3 is used. The length of line in a half square unit is 4100 m. Site and stand characteristics and the stumps of trees felled during the last cutting years before the time of the field work are estimated and measured on 41 sample plots separated by 100 m (Fig. 2).

Diameter at breast height, by tree species, is measured on 21 plots separated by 200 m. Trees are determined by relascope with the basal area factor of 2. All boundary trees are checked by caliper and tape.

Tree height, diameter at 6 m height and 5 years' increment are measured on 4 plots.

In Lapland, which is the northernmost region of Finland (Fig. 4), the total land area is 9,8 mill. ha, the area of forestry land 9,6 mill. ha and the area of productive forest land 5,4 mill. ha. Large areas are covered by scrubs or they are treeless. Production of timber per hectare is small and road net sparse. In this kind of condition a two-step sampling design with combined airphoto-interpretation and field sample-plots has many advantages.

Two-step sampling was applied first time in 1970. In the first step, the land and tree-stand classes were estimated by photo-interpretation on a great number of plots systematically located on aerial photographs taken in a scale of 1:50 000. Point estimates were stratified on the basis of the most important land and tree-stand characteristics onto homogenous groups. A second sample of points was selected from these groups and field sample-plots were measured at the same points. Field sampling was denser in those land and tree-stand classes which are most important from the point of view of planning timber production.

The first-step sample was the basis for area estimates. The final site and tree-stand information is based on the second sample.

The current application of the two-step sampling is planned to give estimates of forest-land area and growing-stock volume with a pre-determined statistical accuracy for 2 Forestry Board Districts and their 17 sub-regions.

Another modification is a systematic lay-out of field sample-plots which can be measured before, during or after the photo-interpretation. In this way the work can be carried out flexibly and additional photo-interpretation points can be taken in order to get results for smaller areas, f.i., for state forest districts.

Systematically located field sample-plots give an independent unbiased estimate and a way to check possible systematic errors in combined photo and field estimates.

Current lay-out of the two-step sampling is illustrated in Fig. 3. In addition to the information presented in Figure 3, the distance between the plots in clusters is 40 m.

It has turned out that the two-step sampling based on photo-interpretation and field sample-plots becomes more and more economical when the costs of field work increase with regard to the costs of aerial photography and photographs. At the moment the area and growing-stock estimates of equal statistical accuracy are approximately 30 per cent cheaper than surveyed by field sampling only. On the other hand, the two-step sampling requires more professional skill than traditional field sampling.

Only temporary sample plots have been used so far. However, part of the field plots measured in Lapland in the 6. inventory were re-measured in the 7th inventory in order to get experience of re-measured plot. During the years 1985 and 1986 some 3000 permanent and systematically located sample-plots will be established all over the country for monitoring the environmental and ecological changes and to get information for timber production forecasts.

FOREST BALANCE BETWEEN THE 6TH AND 7TH INVENTORY

Forest balance is a comparison between growing-stock volume at the beginning and end of a balance period, and increment and drain of growing stock during that period.

In Finland the estimates of growing stock volume and its increment is based on the results of national forest inventories carried out by the Department of Forest Inventory and Yield of the Forest Research Institute. Drain is estimated by studies of cutting statistics, timber utilization and drain carried out by the Department of Forest Economics of the Institute. Drain comprises the removals of timber assortments, logging and silvicultural residues and mortality. Drain is estimated by tree species per annum for each Forestry Board District and Åland.

In the case of period between two inventories the balance is calculated for each District. Balance for total country is a sum of District balances because the inventories rotate by Districts. Field work years of the 6th inventory were 1971-76 and of 7th inventory 1977-84. The shortest balance period of Districts was 5 and the longest 8 years. The average length of the period was 6,85 years.

The basic equation of forest balance is:
initial stock + increment - drain = calculated final stock.

Calculated final stock equals inventoried final stock if the estimates are accurate.

As described earlier, the estimates of growing stock and increment are based on sampling. Their proportional standard error is the smaller the greater are the forest area and growing stock. Drain estimates are based on the total removals and consumption of industrial timber. Only the estimates of timber consumed in farms and buildings and of logging and silvicultural residues have sampling error. All estimates are liable to systematic errors which are very difficult to be observed.

Forest balance has several benefits. It tells the relationship between the drain and increment in districts and in the whole country and the degrees of over- and underutilization of forest resources. Forest balances can be prepared for

periods between the years 1962-84. They are a valuable basis to plan, execute and forecast the production of timber and developing forest resources. They can also be used to check the compatibility of the balance estimates. In this presentation the compatibility is checked by comparing the calculated final stock to the inventoried final stock (Fig. 4 and 5).

The total overbark stem-volume of the growing stock, including also the national parks and nature reserves, was 1519,5 mill. m^3 in the results of 6th inventory (1970-76) and 1663,6 mill. m^3 in the results of 7th inventory (1977-84). Estimate of the increment of the growing stock between the inventories is 469,4 mill. m^3 and the estimate of the drain 334,2 mill. m^3.

Calvulated final stock is 1654,7 mill. m^3 which differs by -0,5 per cent from the inventoried stock. The growing stock of 7th inventory include the trees of 0-2 cm of breast height diameter which small trees were excluded in the 6th inventory. The small trees comprise 0,7 per cent the volume of the inventoried final stock.

The principal conclusions are:

The average annual drain between the inventories, 48,7 mill. m^3, was 3,2 per cent of the initial growing stock volume. The annual increment was 68,4 mill. m^3. The drain was 29 per cent smaller than the increment which means a marked underutilization of forest resources.

Regional balances are presented in Fig. 4 and the compatibility check of 15 districts in Fig. 5. If the growing-stock volume of a forest-balance area is greater than approximately 100 mill. m^3 and the proportional standard error of the inventoried growing-stock volumes are 2,9-2,5 per cent, the compatibility of the balances are good enough for general planning of timber production and forest industries. The corresponding area of productive forest land is 110 000 - 200 000 ha. The greater the average stock-volume per hectare the smaller is the area where this compatibility level is reached.

PRESENTATION OF INVENTORY RESULTS

The main results of the inventory are calculated and published for 19 Forestry Board Districts and Åland, for regional aggregates and for the whole country. Results of Forestry Board Districts are published within half a year from the end of each field-work season. The development of forest resources can be presented in time series starting 1922. Most of the detailed time series began at 1952.

Results for areas aggregated from the 500 Finnish municipalities are calculated for the purposes of planning timber purchases, industrial developments, silvicultural tasks and regional economic activities. The most important data for these purposes are the amounts and structure of growing stock volume, increment and cutting possibilities, as well as stand and site treatments required.

Special reports are prepared for planning timber production on variable input programmes, for preparing the state budget and for assessing forestry income and property taxation. Maps presenting the areal distribution of forest characteristics are prepared by computer programmes.

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FIG. 1. DEVELOPMENT OF LAY-OUT OF FIELD SAMPLING

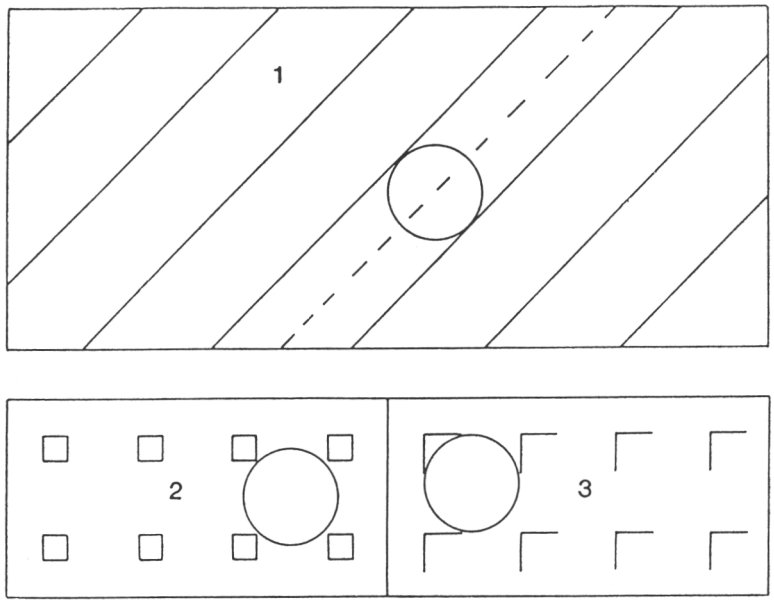


FIG. 2. SAMPLE PLOTS ON A TRACT

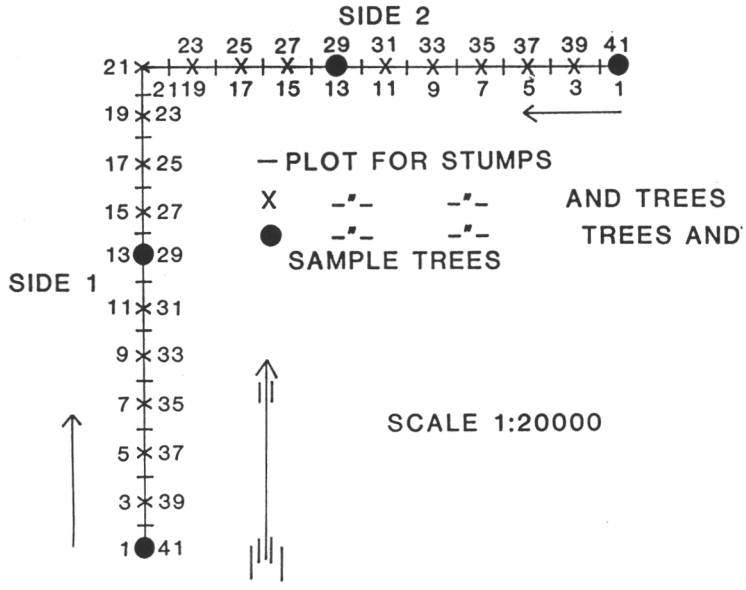


FIG. 3. LAY-OUT OF TWO-STEP SAMPLE IN LAPLAND

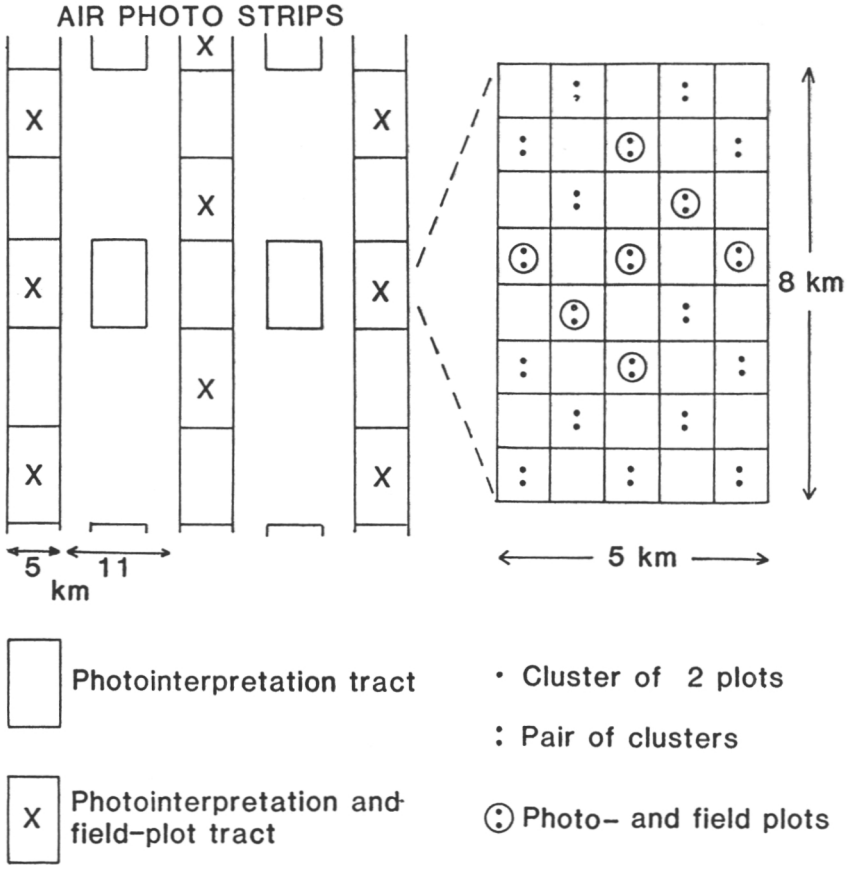


FIG. 4. REGIONAL FOREST BALANCES BETWEEN 6TH AND 7TH INVENTORY

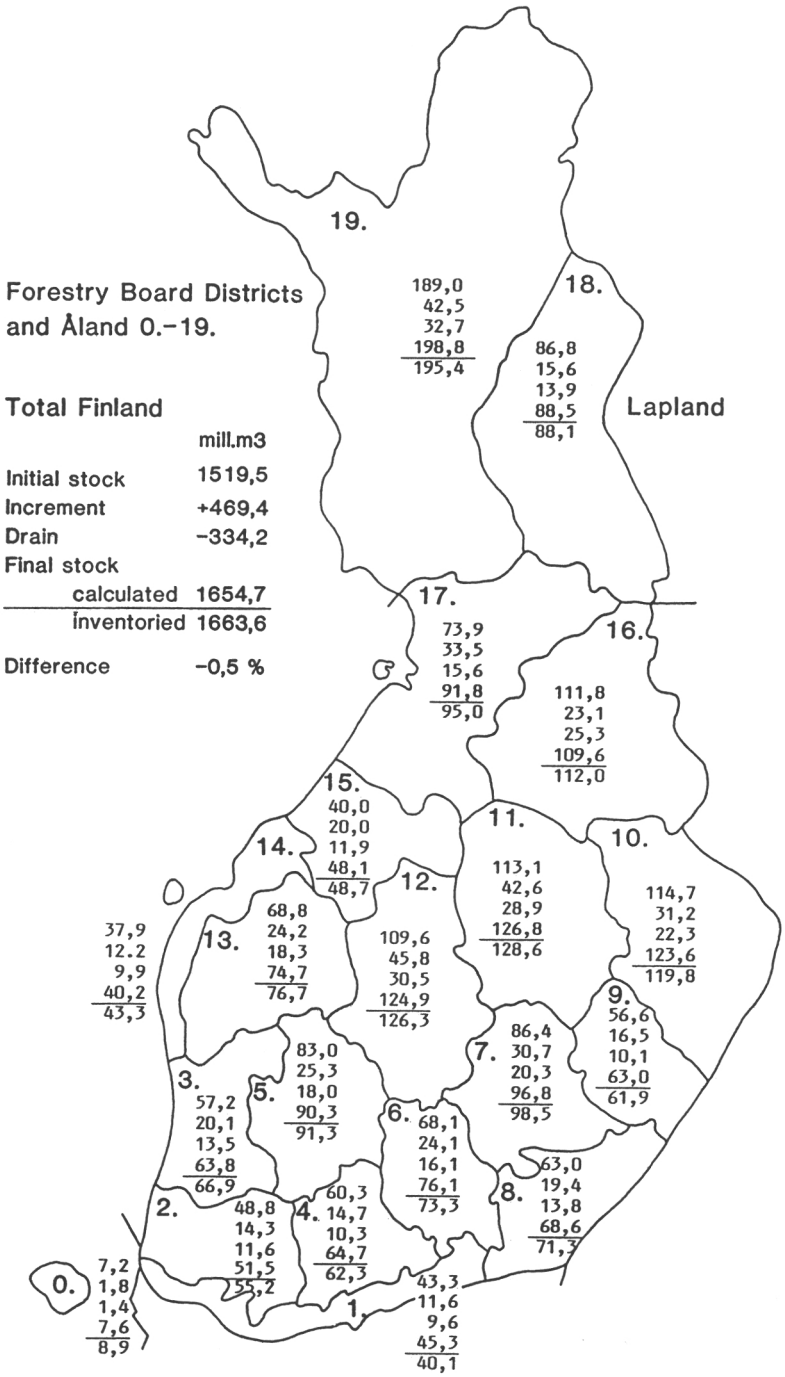
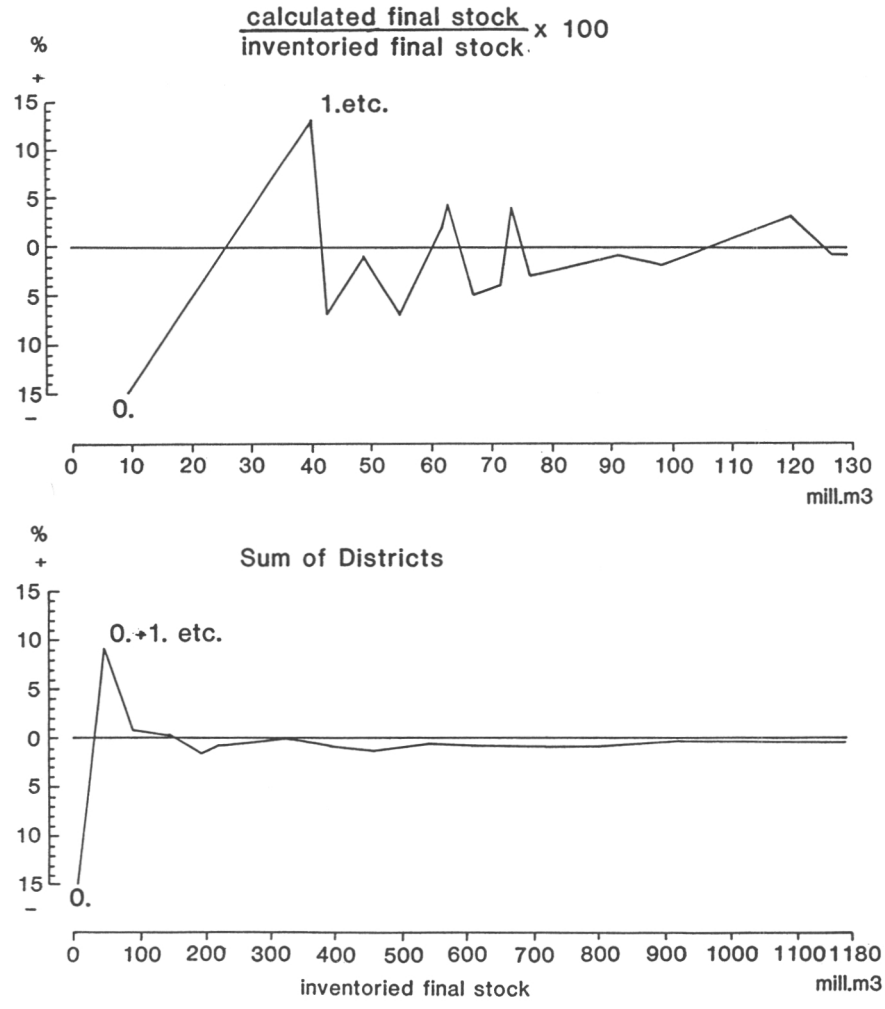


FIG. 5. FORESTRY BOARD DISTRICTS AND ÅLAND
0.–15.



NATIONAL REPORT: FRANCE

by
F. Houllier

1 - Brief description of the most recent survey

The decision of working out a continuous survey of forest resources was taken by an enactment on 24 September 1958. This survey is carried out in every metropolitan administrative department (i.e. excluding oversea departments like french Guyana or french Antilles) by the National Forest Survey (NFS) Service, which depends directly from the Direction for rural Space and Forest ("Direction de l'Espace rural et de la Forêt") within Ministry of Agriculture.

The basic principles of this survey are the following :

- it is a continuous inventory, dealing with every type of ownership (private, state and other public forests): NFS service is totally independant from private owners and from public forest managers;

- the inventory is entirely based on original data, resulting from direct measurements and observations (and not from the compilation of other data gathered by experts, owners or managers);

- the whole (metropolitan) area is surveyed, meaning that every type of land use and every forest tree species are concerned (it includes therefore production and protection forests, small area forests, hedges and tree alignments, poplar plantations as well as other wooded lands).

- for practical and financial reasons, the survey is not carried out simultaneously in the whole country : the basic inventory unit is the administrative department (there are 96 departments in France). The national forest inventory is actually planned so that the whole country is surveyed every 10 years (meaning that 9 to 10 departments are surveyed each year).

A first national inventory based on these principles has been carried out between 1960 and 1980. Thus the first survey cycle lasted 20 years (10 years more than the theoretically planned duration) : this was due to the difficulties related to

the gradual conception (development of the methodology) and implementation of such a survey (financial and technical reasons, field crew training, ...).

The second survey cycle began in 1977 (there was an overlay with the end of the first cycle). It has already been fully carried out in 59 departments (meaning that the results have been published or, if not published, that they have been computed and that they are available). For 17 other departments, the work is in progress. On 1 may 1987, the state of the second survey cycle is thus the following:

Departments with published results	Departments with known (available) results	Departments under survey	Departments to be surveyed in next years
41 departments	18 departments	17 departments	14 departments*
1-3-7-9-10-11-12-15-19-21-22-23-24-25-29-30-32-33-39-40-41-42-43-46-47-48-49-53-54-55-57-63-66-69-70-71-72-81-82-87-88-	04-05-16-17-18-26-34-37-38-44-52-58-59-64-79-85-89-90	06-08-13-14-27-31-36-50-51-61-62-65-73-74-83-84-86-	02-20A-20B-28-35-45-56-60-67-68-75-76-77-80-

* The departments around Paris (75-78-91-92-93-94-95) are considered as a single inventory unit.

The 59 departments which have been fully surveyed twice represent actually a large part of french forests, as shown in the following tables:

- **Area** (exploitable and unexploitable closed forest, excluding poplar plantations and other wooded land; unit is ha)

	State Forests	Other public forests *	Private forests	Total
FRANCE	1 423 720	2 222 750	10 193 857	13 840 327
59 departments	917 510	1 625 725	7 716 440	10 259 675
	64.4 %	73.1 %	75.7 %	74.1 %

* the "other public forests" are mainly composed of common forests (i.e. belonging to municipalities).

- Standing volume (exploitable closed forest; unit is 1 000 m3)

	State forests	Other public forests	Private forests	Total	Total Non coniferous	Total Coniferous
FRANCE	255 716	346 837	1 095 567	1 698 120	1 047 382	650 738
59 departments	159 639	250 765	856 991	1 267 395	761 452	505 943
	62.4 %	72.3 %	78.2 %	74.6 %	72.7 %	77.7 %

- Annual volume increment (exploitable closed forest; unit is 1000 m3/ha/yr)

	State Forests	Other public forests	Private forests	Total
FRANCE	6 534	8 909	44 849	60 292
59 departments	4 408	6 752	37 022	8 182
	67.5 %	75.8 %	82.5 %	79.9 %

These 59 departments have an average forest area ratio of 28 %, much higher than the 20 % ratio of the other departments (which have been surveyed only once). The forest area ratio is 25,2 % for the whole country.

It appears also that, in these 59 departments, the state forests are slightly worse represented than the other public (common) forests and above all than the private forests.

2 - Plans for the next survey cycle (including changes introduced as a consequence of changing information needs of users and/or of technological improvements).

First, it must be stated that the general scheme of the national forest survey allows to incorporate methodological changes within a survey cycle (since the basic inventory unit is the department). On the other side, such changes may lead to some difficulties when results are aggregated at the regional or national level.

The next survey cycle (i.e. the third) has already begun in 7 departments (3 for field work and 4 for the preliminary interpretation of aerial photographs). The methodology has only been slightly changed:

- The basic scheme is the same : use of aerial photographs and 3 phase sampling (see § 4);

- Some field plots already measured for the second survey cycle are relocated and measured again for this third cycle (around 30 to 50 % of the second cycle field plots) : these permanent plots will be used to improve the increment and

drain (fellings and mortality) estimates ; SPR (sampling with partial replacement) estimates should also be implemented. This procedure will also be carried out for the fourth survey cycle.

- Tree measurements are simplified and volume and bark functions (built by using the first and second cycle complete tree measurements) will be used (this is already done for some departments whose 2nd survey is presently under process).

- Measurement of tree diameter at breast height is replaced by the measurement of tree girth (at the same level).

The main methodological change is actually related to forest mapping (see also § 4.3). The aerial photographs are used to etablish a large scale forest map whose limits are verified on the ground every time that the photo-interpretation of the photograph is doubtful. The forest areas are then estimated either by planimeter or by digitalizing these limits. The improvment in precision (for the former cycles, the areas were estimated by statistical methods) should approximatively balance the loss of precision due to the use of volume and bark functions (see above).

The use of satellite imagery (T.M. and SPOT) is under study. In most favourable case, it should be limited to area estimation in plain and not mediterranean regions.

3 - Main users of national forest survey data and results.

The main users of NFS results and data are:

- The administrative national, regional (and departmental) services. They use the survey results in order:

  * to prepare Regional Forest Guidelines ("Orientations Régionales Forestières") based on objective resource estimates and on short- and medium-term prospective evaluations of available cut (there are 22 administrative regions);

  * to judge of the feasibility of wood industrial projects.

  These needs are fulfilled either by the published results (see § 6) or by special results computed according to the specific requirements of these users.

- The National Forest Agency ("Office National des Forêts"), which manages both state and other public forests, and the Regional Centers for Forest Ownership ("Centres Régionaux de la Propriété Forestière"), which help, advise and control the private forest owners. Their needs are generally related to management (i.e. estimate of volume and bark-functions, or growth model building based on NFS data). They are also interested by resource and available cut estimates (since they participate to the elaboration of the Regional Forest Guidelines).

- The wood industrialists who need to know about the space localization of wood resource according to species and accessibility (these needs are expressed in the context of preliminary market studies in order to determine the quantity and quality of available resource around existing or future plants and sawmills).

Universities, forestry highschools and research organizations are also occasionnal users of NFS data and results.

4 - Brief description of the methodology and equipment

4.1 - Data gathering

It is organized in three successive phases (in fact, the second and third phases are carried out simultaneously on partially common samples, but with differents aims).

* **First phase** - Interpretation of aerial photographs, including:

- the delineation of forest stand types,
- point sampling and interpretation (around 10000 to 20000 points per department, meaning a photo point every 30 to 40 hectares).

The aim of this phase is to define differents domains, to evaluate their area at the date of photographs and to prepare forest maps (see § 4.3).

* **Second phase** - Random stratified subsampling of points (within the 10000 to 20000 photo points), which are visited on the ground in order to control, complete and update (at time of field survey) the data issued from the first phase. The aim of this second phase is to provide final area estimates at the time of the survey.

* **Third phase** - Random stratified subsampling of photo points with field work on inventory plots : (around 1000 to 2000 field plots in each department ; i.e. a plot avery 100 ha).

- description and classification of the stand,
- tree and stand measurements.

These basic data allow to estimate various tree and stand variables like: stand age, number of stems per ha, tree and stand volume and increment, ...

This general scheme is adapted to the different groups of forest types (closed forest, other wooded land, poplar plantations, hedges and tree alignments, scattered trees).

The total duration of these phases is generally of two years. The work (photo interpretation and field inventory) is actually carried out by 5 deconcentrated interregional offices

(see map in appendix 1). The computation of results is done in Computer Center in Nancy.

There are always two sets of aerial photographs:

- one with a panchromatic emulsion,
- the other with either an infra-red black and white emulsion (in most departments) or an infra-red colour emulsion (in mediterranean and mountain departments).

The scale varies from 1/15000 (in mountain departments) to 1/25000 (in plain departments with little or uniform forests). The most used scale is however 1/17000. Each departmental set of aerial photographs is such that stereoscopy may be used.

4.2 - Computer equipment

Micro-computers are used during photointerpretation to encode directly the data and to control their consistency: this is done in each interregional office. Micro-computers are also used according to locals needs.

Photointerpretation controlled data as well as field data are finally encoded, stored and processed in Computer Center in Nancy, which uses a BULL-CII DPS 7-45 computer (with a mass memory of 1 Gigabytes and a memory of 1 Megabyte).

This center has developped a data base (around 600 megabytes of memory to store some 2 million trees and 150 000 plots; database management system is IDS-II from CII) which cannot be accessed by external users : actually it is only used to facilitate data processing when computing the published results or other special results according to users requirements.

At the same time, the Research Office ("Antenne Recherches") and the Forest Resource Evaluation Office ("Cellule Evaluation de la Ressource"), which are in charge of developping and implementing new survey techniques and new methods related to the estimation of the available cut, develop presently their own relational data base in the South National University Computer Center (in Montpellier) : this center is connected to the European Academic Research Network (EARN) and owns powerful means (IBM 3090; data base management system is DB2 from IBM).

4.3 - Forest maps

Departmental forest maps are also realized and edited: they represent the geographic distribution of forest stand types at a 1/200000 scale. NFS service has been elaborating such maps for around 10 years. At the beginning, they were grid maps, which directly visualized the survey procedure and results (each photo-point was represented as a 30 to 40 hectare square). In the last years, these grid maps have been replaced by contour maps which generalize at the 1/200000 scale the delineation of stand types which is carried out on aerial photographs (see § 4.1).

For some recent departments, the limits of these maps have been verified on the ground (see § 2) and digitalized at a 1/50000 scale in order to build computer files which may be used to obtain different types of outputs at various scales or to link forest data with other geographic informations (road maps, administrative limits, topographic data, ...).

5 - New data requirements

During the third survey phase (i.e. field work phase), ecological and even floristic data are gathered. In some departments, these data are then used in regional ecological studies in order to provide informations on forest site types and on the relationships between site types and (quantitative and qualitative) forest growth and yield.

Since it covers regularly each department, the NFS service is sometimes asked to note forest damages attributed to big game, air pollution, pest diseases (example: Dendroctonus micans), or heavy frosts.

The increase of questions related to the evaluation of wood available cut lead the NFS service to develop a methodological activity in that domain: growth and yield modeling, survey projection methods.

6 - Published results

6.1 - Departmental results

The survey results of each department are published in two volumes. The first tome is dedicated to most users. It contains:

- a general description of the department, a more detailed description of the various forest stand types and forest subregions and a brief analysis about forest and wood economics in the department;
- tables presenting the most important survey results: area distribution, study of other wooded land, detailed study of closed forests, description of polar plantations and other wooded lands (hedges and tree alignments).
- an analysis of survey results, including (for the second survey cycle) a comparison with the preceding survey, and some statistical informations about the reliability of results.

The second volume is more dedicated to specialists involved in detailed resource analysis. It contains three types of tables, which are directly edited by computer. These tables only refer to exploitable closed forests. They are:

- "A tables": stand tables describing the whole department (tree diameter and species composition according to owner-

ship, forest subregion, and forest stand type);

- "B tables": they only concern coppices (either simple coppices or coppices issued from coppice with standards stands) grouped according to predominant species and age classes;

- "C tables": they provide an estimate of the age distribution of even-aged highforests, grouped according to their predominant species (species are generally conifers).

6.2 - National results

National results are published every year in an administrative note entitled "global results available on january the 1st" ("résultats globaux disponibles au 1er janvier"). They provide, for whole France, area, standing volume and increment estimates with specific results:

- for broadleaved species and conifers and according to the three main types of owners;

- for aggregated stand types;

- and for elementary forest structures (i.e. even-aged and uneven-aged highforest, simple coppice, coppice with standards).

(As an example, see "Résultats globaux disponibles au 1er janvier 1987".)

As a consequence of the survey methodology (see § 1), these results issue from the direct aggregation of departmental results obtained at various dates (on 1 january 1987, these dates ranged from 1973 to 1987).

6.3 - Special results

As earlier mentionned (in § 3), NFS service also provides some special results, which correspond to specific demands. These results may be obtained either from the Computer Center or from the Research Office, according to the required information. Examples of such results are:

- regional and interdepartmental results;

- A, B or C tables at different aggregation levels or for some specific domains defined by users;

- volume and bark functions and growth models estimated from NFS data;

- estimates of wood available cut;

- selected raw data (for example: tree measurement data concerning one species in one department).

7 - Miscellaneous informations

Staff - 12 civil servant and 3 contractual engineers;
14 administrative agents;
132 civil servant and 26 contractual technical agents;
around a dozen of temporary horary agents.

Relations with other organizations -

- Within Ministry of Agriculture: with the Central Service for Statistical and Survey Studies (SCEES in french) and with the Satellite Imagery Commission.

- Other french relations: with the National Geographic Institute (IGN in french), the interministerial Commission for natural Patrimony ("Commission interministérielle des Comptes du Patrimoine naturel"), forest research organizations and forestry highschools.

- International relations: with IUFRO (International Union of Forest Research Organizations), IIASA (International Institute for Applied Analysis) and other national forest survey services (in Belgium, Italy, Switzerland, Canada, USA, Sweden, USSR, Finland and Hungary).

NATIONAL REPORT: MALAYSIA

by

H. C. THANG

1. INTRODUCTION

1.1 Location

Malaysia is a tropical country located north of the Equator within latitudes 1° to 7° North and longitudes 100° to 119° East. The total land area is approximately 33 million hectares with 13.1 million hectares in Peninsular Malaysia, which comprises eleven states and the Federal Territory of Kuala Lumpur, 7.4 million hectares in Sabah and the Federal Territory of Labuan, and 12.5 million hectares in Sarawak. Peninsular Malaysia is separated from Sabah and Sarawak by 720 km of the South China Sea, giving the country a coastline of almost 4,830 km.

1.2 Topography

Peninsular Malaysia consists of east and west coastal plains and central mountain ranges running roughly north to south and reaching up to 2,130 m in some places. The two largest rivers, the Perak River and the Pahang River, flow towards the Straits of Malacca and the South China Sea respectively. At their sources and upper reaches, the rivers are fast-flowing but the lower reaches of the rivers on the west coast sometimes flow through swampy land, while those on the east coast are sometimes impeded by sand bars.

Sabah and Sarawak consist of alluvial and often swampy coastal plains with hilly rolling country inland and mountain ranges in the interior. In Sabah, the central mountain ranges rise abruptly from the west coast to Mt. Kinabalu at 4,100 m, the highest in South East Asia, with many rivers flowing north-west and east to the South China and Sulu Seas. The largest, the Kinabatangan, is navigable for considerable distances and waters an extensive plain. In Sarawak, the eastern mountain ranges rise to more than 1,520 m and contain the largest cave in the world. The largest river, the Rejang, is 564 km long and navigable for about 160 km.

1.3 Climate

The climate of Malaysia is typically humid tropical or wet equatorial and is characterized by year round high temperatures and seasonal heavy rain, especially during the North East Monsoon between November and January. The mean temperatures during the day and night are 32° C and 22° C respectively. The average monthly temperature variation is about 2° C while diurnal temperature variation for inland and coastal areas are 8.5° C to 11° C and 5.5° C to 8.5° C respectively. The average rainfall is about 2,540 mm per year with a maximum of 5,080 mm and a minimum of 1,650 mm. Humidity is always high and ranges from 70% to 98% and the sky is cloudy most of the day, especially during the monsoon months.

2. FOREST RESOURCES

In Malaysia, land, including forest, is defined as a state matter under the Federal Constitution. The total area of natural forests in Malaysia as at the end of 1986 was estimated to be 19.31 million hectares or 58.8% of the total land area, with the proportion of forest land being higher in Sabah and Sarawak than in Peninsular Malaysia, which is more developed as shown in Table 1 below:-

Table 1 : Distribution and Extent of Major Forest Types in Malaysia (million hectares)

Region	Land Area	Dipterocarp	Swamp	Mangrove	Total Forested Land	Percentage Total of Forested Land
Peninsular Malaysia	13.16	5.62	0.46	0.11	6.19	47.0
Sabah	7.37	3.98	0.19	0.32	4.49	60.9
Sarawak	12.33	6.99	1.47	0.17	8.63	70.0
Malaysia	32.86	16.59	2.12	0.60	19.31	58.8

The dipterocarp forest which represents 85.9% of the total forest land, is characterized by the predominance of the family Dipterocarpaceae with many of the species of the genera Anisoptera, Dipterocarpus, Dryobalanops, Hopea, Shorea and Parashorea. It has also been estimated that there are at least 3,000 species of trees with 890 of these species reaching exploitable sizes of at least 45 cm diameter at breast height. Of these 890 species, a total of 408 have been introduced at one time or another to the international markets.

Recognizing the crucial role of forest not only in the production of timber but more importantly in the conservation of soil, water, wildlife and the environment, Malaysia has identified a total of 12.74 million hectares of forested land as the Permanent Forest Estate (PFE) to be managed under sustained yield as shown in Table 2 below:-

Table 2 : Status of Permanent Forest Estate in Malaysia (million hectares)

Region	Protective	Productive	Total
Peninsular Malaysia	1.90	2.85	4.75
Sabah	0.67	2.68	3.35
Sarawak	1.40	3.24	4.64
Malaysia	3.97	8.77	12.74

In recent years, Malaysia has recognized the need for forest plantations to meet domestic timber requirements, especially in Peninsular Malaysia, and to sustain timber exports in the long term. Consequently, programmes for the establishment of plantations of fast-growing tree species, such as Acacia mangium, Gmelina arborea, Paraserianthes falcataria, Eucalyptus deglupta and Pinus caribaea, have been formulated and some have been implemented which could eventually cover more than 500,000 hectares. Initially, the programme in Peninsular Malaysia has been implemented with a loan from the Asian Development Bank to produce general utility timber while programmes in Sabah have been implemented through joint ventures, and a loan from the World Bank, to produce timber and timber products, including pulp and paper, for export. At the end of 1985, it was estimated that a total of 59,643 hectares of forest plantations was established with approximately 12,827 hectares in Peninsular Malaysia, 45,016 hectares in Sabah and 1,800 hectares in Sarawak.

3. FOREST INVENTORY

3.1 Peninsular Malaysia

In 1981 and 1982 the second global forest inventory was carried out in Peninsular Malaysia to collect and update the forest resources information obtained during the first global forest inventory which was carried out in 1970-1972 by the FAO under the Forestry and Forest Industries Development Project.

The objective of the inventory was to enable the Forestry Department to review and/or update the various policies and strategies that had been formulated for the development of the forestry sector in terms of the capacity of the forest resource base to support the wood-based industries and the formulation of more effective forest management systems in accordance with the principle of sustained yield management. Hence, the inventory was designed to collect and generate the following information on the forest resource base:-

i) species distribution by main commercial species and species groups;

ii) frequency of occurrence of species by selected diameter classes;

iii) gross volume per hectare for the main species and species groups by diameter classes for each forest type;

iv) net commercial volume per hectare and by quality classes for each forest type in broad orders of magnitude; and

v) frequency of occurrence of rattans and bamboos which were not carried out during the first global forest inventory in 1970-1972.

In carrying out the inventory, the forested lands were stratified into eleven broad forest types (excluding mangrove forests) using panchromatic black and white vertical aerial photographs of scale 1 : 25,000 while the number of sampling points in each forest type were determined statistically based on their respective coefficient of variation (CV) so as to ensure that the estimated total gross volume for all species having a diameter of 45 cm and above would be within an accuracy limit of ±10% at 95% probability level.

The design of the field sample was based upon an evaluation of the existing inventory data and experience which confirmed a high variability in the physical structure of the forest and of associated gross volume at the micro site level, but which become increasingly homogeneous over expanding areas. Under these circumstances, the use of simple random sampling was rejected in favour of random cluster sampling, in which each cluster sample comprises twelve separate sample plots of 50 m x 20 m each as shown in Appendix I.

In order to select sampling points, a five minute grid was superimposed on broad forest type maps of scale 1 : 250,000 and the randomly selected grid intersection (sampling points) were plotted and transferred to topographic field maps of scale 1 : 63,360.

All trees having a minimum diameter of 30 cm at breast height were enumerated in all twelve sample plots (50 m x 20 m) while trees having diameter between 15 cm - 30 cm were enumerated in three special plots (50 m x 5 m). The following parameters were recorded:-

(i) stump height;

(ii) diameter at breast height;

(iii) log quality; and

(iv) number of log length.

Additional measurements designed to facilitate volume equations study were also taken on the three special plots (50 m x 5 m) of each sample cluster for all trees having a minimum diameter of 15 cm at breast height and above which were as follows:-

(i) bark thickness;

(ii) diameter above stump at 5 m, 10 m and at crown point;

(iii) bole length from stump to crown point and to a minimum top diameter of 15 cm if this occurred below crown point; and

(iv) bole length free of external defect.

The occurrence of rattans in seven species/species groups and that of bamboos in four classes were also recorded in each of the 50 m x 20 m sample plot.

The potential net volumes were estimated only for those species which were either fully marketable or partially marketable using reduction factors to account for defect and harvesting losses.

The field data collected were then analysed by computer from which stand and stock tables were produced by species/species groups, diameter classes and diameter limits; and quality classes for each cluster sample and for each forest type found in each state and that of Peninsular Malaysia.

Forest resource maps of scales 1:250,000 and 1:750,000 together with reports for each of the eleven states in Peninsular Malaysia and that for the whole of Peninsular Malaysia were produced and published.

The total cost in carrying out the field survey of this inventory, excluding salary, was US$ 231,100.

3.2 Sabah

In Sabah, the first statewide forest inventory was conducted in 1969 to 1972 under the Canadian Bilateral Aid Programme (Colombo Plan). The objective of this inventory was to collect forest resources information so as to enable the state government to formulate proper forest development and management plans for the Permanent Forest Estate as well as for the wood-based industries which were as follows:-

(i) the extent of undisturbed forests, logged-over forests and shifting cultivation areas;

(ii) volume of timber stand and species composition;

(iii) the regeneration status of the disturbed forests; and

(iv) production of forest type and stock maps.

Forest typing based on elevation, topography, crown size and crown density was done on a new set of aerial photographs covering the entire state of Sabah at a scale of 1:25,000; while another set of aerial photographs of scale 1:40,000 was taken over specific areas, covering about 33% of the state to provide a basis for topographic mapping. These information were then transferred to the base map of 1:50,000 scale which was later verified with the data collected from field sampling in order to produce a final forest cover map.

For the purpose of field sampling, Sabah was divided into seven sampling units which were then stratified into individual forest types. Sample plots were randomly allocated to each stratum taking into consideration the frequency, extent of occurrence and accessibility of the stratum.

Fixed area rectangular plots were employed during the inventory and for the inland forest three sizes of plots were used, namely:-

(i) main plot of 0.40 hectare in size within which all trees above 40.6 cm in diameter were enumerated;

(ii) sub-plot of 0.08 hectare in size, within which all trees above 20.3 cm to 40.6 cm in diameter were enumerated; and

(iii) sub-plot of 0.04 hectare in size for sampling trees less than 20.3 cm down to 10.2 cm in diameter.

For the mangrove forest the sample plot size was reduced to 0.02 hectare. The layout of the sample plots is as shown in Appendix II.

From the inventory data, height-diameter equations, tree volume equations, stand and stock tables were prepared. The tree volume equations and volume tables were constructed to three utilization standards for the inland forest which were:-

(i) volume to 45.7 cm top diameter;

(ii) volume to 30.5 cm top diameter - applied to trees in the 38.1 cm diameter class and above; and

(iii) volume to 10.2 cm top diameter - applied to trees in the 17.8 cm diameter class and above.

For the mangrove forest the tree volume equations and volume tables were constructed to two utilization standards which were:-

(i) volume to 7.6 cm top diameter - applied to trees in 12.7 cm diameter class and above; and

(ii) volume to 5.1 cm top diameter - for trees in the 10.2 cm diameter class and above.

Statistical analysis was conducted on all the sample data and at 95% probability level the sampling errors for the inland forest and mangrove forest were found to be ±0.9% and ±5.8% repectively which were well within the targeted accuracy limit of ±10%.

Currently, the State Forest Department of Sabah is carrying out a statewide inventory of the disturbed forest with the assistance of the FAO/UNDP as vast areas of the Permanent Forest Estate were released for logging since the first forest inventory. The objective of this inventory is to collect information on the location, stocking, composition, distribution, condition and competitive status of the disturbed forests so as to enable the formulation of appropriate silvicultural and management prescriptions. This project which started at the beginning of 1986 is expected to be completed towards the end of this year.

The inventory method employed is based on the design used for the Disturbed Forest Inventory carried out in Peninsular Malaysia in 1974. Basically, sampling is carried out using systematic line plots, comprising principal plots of size 60 m x 20 m and four sub-plots of 20 m x 20 m, 10 m x 10 m, 5 m x 5 m and 2 m x 2 m as shown in Appendix III.

Within the sample plots the different size classes of trees will be enumerated sequentially which are based on the prescribed minimum acceptable stocking for each of the respective sample plots which are as follows:-

	Sample Plot	Size Class Enumerated	Minimum Acceptable Stocking
(i)	60 m x 20 m principle plot	> 60 cm diameter > 40 cm - 60 cm diameter	2 4
(ii)	20 m x 20 m sub-plot	> 20 cm - 40 cm diameter	4
(iii)	10 m x 10 m sub-plot	> 5 cm - 20 cm diameter	6
(iv)	5 m x 5 m sub-plot	> 3 m height - 5 cm diameter	8
(v)	2 m x 2 m sub-plot	< 3 m height	8

Apart from the enumeration of trees, the incidence of rattans in the 60 m x 20 m plot and climbers in the 10 m x 10 m plot will also be recorded.

The field data will be analysed by computer and colour-coded stock maps of scale 1:5,000 will be prepared. The occurrence of rattans and climbers will also be indicated by using codes to be written above each of the 60 m x 20 m plot.

3.3 Sarawak

In 1969 to 1972 a forest resource inventory was carried out by the FAO under the Forestry and Forest Industries Development Project where eight industrial units of Mixed Dipterocarp Forests covering a total area of 1.2 million hectares were inventorized. The main objective was to collect basic data necessary to facilitate the formulation of industrially oriented forest sector development plans. To this end, the inventory was designed to provide, for each unit, data having a precision in the estimate of net volume within the range of ±10% at the 95% probability level, for all trees having a diameter of 45.7 cm and above.

A total of 503 samples were established through the use of Basal Area Factor (BAF) 10 (ft^2/acre) wedge prism with each ground sample consisting of a cluster of nine Bitterlich point samples or recording units. Following this forest resource inventory the State Forest Department of Sarawak has been carrying out forest inventory on different forested areas annually. The sampling design and methodology used in this inventory is essentially the same as that used by the FAO except that the sampling intensity is much higher. It is anticipated that through this ongoing inventory programme, the total timber resources of the state will be quantified.

Currently, in the Mixed Dipterocarp Forests, the forests are stratified into six major forest types, three crown density classes and four terrain classes with the aid of aerial photographs of scale 1 : 25,000. Each sampling unit consists of a cluster of 9 plots which are established using wedge prism of BAF 4 (m^2/ha) as shown in Appendix IV. The locations of samples are done systematically with a random start. All 'IN' trees with diameter 20 cm and above are measured for diameters. For those 'IN' trees with diameter 45 cm and above, merchantable height with at least one sawlog length of 3.6 m are measured to top diameters of 30 cm and 45 cm. Unmerchantable sections of the trees are excluded.

The objectives of this inventory are to obtain estimates of the growing stock of trees with a precision of ±10% at 95% probability level for trees of diameter 45 cm and above and to prepare stand tables for trees of the more important species with diameter 20 cm and above.

In the Peat Swamp Forests, the forests are stratified with the aid of aerial photographs of scale 1 : 25,000 into nine major forest types only. The inventory carried out is quite similar to that of the Mixed Dipterocarp Forest except that because of the presence and better utilization level of Gonystylus bancanus (Ramin) the minimum diameter and sawlog length measured for this species are 30 cm and 1.8 m respectively while for the other species the minimum measurements are 45 cm and 3.6 m respectively. Each sample consists of 4 cluster plots which are established using wedge prism of BAF 4 (m^2/ha) as shown in Appendix IV. The objectives of this inventory are the same as those for the Mixed Dipterocarp Forests except that for the species G. bancanus, estimates of the growing stock are for all trees having a diameter of 30 cm and above.

At the end of 1985, a total of 3.56 million hectares had been inventorized which represents 41.2% of the total forested land of Sarawak. Of this, 1.98 million hectares or 22.9% were in the Permanent Forest Estate while the remaining 1.58 million hectares or 18.3% were in the stateland forest as shown in Table 3 below:-

Table 3 : Progress of inventory as at 31.12.1985 in Sarawak (million hectares)

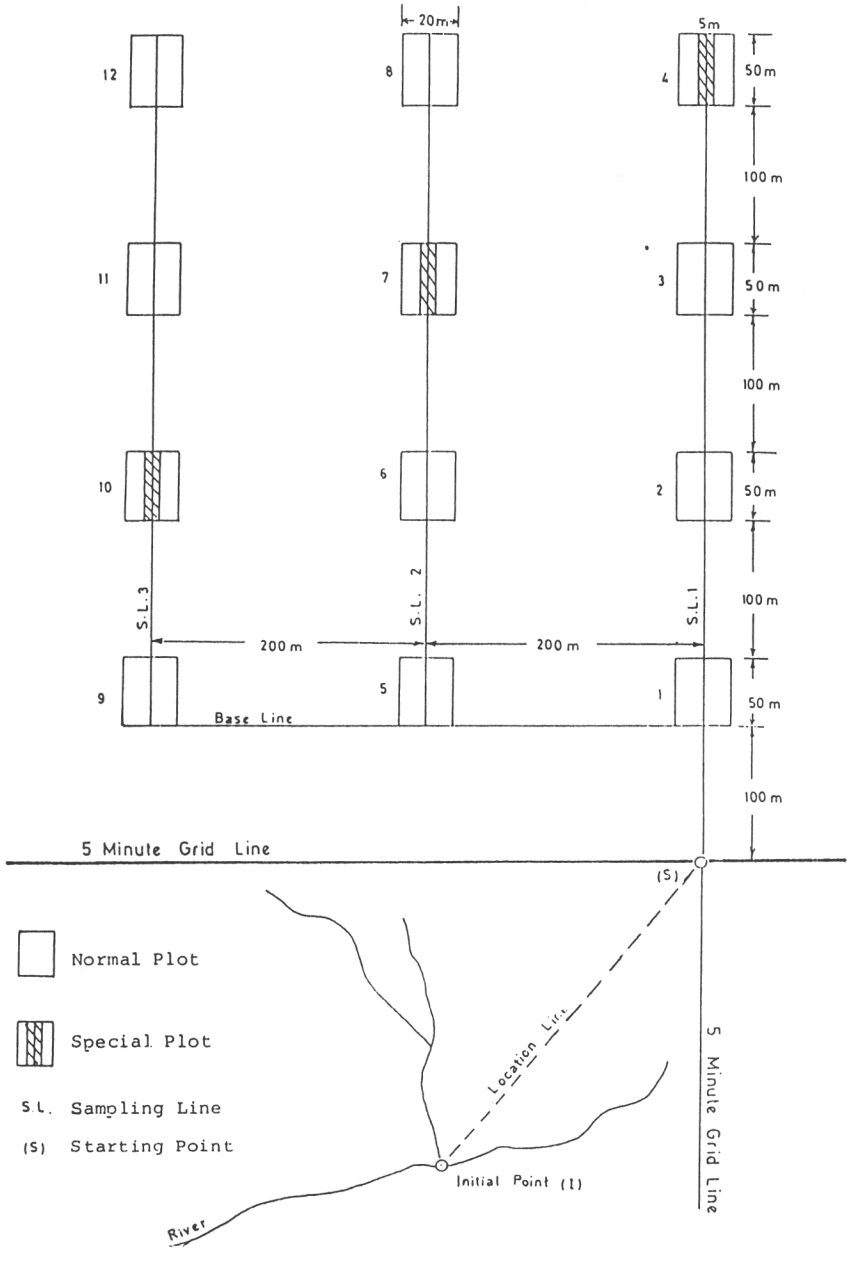
FOREST CATEGORY	TOTAL AREA	AREA INVENTORIZED	PERCENTAGE TOTAL OF AREA INVENTORIZED
Permanent Forest Estate	4.64	1.98	22.9
Stateland Forest	3.99	1.58	18.3
Total	8.63	3.56	41.2

4. CONCLUSION

With the rising costs in carrying out forest resource appraisal and monitoring and the need of timely information for decision making coupled with the changing pattern of wood and non-wood usage from the forest; it is imperative that concerted efforts be devoted in the development of more cost-effective forest inventory methods to meet the above challenges especially with the increasing usage of rattans and bamboos by the rural population in improving their quality of life.

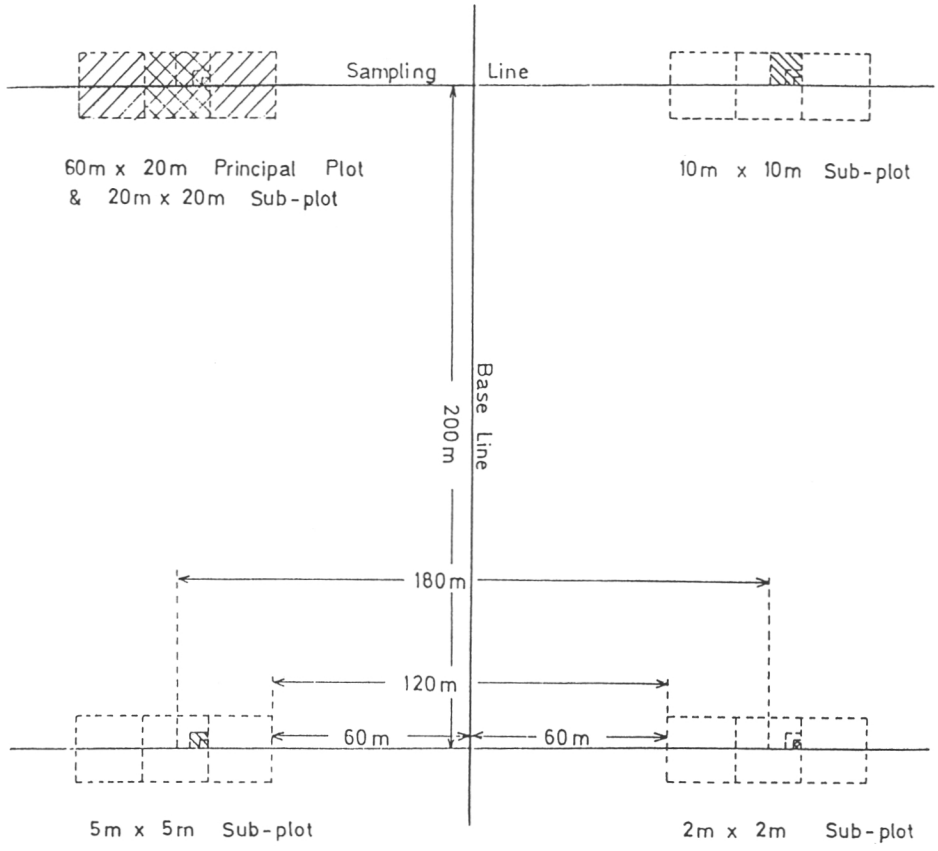
Appendix I

Layout of Cluster Samples



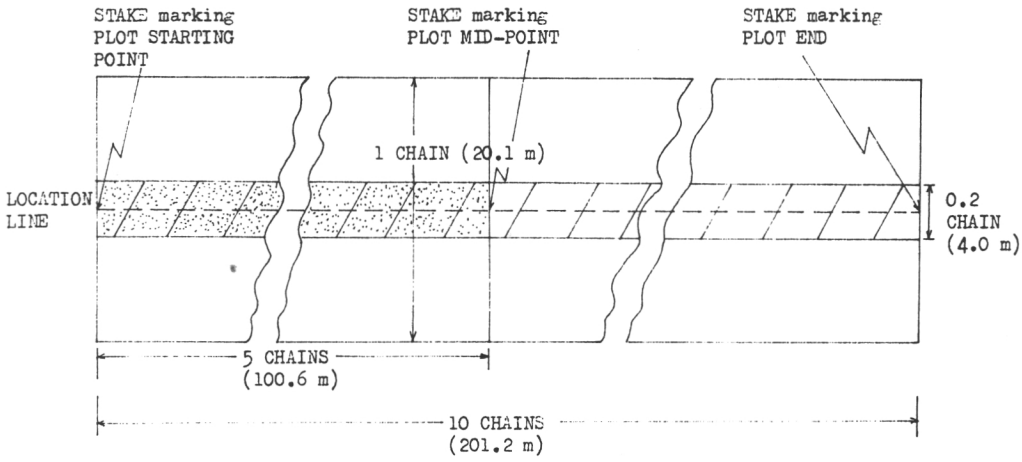
Appendix III

Layout of Sample Plots



Appendix II

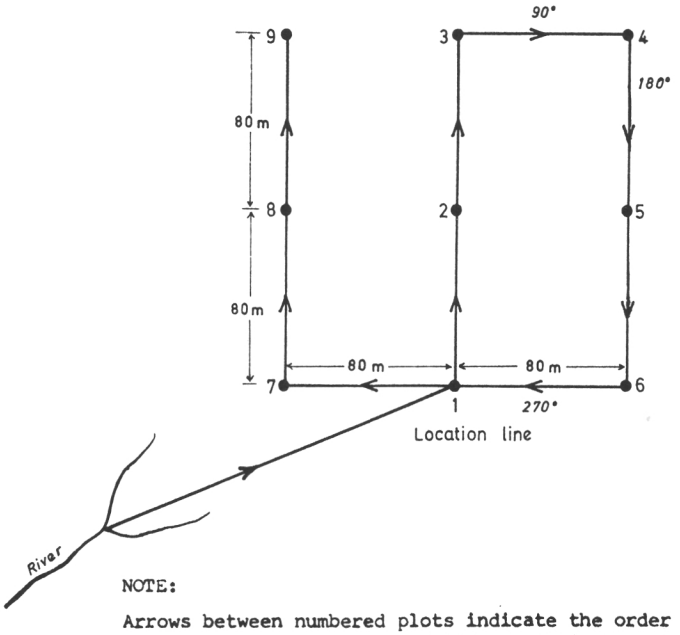
Layout of Forest Inventory Sample Plots



Main Plot - within overall boundary		1 acre (0.40 ha)
Sub-Plot for 20.3-40.6 cm trees		1/5 acre (0.08 ha)
Sub-Plot for 10.3-20.3 cm trees		1/10 acre (0.04 ha)

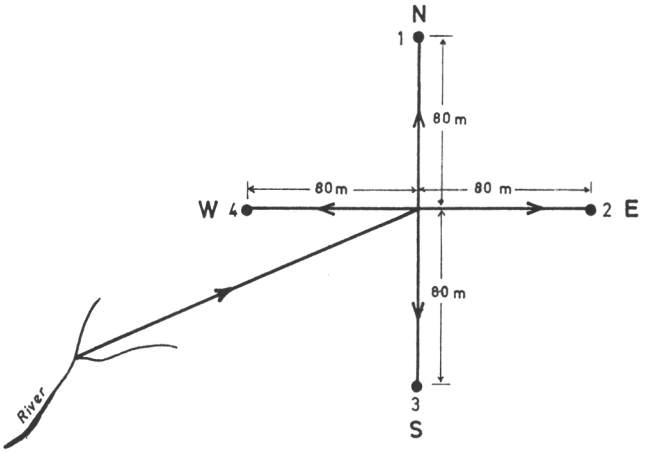
Appendix IV

Layout of cluster plots for each inventory sample in Mixed Dipterocarp Forest



NOTE:

Arrows between numbered plots indicate the order in which the plots are established within the cluster.



Layout of cluster plots for each inventory sample in Peat Swamp Forest

NATIONAL REPORT: MEXICO

by
Victor Sosa

I. INTRODUCTION

This paper contains a briefly report of the antecedents, current situation and future activities, of the forest resources inventory of Mexico at the national level, in relationship with the assessment realized by FAO in 1980, and the world assessment that will be executed in 1990.

II. SCOPE AND COVERAGE OF THE FIRST NATIONAL FOREST INVENTORY OF MEXICO.

The first national inventory of Mexico, began with support of FAO in 1961, in the states of Chihuahua and Durango (north of the country), ending this first assessment of the total country in 1985. The basic objectives were the localization and quantification of the forests lands, the calculation of the timber growing stock, and the increment in the case of coniferous, as well as valuations of the forests damages.

Were studied separately the 32 states of Mexico and published a report for each one of them, with the results derived from the forest inventory, the methodologies and the information available. In this form was developed the first phase of the forest inventory of Mexico.

At present is being analyzed the more convenient way in order to realize the second forest inventory of the country, through regional meetings for opinion and also is realizing a specific project within the agreement for forest cooperation between Mexico and Finland, for this purpose.

III. USERS OF THE INFORMATION

From an analysis realized for the period 1976-1977, based on 1083 requests of information produced by the national forest inventory, was found that the biger percentage of users, were individual persons with 38%. The second place (30%) was for several offices of the federal forest administration, and the third place for foreign institutions with 11%. The remaining 21% of users were other federal and state agencies, and different public and private institutions. In most cases the information was used for support plans and projects.

In the first phase of the national forest inventory, although the information was utilized in intense form, the use not responded to a concrete objective or plan, in which the inventory was considered as a part of the whole planning and operation system for the forest sector.

The second forest inventory of Mexico will be based in the new forest law (1986), that will imply that the forest inventory must be considered within of a sectorial forest planning system, and should be give specific information in order to make decisions and realize actions, inside a conception of the integrated management of the forest resources. In this sense, the main users will be the state and federal goverments, forest owners and forest industries.

IV. METHODOLOGY AND EQUIPMENT

In the first national forest inventory was utilized the next methodology: field data collection using squares of sample with a systematic order and recording unities of 0.1 hectares and low intensities of sampling, measures in order to calculate the volume increment of coniferous, and preparation of the stand volume tables; maps preparation in scales 1:50 000 or 1:100 000 with the forest types, using aerial photographies in scales 1:30 000 to 1:80 000, through photointerpretation techniques; computers utilization for the processing data; and publication of the forest inventory for each state of the country.

The equipment used consisted in terrestrial, aerial and aquatic vehicles and common equipment for the field measures. In the office work, were used stereoscopes, third order transferrings, calculators and computers.

The methodology and equipment for the second national inventory is actually in the definition phase, is necessary to develop a cheaper and faster system, in order to obtain the minimum information required. It will be tested a double sample system, consistent in a first phase over topographic maps, forest maps, aerial photographies and satellite images, and a second phase in order to obtain the field information. It will be used modern mensuration equipment and also for data processing.

V. NEW NECESSITIES OF INFORMATION

The future information necessities of the forest resources of Mexico, are explained in the new forest law and its regulation, an approximation of this necessities are:

- The volumes and composition of the species and forest products; use land destinations and reserves; lands under restoration and afforestation; types of forest vegetation; deforestation for periods; and land tenure.
- The increment and allowable cut.
- The actions to be developed in the forest lands in protection, afforestation, restoration, silvicultural measures and other actions.
- The adequate practices for the integrated management of soil, water, vegetation and other natural resources.
- Specific studies in order to support the sectorial forest plan.

VI. OTHER ASPECTS

In the first national forest inventory, were working a lot of technicians, field and support personnel (may be until 200-300 persons in some period). Currently in the office of the national forest inventory, work only 4 forest professionals, 5 technicians and 13 support personnel. The second inventory costs are in definition, trought the pilot project that will be realized in the state of Tlaxcala with the cooperation of Finland.

In Mexico there is an especialized Institute that make the geographic studies at the national level (INEGI). From this Institute was obtained a lot

of support with aerial photographies and land use and topographical maps in the scale 1:50 000. In the future the coordination with this institution - should be closer, in order to have an integrated system for the assessment of natural resources.

VII. RELATIONSHIP OF THE NATIONAL FOREST INVENTORY OF MEXICO WITH THE 1990 WORLD ASSESSMENT.

Because Mexico is defining currently the form in order to realize the second forest inventory, there is the great opportunity for make it, in close connection with the objectives of the 1990 world forest resources assessment, as a part of the planning and operation system for the forest sector at the international and national levels. The conclusions and support activities that will be derived from this meeting, should be incorporated completely, with the definition works for this new forest inventory of Mexico.

VIII. COMMENTARIES CONCERNING THE RESULTS OF MEXICO DERIVED OF THE ASSESSMENT REALIZED BY FAO IN 1990.

FAO indicate 48.5 million hectares of forest land for Mexico, this figure is 7.6 million hectares superior to the figure that is managed in Mexico, perhaps because was taken a portion of the short forests that can include trees from 5 to 10 high meters, and also because the forest inventory of some states were under processing in 1980.

The data concerning operable and inoperable forests were approximate, because there isn't specific studies of this aspect at a national level. An approximation realized within the works of the agreement Mexico-Finland, estimated the operable forests in 28.5 million hectares for 1980, against 24.3 estimated in the FAO report.

According with the concept of forest managed in the classification used by FAO, could be registered in 1980, 500 000 hectares for Mexico against zero given in the FAO report.

The data of 26.0 million hectares of forest land under shifting cultivation in the FAO study, vary excessively of the 17.8 million hectares calculated in the national forest inventory of Mexico. Same differences can be observed in other figures.

The forest resources information of Mexico obtained by FAO in the 1990 - assessment, is practically unknow in our forest sector. The mexican group that will participate in the 1990 assessment, should be realize and analysis and adjustment of the 1980 information, based in the criterions revision, - new data and methodologies, for subsequent use and spreading.

IX. CONCLUSIONS AND RECOMMENDATIONS

- The second forest inventory of Mexico should be realized with a clear objectives definition, and as a part of a whole planning and operation system for the forest sector.

- The future development of the forest inventory of Mexico, will be realized within economic restrictions, new necessities of information and also a new forest law, that will imply changes in the objectives, metho - dologies, terms, and information uses.

- Is recommendable the participation and support of the FAO in the activities that Mexico develop, in order to define the second forest inventory at the national level, so that this inventory will be compatible with the objectives of the 1990 world assessment.

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SARH

SUBSECRETARIA DE DESARROLLO Y FOMENTO AGROPECUARIO Y FORESTAL

DIRECCION GENERAL DE NORMATIVIDAD FORESTAL

DIRECCION DE APOYOS A LA ACTIVIDAD FORESTAL

SUBDIRECCION DEL INVENTARIO NACIONAL FORESTAL

SUPERFICIES FORESTALES DE LA REPUBLICA MEXICANA

(millones de hectáreas)



SUPERFICIE FORESTAL

143.6

(73.0%)

(Porcentajes con relación a la superficie total del país, 196.6 millones de hectáreas)

SUPERFICIE ARBOLADA

38.9

(19.8%)

OTRAS AREAS FORESTALES

104.7

(53.2%)

BOSQUES	27.5	(14.0%)	CONIFERAS Y LATIFOLIADAS 18.7 (9.5%)
			LATIFOLIADAS 8.8 (4.5%)
SELVAS	11.4	(5.8%)	ALTAS 2.1 (1.1%)
			MEDIANAS 9.3 (4.7%)
ARBUSTIVAS	29.3	(14.9%)	SELVAS BAJAS 17.9 (9.1%)
			CHAPARRALES 7.6 (3.9%)
			MEZQUITALES 3.8 (1.9%)
MATORRALES	56.1	(28.5%)	ROSETOFILO 7.0 (3.6%)
			MICROFILO 38.4 (19.5%)
			CRASICAULE 10.7 (5.4%)
AREAS PERTURBADAS	17.8	(9.1%)	
VEGETACION HIDROFILA	1.5	(0.7%)	

FUENTE: INVENTARIO NACIONAL FORESTAL — MEXICO D.F. MARZO DE 1986

NATIONAL REPORT: MOROCCO

by
Driss Benessalah

1. Scope of the survey

A national forest survey was first initiated by the Department of Forestry in 1976. At that time, the survey was designed to cover the forest area of a whole province, which encompasses some 22,500 km^2. The idea was to start, in a first phase, the survey of the procedure and ensure an adequate training of personnel, who will be able to carry out the inventory in other forest regions of the country.

The objectives of the survey were:

1) To assess the global forest coverage of the province and the volume of the growing stock per forest district and for each forest cover type.
2) To estimate timber volume growth.
3) To compile a global forest map at 1:250,000 for general forest purposes, and a series of 1:50,000 scale maps which would be used as a basis for forest management.
4) To establish volume tables for various species.
5) To assess the forest area decrease and change from 1950 to 1977, based on aerial photography at both occasions.

The survey of this region was terminated in 1979, but, due to budgetary constraints, it was not extended to other forest areas, as it was originally planned.

The results of the survey and the methodology are presented in detail in the final report.

2. Methodology

The survey was based on a double phase sampling design, with a combination of aerial photography and ground sampling.

In the first phase, a photointerpretation on 1:20,000 scale photos was made on a systematic sample of photo plots. The sampling intensity was about one point for fifty ha. In this phase, each photo plot was interpreted according to a pre-established classification systen including the following criteria:

- Terrain utilization
  * production, protection or recreatin forest
  * brushy vegetation, marginal forests
  * non forest lands
- Ownership
- Forest region
- Forest site
- Forest type by species of species group, including natural and planted forests.
- Dominant height (three classes).
- Forest canopy cover (crown closure)
- Forest structure

The above mentioned criteria were used to identify strata from which ground sample were randomly selected. The sampling intensity in the ground sampling phase was a function of the economic importance, the area extent and the variance of the strata, with respect to timber volume. Neyman's allocation of plots was adopted to determine the sample size in each stratum.

The ground samples were used to check the photo classification, to give a full description of forest stands and to take measurements on trees in the plot. Tree enumeration in the field was obtained from three concentric circles of 6, 10 and 18 m radius respectively.

For computer data processing, appropriate tally sheets were designed in order to facilitate data transfer to the machine. The computer was used in sorting and merging plots for strata definitions, for sample selection and computations. Also, various tests were performed to adjust photo misclassification, to control the data and the coding system before computations started.

Forest change assessment was performed on a limited area, representative of the forest conditions in the whole region. The method was based on the comparison of photo sample plots taken on successive photo coverages. The objectives were to determine the changes in land use between 1950 and 1977, namely:

- New forests established in non forest lands
- Changes of closed forests into deteriorated forest
- Changes of forest into brushy vegetation (scrubs)
- Changes of forest lands into agricultural lands
- Changes of scrubs into agricultural lands

The results obtained from the survey indicated that a serious deterioration of the forest lands is taking place. In 26 years, about 13% of the total forest area have been lost.

3. Future plans

Actually, there is an increasing concern about the alarming situation of the forest lands and the existence of a degradation process is well recognized. This phenomenon takes on various forms. One is a direct transformation of forest lands into agricultural land through shifting cultivation, and the other, more insidious, is characterized by a progressive "aggression" on the forest, either by overexploitation or overgrazing or both.

Faced with this crucial problem, the Forestry Department is planning a new national survey. Due to the relatively high costs involved with conventional techniques, and considering the urgent need of information on forest conditions and extent, more interest is placed on new techniques based on space remote sensing. Conversely, the lack of funds and adequate equipment, and the scarcity of experts and trained personnel, remain acute problems to be solved.

Moreover, disagreements exist as to whether space imagery alone would be sufficient in providing reliable information required for global assessment of forest area, timber production, and monitoring changes.

NATIONAL REPORT: NETHERLANDS

by
F.J. Stuurman

a. Latest inventory

The latest inventory was the Fourth National Forest Inventory, executed in 1980-1985

Aims of the fourth inventory are:
- -provide data on national and regional level as a basis for forest policy and land-use planning
- -create insight in the functioning of the forest for:
  - timber production
  - naturte conservation
  - recreational use

The fourth inventory was carried out by:
- National Forest Service (SBB): design, fieldwork
- Netherlands Central Bureau of Statistics (CBS): statistical work,data processing.

The inventory consists out of three parts:

1. Area census of all forest stands in the Netherlands

All forests have been visited and inventoried.

Forested area is characterized as follows:
- -an area of at least 0.5 ha and at least 30 m wide;
- -crown density at least 20% (or temporary lower e.g. in case of clearcuts)
- -tree species must be forest trees (orchards, arboreta and so on are not considered as forested area)

Results were published in 1985.

2. Other data on forest characteristics

The objective of this part, executed by sampling on permanent plots, was to enlight the functioning of the forest for timber production, nature conservation and recreational use.

Results are to be expected in 1988.

3. Woody plantations outside the forest

By sampling estimates were made about the characteristics of side and line plantations, hedges, solitary trees, small groups of trees and

d. Brief description of the fourth inventory

The data collection was done:

1. Area census:

All stands are mapped on topographical maps 1:10.000.
The maps were preparated for the fieldwork in the office using aerial photographs (panchromatic black and white, 23x23 cm, 1:18.000), for tracing all forested areas, and other available invetories (Management type inventories, third national forest inventory).
Most of the other information was gathered in the field.

The location of a stand is identified by the number of the topographical map, the municipality, the number of the map square and a number within the map square.
On each stand information is gathered on:

- forest type (see table 1)
- land-use catagory
- tree species
- age
- form of regeneration
- ownership
- administrative information (location, management unit, forest area unit)
- another forest type based on history (afforestation period, objective of afforestation (production, estate, park, recreation and so on) and former land-use.

and estimated are (for later use in combination with the sampling on forest land):

- diameter
- dominant height and
- standing volume

The following maps have been made (by hand) using the topographical basis 1:10.000:

- -map of all stands
- -map of ownership
- -map of forest complexes

Table 1. Forest types in the fourth National Forest Inventory

Category	Main types
Closed forest (density >60%)	Selection forest
	Normal high forest
	Coppice with standards
	Coppice
	Line shaped plantations in forest
	Special forms of high forest
	Clearcut areas
Open forest (density 20-60%)	Due to natural seeding
	Due to deforestation
Non-wooded area	Due to forest management (e.g. fire belts, log stores)
	Not due to forest management

small patches of forest (<0.5 ha).

Results are to be expected in 1988.

b. Following inventory

The publishing work of the fourth inventory will be completed in 1988. In the mean time we are searching for possibilities to keep this inventory up to date.
Retakes of the measurements on the sample plots will be started in 1988, using the results for making a statistic on growing stock, current increment and wood-yield.
There will be made use of Husky field-computers.

c. Main users

USERS	PURPOSE
National Forest Service:	
Div. Forestry and Landscape Planning:	-underpinning the national Lang-term Forestry Program -underpinning grant schemes on forestry -regional data for better focussing advisory service for forestry -regionalisation of the Long-term Forestry Program -consulting maps, also from preceding inventories, to find out the history of forest sections -estimation of the effects of rotation lengthening or shortening on the amount of pruduced wood -estimation of the effects of regional actions in relation to "acid rain"
Div. Forest and Nature Management:	-data about areas in relation to the division of the country into Forest and Nature Management-districts -national review gives the possibility to make up the species composition over the whole country and to adapt the composition by action
Lower aurthorities:	-making regional forestry plans -making management-plans for own forests
Private foundations:	-illustrating wishes for governmental grant schemes on forestry
Private owners:	-consultation of data of own forests for making management-plans
Research institutes	-selection of suitable forests for examination and investigation

2. Other data on forest characteristics:

Estimates are made, using information of some 3400 sample plots of, among other things, the following items:

- growing stock and current increment
- management parameters (ownership, function, maintenance, thinning, health)
- recreational parameters (attainableness, accessibility, opening up, presence of public roads, provisions for recreation)
- vegetationtype
- stand stucture

3. Woody plantations outside the forest

Estimates are made using 800 aerial photographs. For the line shaped plantations a line intersect sampling procedure was used. Other plantation types such as solitary trees, groups of trees, small patches of forest could be handeled by a simple ratio-estimator of counted number of plantations per unit area. Urban areas have been excluded. The following items have, among other things, been invented:

- plantation type
- area or length
- broadleaved or coniferous
- height class
- surrounding terrain natural, agraric or other
- kind of raod or boundery along wich the plantation is situated
- number of rows of trees
- owners catagory

Storage and processing of data:

Storage: Area census: 40.000 blocks: 20 Megabyte
Other data: 10 Megabyte
Processing: Netherlands Central Bureau of Statistics:
CDC 170 computer
Programs written in Cobol, Pascal and Fortran 5
National Forest Service:

VAX-785 computer
Calcomp A0-plotter
Programs written in Fortran 77
SPSS X- Statistical packet

e. Newly-emerging needs

Long-term Forestry Program:
The government has detailed Dutch forest policy until the year 2000 and indicated the main aims for the subsequent 75 years. Some of the policy lines being stipulated for the long term (until 2075) are:

- -protection and development of the forest sites
- -realization of a diversely composed forest area (with a considerable increase in the area of mixed forest (fron 20 to 60%), an increase in the Douglas fir (from 5 to 17%) and a decrease in the area under larch and spruce (from 11 to 4%).
- -boosting self-sufficiency in wood from 8 to 17% by extension of

the forest area and reforestation with high producing species.
-significantly enhancing nature values in the forest (in 18% of the forest the accent will be on nature).
-an even better functioning of the forest for outdoor recreation and as a landscape element
-extending the forest area by at least 45 000 ha, of which being 15 000 ha fastgrowing forest

It will be necessary to verify if these aims of the Long-term Forest Program will be achieved. Data will be needed for this control. Therefor the sample plots will be re-invented every 5 years. With the data collected the following statistics will be made of:
-the annual wood-yield
-a 5 year estimation of the growing stock and the current increment
-a view on the changes in forest type and tree species

Non-wood products: No data are collected by the National Forest Service.

Biomass:
Investigations (University of Amsterdam) in forest-reserves will give rough data on biomass, collected in about 70 reserves representating many forest types in the Netherlands.

Forest health:
Data from some 3000 places in the Dutch forests are collected by workers of Forest and Nature Management. Using these data a yearly report is produced by the departments of Forest development and of Statistics of the National Forest Service. Also in the fourth forest inventory data about health were collected, but these have become obsolete.

f. Pubications

First, second and third forest inventory:

Staatsbosbeheer, 1948,De Nederlandsche Boschstatistiek, 1948 (with summary in english), Staatsuitgeverij, s-Gravenhage.

Centraal Bureau voor de Statistiek, 1966, De Nederlandse Bosstatistiek Deel 9, Nederland, 1953-1963 (The Dutch forest inventory, part 9, The Netherlands, 1953-1963) with summary in english), s-Gravenhage.

Centraal Bureau voor de Statistiek, 1971, De Nederlandse Bosstatistiek 1964-1968 (The Dutch forest inventory, 1964-1968 (with summary in english), s-Gravenhage.

Jansen, J.J., 1978, National forest inventory in The Netherlands. In: Proceedings National Forest Inventory, 18-26 june 1978, Bucarest, IUFRO S4.02, pp. 474-478.

Fourth forest inventory:

Centraal Bureau voor de Statistiek, 1985, De Nederlandse Bosstatistiek deel 1: de oppervlakte bos 1980-1983 (The Dutch forest inventory, part 1: the forest area 1980-1983 (with summary in english), s-Gravenhage.

Daamen,W.P., J.J.Jansen, T.M.Ritskes and H.Schoonderwoerd, 1985, The Fourth National Forest Inventory. In: Proceedings National Forest Inventory in Euriope, edited by D.R.Pelz and T.Cunia, Mitteilungen der Abteilung fÜr forstliche Biometrie 85-3, Universität Freiburg, BRD.

More details about organisation, execution and results of the fourth Dutch forest inventory can be found in a special issue of Nederlands Bosbouwtijdschrift 59, april 1987, pages 76-127, only in Dutch:

Bunschoten,L., 1987, Overzicht van de geschiedenis van de Nederlandse Bosstatistiek, blz 76-78.
Daamen, W.P. en T.M.Ritskes, 1987. Analyse van de wijzigingen in het Nederlandse bos in de periode 1968-1983, blz 94-101.
Dirkse,G.M. en D.C.P.Thalen, 1987. De "natuurfunctie" van het Nederlandse bos, enkele resultaten van de Vierde Bosstatistiek, blz 116-127.
Jansen,J.J., 1987. Trend en prognose van leegkap, herbebossing en bebossing in Nederland: 1950-2000, blz 102-115.
Ritskes,T.M. en W.P.Daamen, 1987. Doelstelling en uitvoering Vierde Bosstatistiek, blz 79-83.
Ritskes,T.M. en L.Bunschoten, 1987. Enkele uitkomsten uit de integrale inventarisatie van de Vierde Bosstatistiek, blz 86-93.

g. Other aspects

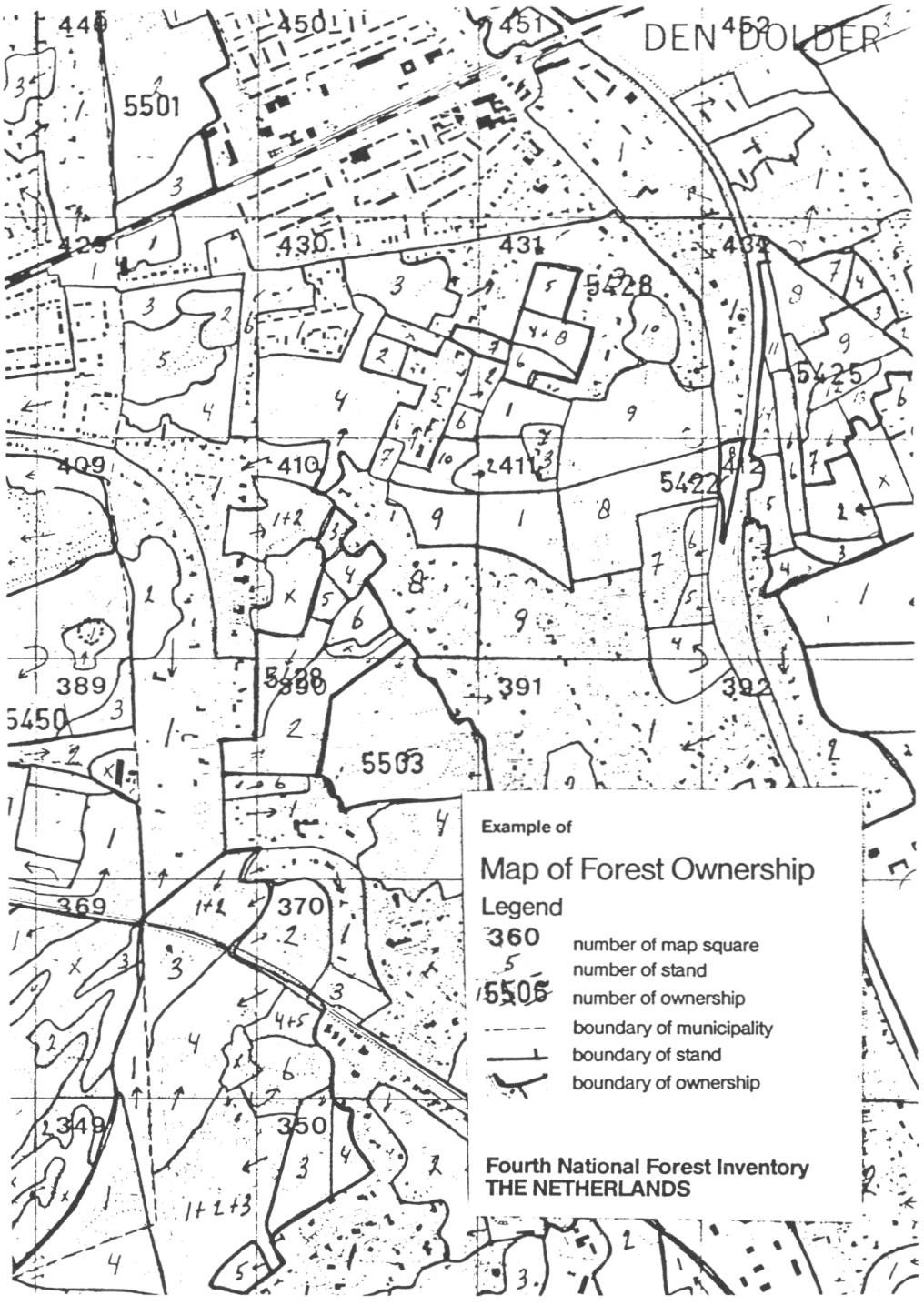
Costs of the latest inventory:

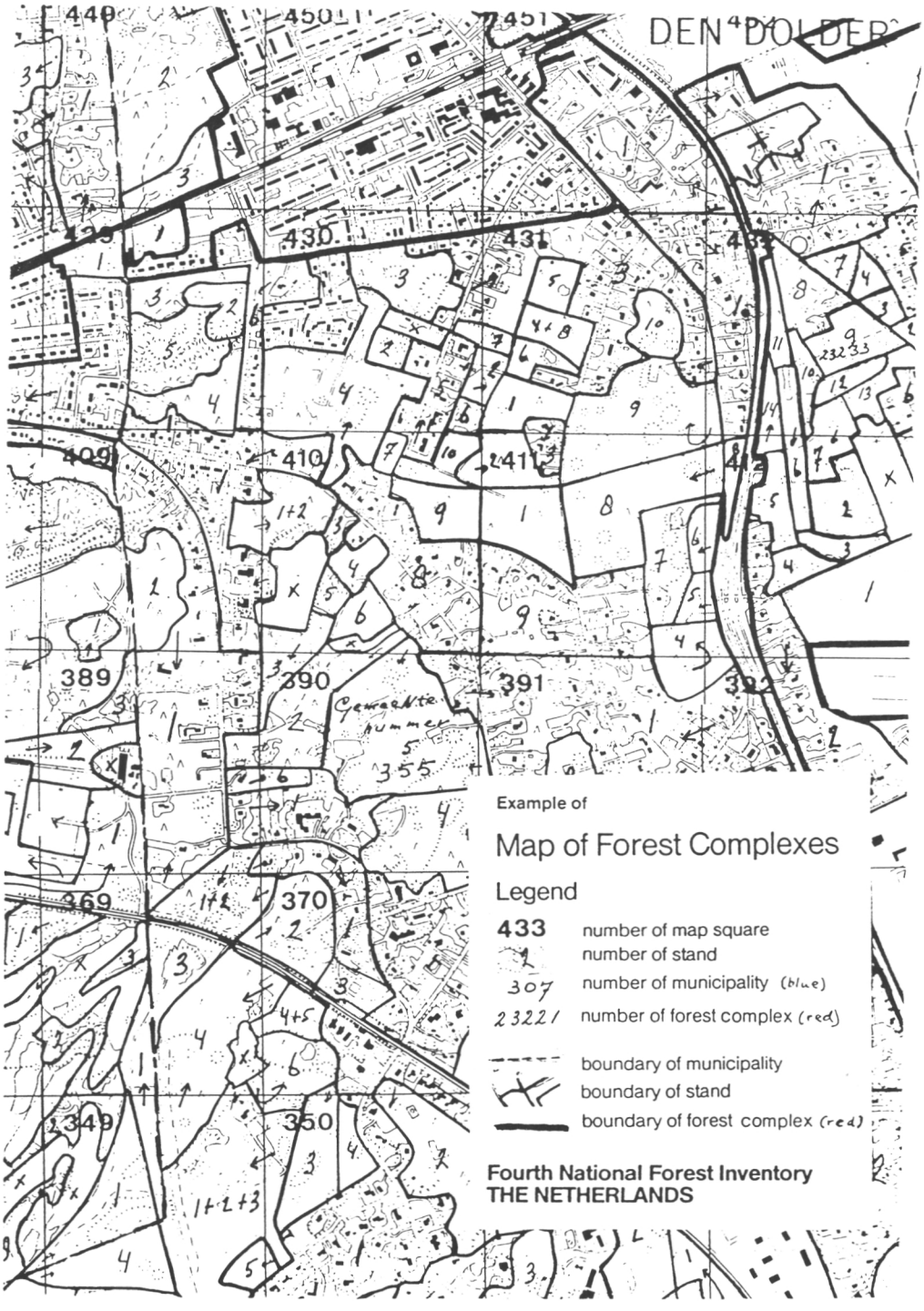
	Man-years SBB	CBS
Data collection:		
Fieldwork and office work:		
1. Area census (340.00 ha):	45	3
2. Other data on forest characteristics:	12	2
3. Woody plantations outside the forest (80.000 ha, 1.5 years photo interpretation and 1.5 years fieldwork)	3	1
Statistical developments	1	0.2
computercosts	PM	PM

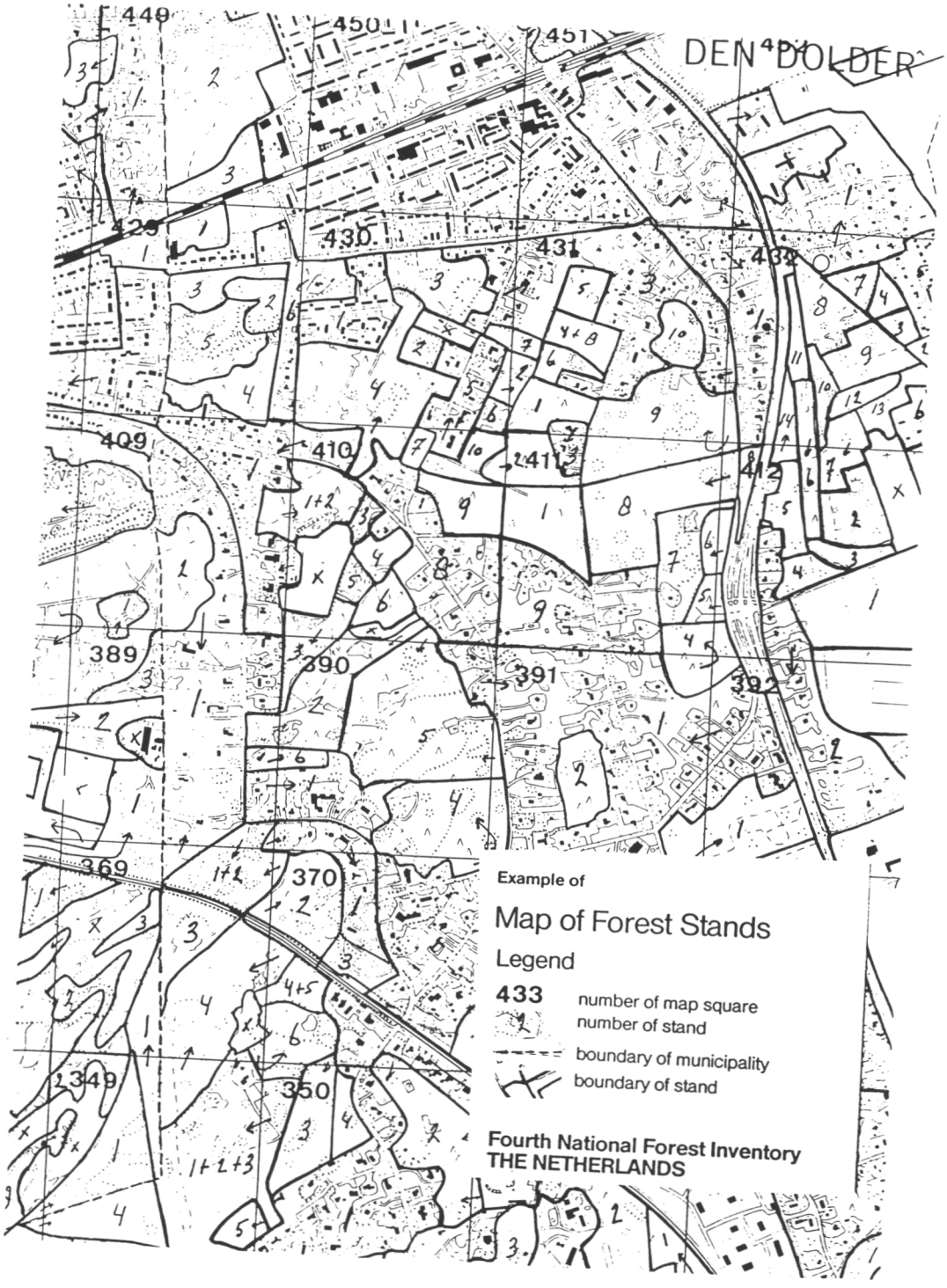
Yearly costs: Storage of the data PM
Answering of questions 0.2 man-year

Relationships between forest inventorie and other land surveys:

There are some relations with the land-use statistics (CBS). Both inventories are based on a 0.25 ha grid cell system. Analyses of the differences will be carried out in the near future.
In this moment there are no computerised relations between the forest inventory and other land surveys.


DEN DOLDER
Example of
Map of Forest Ownership
Legend
360 number of map square
5 number of stand
5506 number of ownership
boundary of municipality
boundary of stand
boundary of ownership
Fourth National Forest Inventory
THE NETHERLANDS


DEN DOLDER
Example of
Map of Forest Complexes
Legend
433 number of map square
number of stand
307 number of municipality (blue)
23221 number of forest complex (red)
boundary of municipality
boundary of stand
boundary of forest complex (red)
Fourth National Forest Inventory
THE NETHERLANDS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Example of
Map of Forest Stands
Legend
433
number of map square
number of stand
boundary of municipality
boundary of stand
Fourth National Forest Inventory
THE NETHERLANDS

NATIONAL REPORT: NIGERIA

by
J.O. Abayomi

Introduction

The reserved forest estate of Nigeria covers an area of 92.3 million hectares, which is approximately 11% of the total land area of the country. Four-fifths of the reserved forest estate is savanna woodland and one-fifth high forest. The high forest supplies the bulk of the country's timber, while fuelwood, poles and small-sized timber are obtainable from the savanna woodland. Forest plantation programmes are being vigorously pursued within the limits of available funds to augment the rapidly diminishing timber of the natural forest, to supply pulpwood to the pulp-mills and to improve the quantity and quality of wood production especially in the savanna woodlands. Apart from the production of various wood products, the forest reserves of Nigeria are economically important for fruit trees, medicinal plants and the production of tannins and gum-arabic. The protective function of forests is also recognised in the areas of wildlife conservation and the protection of farmlands in the arid zone against strong dessicating winds.

Since the 1930's the management of forest reserves has been based on the results of various reconnaissance and pre-investment forest inventories. The most recent, extensive and sophisticated forest inventory in Nigeria was the indicative inventory of the reserved moist forest of Southern Nigeria, which was carried out between 1973 and 1977. A comprehensive review of past forest inventories in Nigeria has already been carried out (Kio, Ola-Adams and Abayomi, 1985).

The Indicative High Forest Inventory

The indicative high forest inventory was carried out from 1973 to 1977 by the Federal Department of Forestry with the assistance of FAO under the United Nations Development Programme. The inventory covered 1,330,100 hectares of reserved high forest in Southern Nigeria, excluding mangrove forests, unreserved high forest areas and the savanna vegetation zones. The two main objectives of the inventory (FAO, 1979) were (i) to determine the amount and quality of timber of saleable size available of the species now being utilised and those with potentials; and (ii) to assess the degree of exploitation and the quantity and type of regeneration that could be expected in the near future. The data resulting from the inventory were intended to serve as guidelines for taking policy decisions at state, regional and national levels on timber production, conversion of natural forest to forest plantations and selecting areas of priority for intensive management surveys.

It was not possible to use aerial photography for stratifying the inventory area because the available aerial photographs were

outdated, and new ones could not be produced. The inventory was therefore based on purely ground methods, using a systematic sample of clusters. Each cluster consisted of four tracts arranged in a square of 1200 metres. Each tract was a 200 m square with 8 plots spaced at intervals of 100 m. On each plot, point sampling was carried out with the Wide Scale Relascope using a Basal Area factor of 4 m^2/ha. Sample trees with a minimum of 40 cm diameter at breast height or above buttress were measured for bole volume using sectional diameter measurements with the wide-scale relascope. The assessment of trees of between 20 and 39 cm diameter was done at each plot within a radius of 9.77 m. The sampling intensity of the inventory was such that the standard error of the total net volume of stems of currently utilised species above 60 cm diameter did not exceed 20% at the 95% probability level for a forest area of about 38,800 ha.

Bole volumes were estimated by means of taper functions, and were sorted according to six utility groups and five log assortment classes. For each State covered by the inventory, stand, basal area and cumulative stock tables were compiled for specific forest types within individual, and groups of, forest reserves. The total net stock volume of currently utilised species with diameter of at least 60 cm in the 1,330,100 ha of surveyed forest reserves was 74.6 million m^3 and 28.0 million m^3 respectively.

Inventory data on completed field sheets were checked and punsched on to cards, which were then tested by an editing programme for the rectification of any wrong data. Stand, basal area and cumulative stock tables were prepared with the aid of the IBM System 3 computer, while the Hewlett-packard 9830 A computer was used for regression analyses of taper functions. The computer-programmed survey data were stored on three magnetic discs, and tables were provided with instructions to enable a programmer to utilise the original data for any further compilation that might be desired.

The National Vegetation and Land-Use Survey

A national vegetation and land use survey, otherwise known as the NIRAD project, was commissioned by the Federal Department of Forestry and executed between September 1976 and September 1978. In the project, Side Looking Airborne Radar (SLAR) imagery was acquired and interpreted over the whole of Nigeria, and maps produced by the colour printing of 69 sheets of interpretation overlays at a scale of 1:250,000. The maps were later used by the Federal Department of Forestry for estimating the total area and timber content (by extrapolation from the indicative high forest inventory data) of the unreserved natural moist forest and derived savanna vegetation zones. These maps were also used for suppplementing the information available from Landsat satellite imagery, especially for the northern part of the country, which is usually under cloudfree conditions.

Plans for proposed national forest resources assessment

As a follow-up to the Indicative High Forest Inventory, a national forest resources survey has been proposed by the Federal Department of Forestry for execution during the 5th National De-

velopment Plan period (1988-1992). Necessary prefeasibility and feasibility studies for the proposed survey have been carried out by a group of consultants. The survey is expected to provide data for the efficient management of the national forest growing stock as well as non-wood products and services. Area information on all forests, both reserved and unreserved, will be updated, and the amounts and types of data to be collected to meet the defined inventory objectives will be determined before the commencement of the inventory.

Data collection, processing and storage

The collection of productivity data from the national forest estate will be done by conventional ground methods in combination with remote sensing through aerial photography, SLAR and LANDSAT satellite imagery. Pilot surveys will be carried out within the various forest strata recognised with the aid of remote sensing facilities. This is to determine suitable sampling intensity based on factors such as costs, stratum variance, stratum size and specified allowable error. The sampling intensity for the inventory as a whole is however expected to be between 0.1 and 0.5 percent.

Different sampling designs will be used for different strata. Systematic cluster sampling has been suggested for the moist forest zone to conform with the sampling methodology of the Indicative High Forest Inventory. Some of the clusters already established will be retained in the national forest inventory to facilitate the determination of increment, drain and mortality. At least 50 clusters are expected to have one of their four tracts converted to a one hectare permanent monitoring plot (FAO, 1980). Mangrove forest areas are to be stratified according to accessibility, and selective sampling carried out with square or slightly rectangular plots. Stratified random sampling has been suggested for the savanna zones and all forest plantations in the country. In the savanna vegetation, 20 metre wide strips will be laid with lengths varying from 400 m to 500 m with decreased stocking. Square sample plots of between 0.04 and 0.16 hectare will be laid in forest plantations of varying ages and stockings. Suitable mensurational and tree sampling techniques will be employed within individual sample plots for estimating stand basal area, height, volume and biomass. Height and volume regression equations will be computed for preparing stock tables, as well as allometric models relating tree biomass to d.b.h., height and stem volume for all stand components, trees and shrubs alike.

The processing and storage of the inventory data will be carried out with the aid of versatile but inexpensive minicomputers. The ICL computer recently purchased by the Federal Department of Forestry with EEC aid will be quite useful for data processing and storage. This minicomputer has three terminals and operates in both Fortran and Basic languages. It has a statistical package (microstat) and a storage capacity of 363 K - bytes.

Logistical considerations

To implement the National Forest Inventory, the creation of a National Forest Resources Survey Unit (NFRSU) has been advocated to function under a proposed National Forestry Commission (NFC). The whole country will be covered by four NFSC zonal units, which are to forward data and information to NFRSU for processing. Part of the ground survey might be contracted out to reliable local organisations if NFC is found to have inadequate manpower and equipment. If available aerial photographs and satellite imageries are out-dated, they will be replaced with new ones. The Federal Survey Department and the Nigerian Air Force can assist with fresh aerial survey, photogrammetry and mapping of the country's forests. If necessary, assistance may also be sought from UN/FAO Forestry Division for aerial photography, and from National Aeronautic Space Administation (NASA) for the provision of up-to-date prints of all available Landsat Imageries for Nigeria with less than 80 percent cloud cover.

The training of Indigenous manpower is essential for the success of the proposed survey. There is presently a serious shortage of trained manpower in aerial photo interpretation, remote sensing technology and electronic data processing. Series of short, intensive local courses are expected to be run under the joint sponsorship of the Federal Government and FAO. Considerations have also been given to the requirements of physical inputs (infrastructures, equipment and materials). Well-equipped office and laboratory buildings are necessary for electronic data processing, aerial photo-interpretation and map production from aerial photographs, SLAR and Landsat imageries. The various equipment needed for field work have also been listed.

The personnel expected to carry out the survey will comprise one FAO expert, one Project Co-Manager, 16 professional staff (4 per zone), 20 field staff (5 per zone) and 30 Headquarters staff. This brings the total personnel costs to ₦437,000. Infrastructure is estimated to cost ₦546,600 and equipment and material ₦1,959,000, while ₦361,000 is expected to be spent on training. The estimated grand total cost of the inventory is ₦3,303,600 or approximately ₦3.3 million. The Federal Government is expected to provide ₦3.2 million, while FAO will be requested to pay ₦0.1 million to cover the salary and allowance of the Foreign Expert.

Phasing of the Inventory

The forest inventory is to be carried out in three phases lasting for a total of 36 to 42 months. The first phase, lasting between 18 and 24 months, will involve the acquisition of materials; staff training; aerial photography; Landsat imagery and radarography; computer installation. The second phase will involve field sampling over a period of 12 months. The third phase will last for six months and be devoted to data processing and the writing of the inventory report.

Usage of inventory data

The main users of the national forest inventory data will be the Federal Department of Forestry, the State Forestry Departments, the Forestry Research Institute of Nigeria and the University Forestry Departments. Wood-based industries, businessmen and industrial consultants can also benefit from the inventory data. The Federal Department of Forestry can use the inventory data to review the National Forestry Policy; to provide data-backed justification for the creation of more forest reserves and the provision of more funds for national forestry programmes; to facilitate the execution of its advisory, planning, coordinating and monitoring roles in national forestry and forest industries development; and to provide technical services to the State Forestry Departments in the areas of remote sensing, cartography and data processing.

The State Forestry Departments will need the inventory data for efficient forest management and planning. They can use the national forest inventory to carry out management inventories for the planning of their large scale forest plantation programmes. The national forest inventory will be useful to the Forestry Research Institute of Nigeria for establishing its priorities and targets, and to the University Forestry Departments for their teaching, research and consultancy activities. The national forest inventory is potentially useful for industrialists interested in fruit trees, medicinal plants and trees producting gum arabic and tannins.

Conclusion

Apart from the assessment survey of the country's forests, the proposed national forest inventory will also involve socio-economic studies on such items as: population growth and distribution; forest revenue generation; land use practices and their effects on forest cover, soil and the environment; trends in the demand for wood and wood products as well as non-wood products and services; and rates of production of wood-based industries. It shoud be noted that forest inventory practice is still in its infancy in Nigeria, and rather limited research work has so far been done to determine the best sampling and mensurational methods for different types of forest stands and inventory data. Nevertheless, the proposed first national forest inventory is long overdue, considering the importance of forestry in the national economy.

The repetition of SLAR coverage of the whole country during the inventory period will provide useful information on the changes that have occurred in the vegetation and land use patterns since the period of the NIRAD project. The proposed national forest inventory shoud facilitate the formulation of a land-use policy within the frame work of national development planning. The land use policy should define the areas of the country to be allocated separately to agriculture and forestry (Umeh, 1979), forest areas being delineated for the following management objectives, namely, wood production, agro-forestry, soil conservation, parks, game reserves and nature sanctuary.

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NATIONAL REPORT: NORWAY

by
Torgeir Løvseth

INTRODUCTION

Concerns for the status and management of the nation's forest resouces led to the creation of the National Forest Survey of Norway in 1919. Operating first as an independent organization under the Ministry of Agriculture, now as a division in the Norwegian Forest Resarch Institute, the Division has completed five assessments of national forest resources.

The first inventory, or survey, was nationwide in scope and was carried out from 1919 -32. The second and third surveys, which were taken during the periods 1937-56 and 1957-64 respectively, concentrated on the forest resources in the counties that were considered to be of greatest forestry importance. These inventories were organized, conducted, and analyzed on a per county basis, with the results being published as they became available. With the fourth inventory, which was conducted from 1964-76, the emphasis shifted from a series of individual county surveys to a large regional assessment. The most heavily forested counties were administratively subdivided into 37 districts. For each of the years of the inventory, one-twelfth of the sample plots were distributed across the entire 13 county region and observed. After twelve years, enough plots were taken to make statistically reliable estimates at the district level. The fifth survey, which was carried out from 1982-86, was as national in scope as the first survey. For this survey, the country, less than Finnmark County, was divided into 5 regions, However, since most of the western region had not been inventoried since 1929-30, all exept one of the western counties were inventoried and analyzed as separate areas.

From January 1, 1988 the National Forest Survey will unite with the Institute for Land Survey. As yet the new organization is not given name.

THE FIFTH SURVEY, 1981-86.

The primary objective of both the fifth inventory and the earlier, has been to provide the data necessary for national planning. Essentially the early

inventories were periodic assessments that were designed to estimate the quantity and general location of timber on productive forest land. Productive forest land is defined as land that is expected to have an annual wood growing capacity of at least 1,0 cubic metre per hectare.

As forest management has become more intensiv, with more land management legistation, the additional inventory objective of monitoring timber growth on productive forest land was raised. To the extent feasible, estimation of the most probable causes for changes in timber volume, gains or losses, would be included in the plans for the future inventories. However, before growth monitoring was to take place, it seemed appropriate to first update the earlier surveys by making a reasonably rapid national survey of the quantity of timber on the productive forest land. The fifth survey, which was conducted at a lower intensity than the previous survey, met this need.

For the last two surveys, an apparent statistical constraint has been to have sufficiently large sample to yield a sampling error of no more than four percent. This specification has been applied at the district level for the 1964-76 inventory and at the regional level for the 1981-86 (fifth) inventory.

Practical consideration have greatly infuenced the survey design. In the fifth survey the sample units were square clusters. The individual plots that were spaced at regular intervals along the perimeter were kept small so as to minimize measurement problems on steep terrain. The overall size of the square and number of plots per square were designed so as to represent, on the average, one day's work for the field crew. The distribution of the square clusters of plots has been uniform and systematic throughout the area of interest. The intercluster spacing were a function of primarily the time available to complete the inventory, the total budget for field work, and the size and nature of the area to be inventoried.

Total number of sample plots, relaskop plots, factor 4, on productive forest land was 30 000.

CURRENT SURVEY

The sixth inventory began this year.

Forest land management planning and practices have become more complex. The informational needs for national forest policy planning have also become far more demanding. The major afforestation efforts in the wesrern part of the country, plus the general shift of Norwegian forestry to increasingly intensive methods, suggest a change of survey objectives from periodic assessment of current values to more careful monitoring of changes in resource levels.

Continued intensification of forest management will eventually require the ability to predict responses to alternative policies and mangement techniques.

The data base which contributes most to investigations of changes and trends involve the periodic remeasurements of the same plots. Furthermore, impact assessment of the forest resource to changing national forest policy or changing environmental conditions (such as acid percipitation) is likely to necessitate the emasurement of additional non-timber, terrain and environmental variables.

With the exception of research plots that are primarily used for growth and yield studies, there is currently no national distribution of plots that could be relocated and remeasured as part of the survey. It is for this very reason that one of the objectives of the new survey is to install such permanent plots.

The sixth survey is designed as a systematic sampling without the use of aerial photographs and similar supplemental data sources.
On the maps prepared by the Geographical Survey of Norway, there is a grid net formed by parallell lines one kilometre apart, running North-South and West-East. In this grid net every third cross on both axis is selected for installing a permanent plot. Every permanent plot thus represents nine square kilometres of land area. The total number of permanent plots will be 11 000, whereof 66% on productive forest land.
This survey is organized and carried out on a per county basis. The remeasurement interval is seven years, and the permanent plots are installed in 2-3 counties each year. Access to the plot is well monumented and documented, but blatantly conspicuous markings are not used.

In the previous survey relaskop plots were used to select the trees on the sample plot. In this survey we have chanced to nested fixed dimension plots, The plot size is 100 square metres for all trees with a diameter at breast hight of at least 5 cm, and 200 square metres for trees with a diameter at breast hight of at least 20 cm.

The previous surveys have used clusters of plots. There are many ways of creating clusters. Our cluster design consists of one permanent plot and one or more temporary plots. The number of temporary plots and the spacing between them, depends on the size of the county, the distribution of the forest land within the county, and the variation in the forest condition.

The remeasurement interval for the permanent plots is seven years. After the first measurement occasion, reports can be prepared for one

half of the counties. The other half of the counties will get their status reports after the second occasion of measurement of the permanent plots.

Special provisions will be made for monitoring tree damage and for subdividing growth or losses due to specific causes such as airborne pollution. Of course, the new survey includes descriptions that have been important components of earlier surveys. This is done in a manner that is consistent with the traditional responsibilities of the National Forest Survey, and would produce estimates compatible with earlier inventories.

A special data processing and information system for the National Forest Inventory, LSKSYSPG, is worked out. The basis for the system is "Statistical Analysis System" (SAS). The data recording in the field is done the traditional way. As yet we have not been able to derive advantage from the portable computers in the field work.

Preliminary results from the fifth survey, completed in 1986, are published (in Norwegian) for three of the five regions.

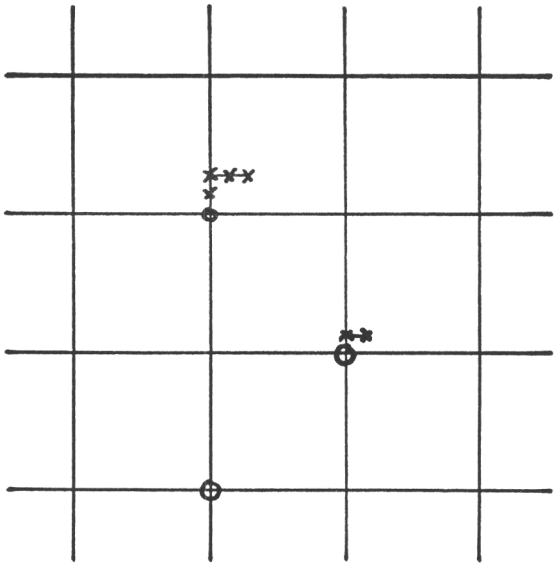
The field work is carried out by 11 crews. Each crew consisting of a leader (forest technician) and two assistants. Nine of the leaders and all the assistants are engaged for the summer season, from June to October.

The total annual cost is 700 000 US$: For the field work 500 000 US$, for the staff 150 000 US$, and for data processing and publication 50 000 US$.

We belive that by the time the first measurement is completed, advances in computer software and hardware will permit the results of this inventory to be geographically as well as statistically combined with other inventories as a nationally integrated, natural resource data base. It is further assumed that computer drawn maps will become an increasingly important method of communicating inventoty and analysis results. There seems to be a high potential for cooperative work in such endavors in the new organization.

THE NATIONAL FOREST SURVEY OF NORWAY

SAMPLE PLOTS 1987-1993.

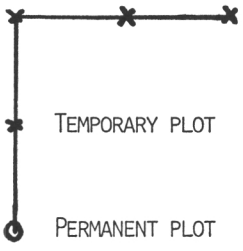


PERMANENT PLOT

TEMPORARY PLOT

CLUSTER, COUNTY OF ØSTFOLD 1987.

PLOT SPACING, 400 METRE



NATIONAL REPORT: POLAND

by
W. Barszczewski

1. Brief description of the scope and coverage of forest inventory in Poland.

The total forest area in Poland equals 8.666 thousands ha, and accordind to the holdings status consist of:

- state forest managed by economical organization named - State Forest - whole area is - 6.802 thousand ha;
- state forest belonging to state enterprises and state institutions, but not subsordinated to a/m organization - total area 333 thousand ha ;
- nan state forests - owned by private farms,cooperatives, communities; - total area - 1.531 thousand ha.

The main source of knowledge on state forest resources in Poland has been periodical management inventories,carried out for all forests a/m categories of holdings.

It's indispensable to underline that large area inventories on general forest resources assessement havn't been done in our country.

An object for inventory works it is individual economical-administrative unit, and according to state regulations the forest management plan is carried out for it separately.

Forest management plan defines 10 - years economical activities for forest administration, to the best satisfaction of economical and social, present and future needs of population.

Inventory dates and economical tasks collected for the regional and state levels, are used by regional and state authorities

to establish forest policy and planning of economical activity.

The scope and the means on forest inventories and elaborating forest management plans,define the special instructions,prepared by authoritative bodies of forest scientists and practitioner-foresters. These instructions have been confirmed by state forest authority.

Considering the mutable social function and different means of forest economic planning,with reference to property categories, we have in Poland separare instruction on forest inventoring and elaborating economical plans,for organization State Forest, national parks, non-state forest etc.

In spite of methodical difference on forest inventory and economical planning in different property categories,the main kinds of inventory dates are comparative;for instance:

- growing stock,/ m^3/
- tabels of classes of age by species/ volume and area/ with division for groups of forest,forest sites,management classes,
- dates on forest utilization and reforestation works.

Therefore collection basical inventory dates from all economical administrative unit,provide the knowledge on the state forest resources for whole country.

2. Methodology of execution of forest inventory and updating of inventory dates.

All kinds of inventory works,elaboration of forest management plans and other projection works,are beeing executed by special state enterptise,named Bereau for Forest Management Plans and Forest Geodesy. This enterprise includes the Office Management and 13 Field Departments,with staff of specialists foresters, geodets, computer scientists,road building engineers and water mvlioration,

The main task of a/m enterprise is forest inventory and elaborating forest management plans for economical organization of State Forest. State Forest cover 78,4 % of total forest area in Poland and provide 92 % of whole woody material produced in the counrty. It is necessary to inform that all economical forest units, conduct economical activity on the base of the forest management plans. After last world war is being executed the fourth forest inventory for the State Forest.

There are 10 years cycle of executing of forest inventory and elaborating management plans. Every year management inventory is carried out for 10 % of economical unit named the forest district Therefore the last inventory/ from 1979 to 1988 / have been usung to updating previous forest management plans.

Inventory works in forest district, consist of two stages of works In the first stage geodetic service update the contens of previou elaborated forest map /scale 1 : 5000/ and limite lines of the forest disrtict. Updated forest economical maps are also used by Country Geodetic Service and Country Cartographic Resource. The second stage includes estimation of stands and forest sites. The forest management inventory is carried out on the ground; the smallest valuation unit is stand named also subcompartment. The way of execution of management inventory is as follow:

- the stands belonging to III class of age and older are covered with random sample plots - mainly relascopic or seldom circular,
- the measurements taken from these samples are the base for computing of growing stock and assessement features of stands.

In different stands, dependly on the age and structure of stand there are from 3 - 20 relascopic samples. Groving stock of stands of the II class of age and in the I class / if there are compact

wood/ is inventoried with estimation of vilume and taxation features,as well as sample plots. But in this case taxator decides on location and numbers of samples.

So the growing stock of the stand of III class of age and older is calculated with mathematical and statistical method.

Inventory dates and measurments taken from the stand,are filled in a special form with application numerical code.

The following dates and informations are being registrated:

- name of forest district,
- number of: common,basical administrative unit /village/, forest range,
- number of compartment and subcompartment /stand/,

Dates for forest land:

- kind of surface /stand,failplace,etc./,
- feature of stand /for instance - seed stand/,
- structure of stand,
- group of forest and category of protection,
- kind of management class,
- zone of damages caused by air polluted,
- surface of subcompartment /stand/,
- forest site type,
- geographic features,
- kind of vegetal cover,
- species of trees,
- species composition /rate of species %/,
- age of stand /or species/,
- stand density,degree of crop density,stand quality class,
- technical class of wood and silvicultural quality,
- volume of compact wood per ha ,

- dates on underplantation and undergrowth.

The form contain information on the kind of silvicultural operations and volume of thinning. The back of the form is destined for registration of dates of sample plote /relascopic or circeler/ The forms filled in terrain with real information for all stands, are sent to Date Processing Section of the Management of Bureau for Forest Management Plans and Geodesy. After logical and formal testing the date carriers are preparated with computer Mera 9150. Then date carriers are sent to The Center of Forestry Date Processing where with computer Odra 1305 the following materials, tables and computions are carried out :

- printed reader of assessement description, including complete collection dates for all valuation units,
- registration of areas,
- tabele of classes of age / area and volume/ with respect to species of trees, forest sites, groups of forest, categories of protection and management classes,
- another tabeles and computations characterising the state of forest at foresr district.

Whole this inventoring material come back to the proper Field Department where forest management plan for forest district will be completed.

In Center of Forestry Date Processing inventory dates are computed for each regions and for whole country and collected in the bank of dates on the magnetic types.

On the base of information recived every year from forest distric / concerning economical activity/ - the dates collection is updated on the changes of forest area and forest resources in classes of age and specieses.

By this mean state administration and forest authoritities receiv the real informations on state forest resources. It is very important to establish proper forest policy and economical planning.

Non-state forest and other categories of property include about 21.2 % of whole fotest area. It is necessary to underline that inventory dates of these forests are also collected in the bank of dates, in Center of Forestry Date Processing.

These dates haven't been updated every year. They are replaced by new dates after periodical inventories.

The mathematical and statistical method on assessement forest resources in Poland as a base for elaborating forest management plans and obtaining dates for the bank of dates,will be continuated as before. Intended for the future modification and improving the principles of forest inventory /f.e.Stratification of stands/ can't be contradictory to principal of mathematical and statistical method.

The changes on the next forest management inventory are being discused by forest authority. The discuse concern to the range and the means of inventory work and date processing.

We are going to take the following changes into consideration:

a/ to extend application of the mathematical and statistical method for all categories of property,to use of the uniform methodology on forest inventory and date processing for all Polish forests,

b/ increasing resources of informations on sanitary and health state of forest - degrees of damage caused by different factors as: air polluted,insects,fungal pathogens,hurricane winds,etc.

c/ increasing information on sortimentative structure of wood resources,

d/ application of the stimulation method on development forest resources with support of electronic dates processing for elaborating results of inventory and prognosis.

3. The cartographic documentation and remote sennsing application to forestry.

Results of management inventory apart of dsscription,tabels and computations, have been ilustrated with cartographic documentations. The proper cartographic documentations have been prepared for all forest districts and other forest objects. Each successive inventory and surveing works are used to updating forest maps. The basical forest economical map at the scale 1 : 5000 has been carried out for all forest districts by geodetic service This map ilustrate the limite line on forest district, line of area division, border of valuation unit / subcompartment/, net of forest roads,water melioration system and other cartographic detales important for forest economy.

The economical mape is updated with application airial photographs and photogrametric methods,or with surveying works on the ground. Updated forest ecomomical map is a base for elaboration rewiew thematic maps at the scale 1 : 25.000 as:

- map of forest stands,
- map of utilization and aforestation,
- map of forest protection,
- map of recreation and touristic implementation.

All these maps are elaborated as a enclosures of forest management plans. Remote sensing is applicated for mapping as well as to estimation of sanitary and health condition of stands, mainly attributed to air pollution.

The large scale airial spectrozonal photographs have been used for hazard zone delineation and astimation of degrees of damages. This method will be increasked and perfected in future.

4. Large area inventory on the sanitary and health state of forest.

Deterioration of health state and sanitary condition of forest took place in Poland beetwen 1979 - 1982,as result of damaging activity of insect, fungal pathogens and hurricane winds - it required to asses the scale of these natural calamities and to undertake provential action. For these purposes in 1983 and 1985 a large area inventories for the State Forest were carried out. Inventories were made with mathematical and statistical method and random circular sample plots. The base for estimation healthy state was volume of living trees of respective cathegory of healtl in overall volume of trees. Sanitary condition was estimation with volume of dead trees in total volume of trees.
All informations have been obtained with research sample plots. There were 22 thousands sample plots appointed for State Forest. Results of large area inventory have been used mainly to settle economical undertakes in order to clean up forest in the scale Regional Board of State Forest.
The results have been also used for prognosing of development healthy state and sanitary condition of forest as well as verification of prognosis of development forest resources and possibilities of utilization.

5. The means of date publication and accesibitity.

The forest management plan is the basical date collections for the forest administration. For forestry authorities and planers different kind of date collections,are stored in the bank of

dates in Center of Forestry Dates Processing.

These dates can be printed as a booklets tabulations / for instance - updating of state of forest resources, results of large area inventories etc./.

Some dates and informations are published in forest periodicals and bulletins issued by Forest Research Institut.

A/m inventory dates are used by following organizations and autorithies:

a/ Ministry of Agriculture,Forestry and Food Economy,

b/ Supreme Board of State Forest,

c/ Regional Boards of State Forest,

d/ Administration of Forest Districts,

e/ Bureau for Forestry Management Plans and Geodesy,

and other state and administrative organizations.

NATIONAL REPORT: SWEDEN

by
Göte Bengtsson

1. Background and history

The Swedish forests are of great importance for the welfare of the nation. They also provide many other countries with large amounts of forest products and offer recreation opportunities to people from more densely populated countries in Europe. Forestry and forest industry make out an essential part of the Swedish economy and of the total net export value. The total growing stock and annual increment in our forests are today larger than ever, but there is still a great potential for increased timber production. In recent years air pollution has become a severe threat to the health and productivity of the forests.

Therefore, it is quite obvious that there is a need for relevant, accurate and actual information on the land and forest resources for a proper planning and control of the utilization and management of these resources.

The first National Forest Inventory in Sweden (NFI) was performed in 1923-29. From 1953 the NFI is a continuous process, where the whole country is surveyed each year.

From being more or less a pure timber inventory from the beginning, the scope has gradually been widened to include also some non-wood products and services and environmental aspects. The last mentioned types of information have as a rule been collected during one or a few years as extra observations, financed from separate funds.

The present objectives of the NFI have been formulated in the following way: "The NFI shall continuously provide information for the planning and control of the utilization of the forest resources on national and regional level. It shall also provide information for forestry research. ... The NFI shall present information on actual conditions and on past and present changes of the forests."

It should be emphasized that the NFI is a tool for the strategic planning.

The NFI is a well established, permanent organization, being a separate unit, the Department of Forest Survey, within the Swedish University of Agricultural Sciences.

The present inventory design was introduced in 1983.

2. Scope of the present inventory

The main types of information presented are as follows:

- land use
- areas of various types of forest land and forest cover
- growing stock, by species and diameter classes
- annual increment, mortality (rough estimate)
- annual cut, areas and volume (based on stump inventory) for estimation of annual fellings and removals
- areas treated with various types of silvicultural treatments
- regeneration status (on clear-cut areas and in seedling stands)
- need of silvicultural treatments
- detailed information on the soil and ground vegetation, including collection of soil samples for chemical analysis (only on the permanent sample plots).

Hence, most important aspects of the timber resources and forest management are covered on a routine basis. However, since 1976 no assessment of timber quality is made. (Up to 1975 a subjective judgement of saw-timber quality was made.) Neither is information on total tree biomass presented regularly. One national assessment was made a few years ago, using fairly rough methods for conversion of estimated stem volume to biomass estimates.

Five ownership categories are distinguished.

Almost all the land area is comprised by the NFI, the exceptions being high mountains, urban areas, national parks and some types of nature reserves, some military areas and parts of the agricultural land. Of course, the main emphasis is put on forest land.

Some changes in scope and priorities in the new inventory from 1983 are

- more emphasis on estimating changes of the forest resources
- more emphasis on questions related to future potential production, including e.g. the need to supply data for improvement of methods for long-term growth projections and information on restrictions that may influence forest management as concerns timber production
- environmental aspects are more important than earlier, e.g. the effects on forests of air pollution and changes of forest soils
- more emphasis on collecting information on certain types of non-forest land.

Although there is an increasing concern about non-wood products and services and the multiple use of the forests, the real demand for comprehensive information on a regular basis concerning these aspects has been fairly limited, so far. However, since 1983 observations are made on a routine basis as regards the available amount

of winter food for moose and deer and the degree of grazing. And substantial resources are spent on the soil and ground vegetation inventory.

After the question of the health status of the forests and the extent of damage due to air pollution had become burning in 1983, observations of defoliation (needle loss) of coniferous trees were introduced in the ordinary work of the NFI in 1984. The first results were presented before the end of the year. This is a good example of the capability of a national forest inventory system of the Swedish type to include new observations all over the country, in a uniform way, on short notice and at low marginal costs compared to the costs for organizing separate inventories. Another reason for integrating the "forest damage inventory" in the NFI, besides the cost reason, is that this faciliates the evaluation of "damage" data together with all the ordinary information from the NFI. For instance, the use of forest damage data in connection with long-term forecasts of timber yields and potential cut is faciliated. The forest damage inventory will most probably continue during a long time ahead and be considered more or less as a permanent part of the NFI.

3. Inventory design, equipment, storing and processing of data

Almost all information is collected in the field, from the ground, using a systematic cluster sampling design. Hence, remote sensing techniques are not used so far for any measurements or classifications. However, conventional black and white aerial photographs are used for orientation purposes and as a help for the field crew leaders to make a relevant division of the forest area into single compartments, which somewhat improves the classification of the stands.

The inventory cycle is ten years, but during the latest two decades normally only the data from the most recent five year period (five separate sets of sample plots) have been used in order to provide actual information.

From 1983 the NFI is partly based on permanent, inconspicuously marked sample plots, to be remeasured with five years intervals, in order to meet the increasing demand for accurate estimates of various changes of the forests. As before, temporary plots are and will be used as well. During the period 1983-87 about 23 000 such permanent plots have been established, of which 18 000 on forest land. The reinventory of these plots will start in 1988.

The recording, storing and processing of data is now fully computerized. Every field crew is equipped with two hand-held microcomputers for the data entry. Tests for validity and to some extent completeness are performed in these computers already in the field. Data are transmitted via telephone to the computer centre at the Faculty of Forestry in Umeå for further tests, processing and storing in a large data base.

The data base contains all original data from each single sample plot and each single tree together with some calculated variables such as volume and increment. This means great flexibility in the

use of the information for various types of analysis. Standard data base soft-ware as well as tailor-made computer programmes are used for handling data and presenting results. The flexibility of this system makes it possible to present results for any arbitrary geographic area or sub-population which is large enough with respect to sampling errors. It also faciliates the presentation of results in form of maps.

4. Main use of the results

The information from the NFI is used by a wide range of users for many various purposes. Important users are

- the Ministery of Agriculture and some other ministeries
- the National Board of Forestry and other state agencies on the national level, e.g. the National Board for Environmental Protection
- the (24) County Forestry Boards and other public agencies on county level
- the Forest Service (in charge of the management of state forests)
- forest industry organizations, private forest owners organizations and other organizations on national and regional level
- single (large) forest or forest industry enterprises
- research people.

The communes seem to show an increasing interest in the information, although the NFI can give results with a reasonable precision only for the very largest communes.

Inventory results are presented regularly in Statistical Year Book by the National Board of Forestry, in reports from the Department of Forest Survey, in lectures and articles etc. Basic, detailed data are often used in special investigations, performed by the Department of Forest Survey or researchers at other departments within the university, by various public or private organizations and by state committées.

Briefly expressed, the results are used for formulation and follow-up of national and regional forest policies, for considerations in land use policy matters, for planning the timber supply to the forest industry and for estimating the potential energy supply from fuel wood (logging residues, small trees), and many other purposes.

The use of results has increased gradually during the latest decades, partly due to the availibility of computers. It is quite evident, however, that the information is still underutilized, both for traditional and new applications. - This situation is probably not unique for Sweden. - There is an urgent need for increased and improved dissemination of results to various types of consumers, including politicians, mass media and the public, as well as to other countries and international bodies.

One very important application is long-term forecasts of timber yields and potential cut. Great progress has been made in this field since the first fully computerized models in Sweden were developed some 15 years ago. The present and so far most advanced model for regional forecasts, the Hugin System, has a great

flexibility and capability to simulate the consequences of a wide range of forest management alternatives. The Hugin System has been used for the most recent national analysis of future management alternatives ("Cutting calculations 1985"), to be finally reported during the coming winter.

Some of the NFI data can be used, and are indeed used by the forest enterprises in their own forestry planning, e.g. sample tree data and increment data, in order to reduce their inventory costs. The largest forest companies can also use all the NFI information on their lands to provide estimates as a complement to and for comparison with estimates from their own data.

5. New needs of information and future plans

Experience shows that the need of information on the forest resources is not constant over the years. The general trend up till now has been the need to cover more aspects than earlier and to collect more detailed and accurate data by trying to use more objective methods for measurements and classifications.

It is certainly important to try to foresee the future need of information and try to adapt the inventory according to this.

However, it is also important not to spoil or disturb long time series of key variables. Changes of inventory methods, variables and definitions should not be made too often, because they make the evaluation of results more difficult and may also have a negative effect on the quality of data and on inventory costs.

Some new needs that have been identified or discussed in Sweden will be mentioned. Some of them seem to be in line with what has been discussed or even already implemented in other countries.

Biomass estimates. - Most probably, estimates of total biomass of trees, of branches and possibly of stumps will be presented regularly, as a complement to traditional estimates of total stem volume. New biomass functions for the whole of Sweden (pine, spruce and birch) are right now being completed and will be used for these assessments.

Saw-timber quality. - There is a need to elaborate and introduce some method for describing saw-timber quality in an objective way in the NFI, which also could be a basis for projections of future quality of the trees in connection with long-term forecasts of timber yields and analyses of the outcome of various possible management alternatives.

Vitality and damage. - The problem of assessment of the vitality (health) of trees and various kinds of damage needs more attention. This includes the effects of air pollution as well as other kinds of damage, for instance by moose and root rot. For the next three year period there are preliminary plans to include also broad-leaved trees in the "forest damage inventory" and to make some extra reinventory of the permanent sample plots in selected areas in order to provide rough estimates of the extent of cutting of damaged trees.

Non-wood products and services and "environmental aspects". - Probably these aspects will be given still more emphasis during the 1990's than today. A new project has been started to investigate the real need of such information and to what extent such data could be collected within the frame-work of the NFI. The special soil and ground vegetation inventory on the permanent plots will be continued. However, the first reinventory will probably not be made until after ten years, i.e. starting in 1993.

Recently it has been discussed if the NFI should include also some national parks and nature reserves, possibly also the sub-alpine birch forests, which are not surveyed at all today. It could be of great value in the future to have the same type of information from such areas not directly (or only slightly) affected by man or in climatically marginal areas, as a reference for evaluation of changes in the environment and effects of changes of the climate.

The collection of moss samples for assessment of regional patterns in the deposition of heavy metals will continue with five years intervals. (Previous assessments have been made in 1975, 1980 and 1985; the last time similar investigations were made in Denmark, Finland and Norway as well.) Other indicators of the immission rates of air-borne pollution have also been discussed, e.g. an assessment of the occurence of certain lichens on tree stems and analysis of the content of sulphur, as indicators on the deposition of sulphur compounds. (A nation-wide pilot study was performed in 1984.)

It has also been suggested that an inventory of lichens available for reindeer grazing be performed in connection with the NFI.

Information for smaller geographical units. - There seems to be an increasing interest to have the possibility to break down the information from the NFI into smaller geographical areas, for instance communes. However, it is necessary to find out if it is this type or other types of information (area covering instead of sample information) that is needed for such purposes. There might also be a need of intensifying the NFI in areas of certain interest, for instance in areas where increasing land use conflicts can be foreseen.

Economic data, data on ownership structure, restrictions etc. - The need for data on forest owners related to the information of forest resources has become evident during recent years. Further, there is a need of improved information on the many kinds of restrictions that are obstacles for increasing the annual fellings up to the estimated allowable cut and for intensified forest management. Such data must to a great extent be collected with other methods than those used by the NFI.

As concerns inventory methodology and techniques the potential of using satellite imagery as a complement to the present field inventory methods will be further explored. At our department we believe that the satellite technique, although not competitive today for our purposes due to high costs, is more suitable for our NFI than traditional aerial photos. The satellite technique could be a means to provide some of the desired information for smaller areas. Further, it is probably the only realistic way to significantly improve the estimates of the annual clear-cut area and accordingly the total fellings, at a reasonable cost. The very low

precision of estimates of the last few years cut for various owner categories in various regions is at present the weakest part of the NFI, and probably in Swedish forestry statistics on the whole.

It should be stressed, however, that the use of satellite imagery can be only a complement to field inventory. Extensive field work has to be performed also in the future, because much of the information must be collected on the ground.

The permanent plots will most probably be maintained during at least 20 years ahead, and at least some part of them during a much longer time. The repeated inventories of the tree cover, soil, ground vegetation, etc. will provide a comprehensive and for Swedish conditions unique data base for various types of analysis and research.

The advanced computer techniques, geographic information systems and other tools will make it possible to link various types of information from different sources in a way that we could only dream of a couple of decades ago. The costs and all practical problems should, however, not be underestimated. And the delicate matter of integrety of individual forest owners must not be forgotten.

6. Other aspects

The total costs for the NFI is about 11 mill SEK per year (corresponds to 1,7 mill US$), which means 0.47 SEK per hectare of forest land or 0.15 SEK per cubic metre potential annual fellings. The soil inventory during 1983-87 costs some 3 mill SEK per year and the forest damage inventory in connection with the NFI costs 1.3 mill SEK.

In Sweden there is also another nation-wide forest inventory, the "General Forest Inventory" (GFI), which started in its present standardized form a few years ago. It is managed by the National Board of Forestry and the County Forestry Boards. It is a compartment-wise complete inventory of all land belonging to small private forest owners (50 % of the total forest area in Sweden), intended to be finalized in 10-15 years. The objectives of this inventory are quite different from those of the NFI. The main purposes are to provide data for management plans for single estates and to provide the local forestry administration with information needed in its work to supervise that forest owners follow the forestry act and as a basis for advice to forest owners, as well as a basis for decisions on state subsidies to single forest owners. The information collected is neither as detailed nor as accurate as the information collected by the NFI. The annual costs for the GFI is several times higher than for the NFI. An investigation is now being performed to explore the potential of combining information from the two inventories for certain purposes.

There are also other types of inventory performed by the National Board of Forestry and the County Forestry Boards, as well as by forest companies and the Forest Service. However, these will not be discussed here.

7. Concluding remarks

As discussed above there has been and will probably be an increasing demand for information from the NFI. However, there is always an upper limit of how detailed information an inventory team can collect without negative effects on the quality of work. Further, it is of little or no use to collect information that is not very much or not at all used.

This paper concentrates on objectives and need of information. Details on the methods and techniques used could be found in the publications listed below.

According to the author's opinion there is a need of intensified and regular contacts between the organizations responsible of the national forest inventories in Europe, as probably also in other parts of the world, for exchange of experience and ideas. Such cooperation might increase efficiency of inventory work. It would hopefully also faciliate future harmonization of inventory methods, classifications and the presentation of inventory results.

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NATIONAL REPORT: SWITZERLAND

by
F. Mahrer & R. Sutter

1. Scope and coverage of the first Swiss National Forest Inventory 1983 - 85

The aim of the NFI is to furnish the federal government with a sound basis for decision-making and planning concerning national forest policy.

The focus is on data on forest area, stand composition, forest health, reserves of the various assortments and qualities of timber, and forest road networks. Successive inventories will reveal changes in the forest and provide a foundation for reliable prognosis. Probably the most important result of the interpretation of all these data will be the determination of the potential yield and its accessibility.

The NFI employs a sampling procedure in which the sample plots are situated in a systematic grid at square kilometer. The sample grid covers the whole of Switzerland. The first survey (1983-85) was conducted on three levels:

- with aerial photographs
- in the field
- with topographic maps

With the exception of water areas and altitudes above 2500 m a.s.l. (i.e. areas where no forest can grow) all of the sample points are investigated on the aerial photographs. The **application of the aerial photographs** in the first survey of the NFI serves the following purposes:

a) The **determination of the forest area.**
   The sample plots are classified into the categories forest, brush forest and non-forest.
b) The **selection of suitable reference points.**
   These are points clearly definable on the photo as well as in the field used to locate the sample plot centers in the field.

The principle task of the aerial photo-interpretation in the first NFI was the **rationalization of the field work:**

a) The field teams know beforehand - through the information supplied by the photo-interpretation team - which sample plots they have to visit. Costly survey work can be avoided in the following cases:

- The sample **plot center** falls just **outside a forest area** (the field team would have to locate the center for verification).
- **Width** and/or **crown cover** are **insufficient.**
- There is **brush forest** that is not being surveyed in the field. This subcategory accounts for 4.5% of all the sample plots and is found in mountainous regions where access is difficult and time-consuming.

b) The **time for locating the plot center** is substantially shortened through the supply of reference points that lie much closer to the center than those on the map.

c) Aerial photographs as such are very helpful for orientation in the field. Since they contain much more detail than maps, the surroundings of the plot center can be better recognized (e.g. single trees, borders of stands etc.)

The data collection of the **terrestrial survey** is focused on observations that give a good idea of standing crop and potential yield.
Exposition, relief and inclination are determined as part of the **site** description.
The most important observations on the **stand** are forest form, diameter class, proportion of mixture , crop density and structure.
On each **sample tree** DBH, species, and layer are determined and crown class, damage and quality assessed. Tree height and diameter at 7 m is measured in a subsample of these trees. The latter serve for the construction of the tariff functions, where species, site classes, regions, and stand data are taken into account.

2. Plans for the next inventory

The beginning of the next survey is scheduled for 1992.
For any successive inventory the catalogue of data collection has to be brought up to date. The interpretation of the control survey may facilitate the decision of what (measurements or assessments) could be omitted or what could be left until the next survey.

Presently a **combined inventory** that is terrestrial sampling combined with (denser) sampling on aerial photographs is being tested. The most important question to be answered by this test is whether the assessment of the standing crop can be improved at no extra cost. The possibilities of the combined inventory can be checked with the data from the first NFI.

It will be studied whether **phyto-sociological** and other site-related data could help in classifying the site by purely field data. This way the present "construction" of the site-classes on the basis of different data sources (field, aerial photographs, maps) could be dispensed with.

Of the non-wood functions of the forest, one intends to focus mainly on the **protective function.** The question is whether suitable characteristics for the quantification of the relationship danger - object to be protected - protec-

tive ability of forest can be found. Sampling merely the forest, as it was done - due to financial reasons - in the first NFI, does not suffice to answer this question. In order to detect possible dangers and to locate objects to be protected, surveys outside the forest will be needed. Of great importance is the "hierarchy of criteria of objects" in which the protective function is classified according to the importance of the object to be protected.

3. Main users of the inventory data

The users of the NFI data can be divided into the follwing categories:

I Federal administrative offices, universities and polytechnics, and research institutes. Private concerns working in commission for federal institutions.

II Cantonal administrative offices and scientific institutions with a place of business in Switzerland. Private concerns working in commission for the above.

III Private industrial associations which have financially supported the NFI.

IV Others.

Categories I and II are considered to be the main users. The federal administrative offices are using the results of the inventory as a basis for a national forest policy. Special attention is paid to the nationwide wood-supply (presently the wood consumption in Switzerland exceeds the annual timber harvest by 40%). Certain inventory results (e.g., accessibility study) may furnish a good basis for an optimal distribution of public resources in financing subsidized projects. Data on forest area and forest distribution may be of interest to officials concerned with land-use planning.

The national as well as several cantonal forest damage inventories use the permanently established sample plots of the NFI for their different purposes.

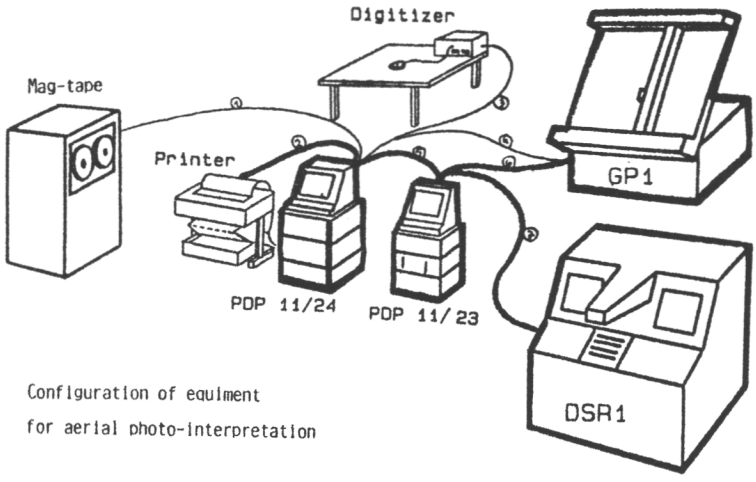
4. Methodology and equipment

a) Data collection

- on aerial photographs:

The NFI employs the panchromatic aerial photographs at a scale of 1:25'000 of the Swiss Federal Institute of Topography. The time lag between the taking of the photographs and the survey in the field varies from 1 to 4 years.

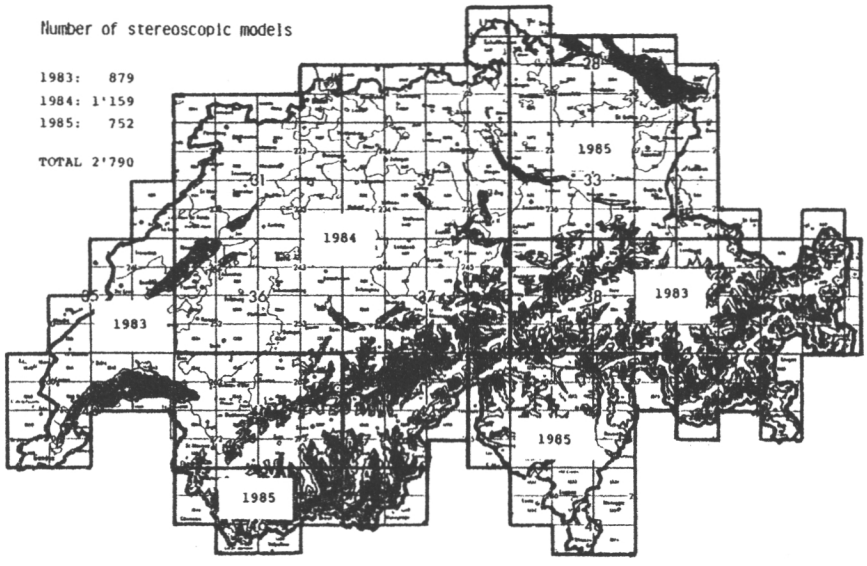
The **interpretation** of the aerial photographs is accomplished by means of an analytical plotter (KERN DSR 1).



Configuration of equipment for aerial photo-interpretation

The photointerpretation work can be divided into the following sections:

- The **stereo pairs** (two adjoinig photographs) have to be chosen in such a way that all the sample plots fall within the overlapping area, only altitudes above 2500 m and lakes (dark areas on the map below) are disregarded. For the whole of Switzerland 2800 stereoscopic models (stereopairs) had to be chosen.



- The **passpoints**, points with known heights used for the absolute orientation of the stereoscopic models, are selected from the 1:25'000 maps. The x- and y-coordinates of these points are measured with the help of a digitizer table. Close to 20'000 passpoints have been digitized.

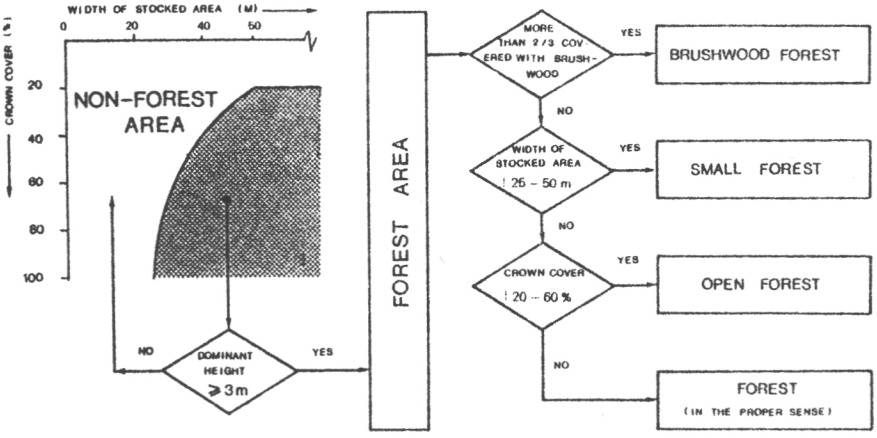
- The **orientation** of each stereopair takes approximately 20 minutes altogether. After the absolute orientation the stereoscopic models fit into the coordinate grid of Switzerland with a standard deviation of 2.5 m horizontally and 1.5 m vertically.

- The **measuring program of the NFI** moves the floating mark of the analytical plotter from one sample plot center to the next, at each point awaiting the decision of the interpreter.

- Suitable **reference points** from the aerial photographs are objects that can not be measured from the maps and lie close to the sample plot center, such as single trees, rocks, electricity pylons etc. The list of reference points given to the field teams contains the description of the objects and their x-, y- and z-coordinates.

- The information obtained through photo-interpretation is copied onto a foil that is laid over the negative of the aerial photograph and they are enlarged together. The enlargement with a scale of approximately 1:12'000 is handed over to the field teams.

The criteria for forest delimitations are based on quantitatively definable parameters:

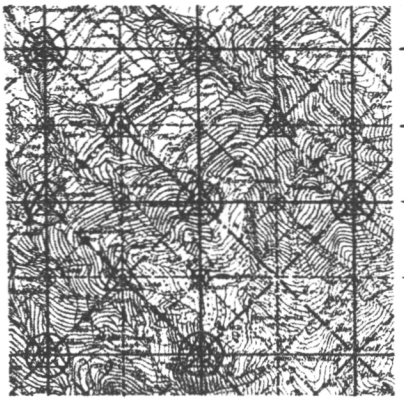


- in the field:

Principle: All the **sample plots are** of **permanent** nature.

- How are the sample plots distributed over Switzerland?

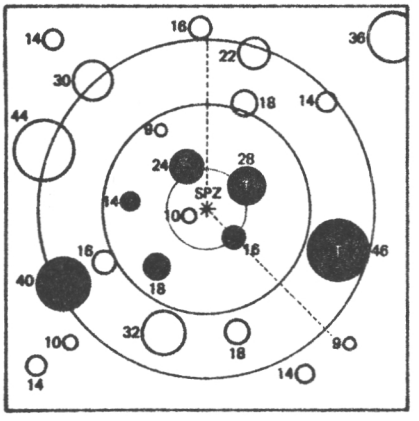
For its first phase (1983-85) the NFI employed a 1 km-grid using the coordinates of the topographical maps of Switzerland. The square layout enables the later establishment of denser grids that fall within the wider one.



- How are the sample plots located in the field?

The sample plot centers are located by means of reference points whose coordinates are measured from aerial photographs or maps. The location is done with the help of a pocket calculator fed with a fixed program, and simple surveying instruments. Control measurements have shown that the location of the plot centers is accomplished with an average deviation of 4 m. This relatively accurate procedure guarantees an unbiased location of the plot centers and is also justified in view of the projected "combined inventory". Thus these centers can easily be relocated in successive inventories.

- How is the sample plot established in the field?



Sample plot center (SPZ): marked with an aluminum tube at the center and with two to three color marks at some distance.

Area of interpretation (IF): 50 x 50 m square oriented towards north with the sample center at the intersection of the diagonals. Data on area and data on stand always refer to this area. The IF is also identical with the area of interpretation on the aerial photographs.

Sample plot area: Concentric circles of 200 and 500 m2 with DBH-limits of 12 and 36 cm are used. This procedure was chosen as a result of a comperative test between single plot sampling, line sampling (acc. to STRAND), angle point sampling (acc. to BITTERLICH), and concentric plot sampling with regard to time-consumption and accuracy. Tariff trees are all the trees within the sector between azimuth 0 ^{g} and 150 ^{g} and all the trees with a DBH of 60 cm and more. Regeneration is sampled within a circle of radius 3 m. All the radii are corrected for inclination.

The results of the comperative test are the following:

Sampling method:	Standard error: standing crop	stem count	Time consumption:
	m3/ha	per ha	min.
Fixed radius plots	18.7	18.3	21.9
Angle point sampling	18.5	27.2	14.2
Concentric plots	**16.9**	**18.2**	**14.2**

What data are collected on the sample plot?

Variable (No.)		Kind of data collection: measurem./enumer.	estimation	qual. assessment	interview	others	Explanations	Used for
Identification of SP								
- coordinates	(1.1)					x		stratification
- commun eg.	(2.3)				x			- into units of administration (2.3 -2.6)
- forest managem. unit	(2.4)				x			- into freely choosable units
- forest district no.	(2.5)				x			- defined by coordinates only
- canton	(2.6)				x			
- ownership	(2.7)				x		2.7 by categories	
Forest/Non-Forest		x					terrestr. verification of photointerpr.	forest area
Site								
- aspect	(2.8)	x						- stratification into site classes
- topography	(2.9)		x					- site quality (acc. to.Keller)
- inclination	(3.3)	x					altitude according to photointerpretation	
- altitude						x	soil sample taken from top layer of soil	
- soil sample						x	(without humus)	
Hazards/Forest functions								
- landslide	(2.10)			x				- hazards of forest areas
- erosion	(2.11)			x				- "forest functions"
- rockfall	(2.12)			x			assessment of clearly visible traces	
- snow movements	(2.13)			x			in the terrain	
- fire	(2.14)			x				
- grazing	(2.15)			x				
- over-utilization	(2.16)			x				
Timber harvest								
- obstacles	(2.17)			x			2.17 correction factor for the calculation of time consumption for harvesting	- basis for calculation of time consumption for harvest and log.
- logging systems and distances	(2.18)				x		2.18 actual skidding roads and logging facilities	- accessibility of potent. yield - prognosis of potential yield
Exploitation								
- stumps?	(2.19)			x			recording of presence of stumps for verification of the forest service's information	- exploited/non-exploited forest areas
- year of last exploitation					x			
Description of stand								
- land use category	(2.20)			x			2.20 exclusion of permanently or temporarily not timbered forest areas	stand composition: non-producing/producing forest areas
- forest type	(2.21)			x			2.21 - 2.29 single assessments for the formation of stand types; flexible description of the actual conditions	stand type - composition
- forest form	(2.22)			x				age situation
- diameter class	(2.23)		x	x				standing crop situation
- regeneration	(2.24)			x				forest situation: damage, stability, hazards, quality of forest
- reserved trees	(2.25)			x				type and stand type
- age of stand	(2.26)	x	x				2.26 only for even-aged, evenly formed stands, plus counting of annual rings on stumps	
- proportion of mixt.	(2.27)			x				stratification
- crop density	(2.28)			x			2.30 necessity of tending or treatment	
- stand structure	(2.29)			x			2.31 proposed next treatment	
- possibility of expl.	(2.30)			x				
- treatment	(2.31)			x				
Single trees								
- species	(3.6)			x			3.6 detailed list of species	tree numbers
- DBH	(3.7)	x					)	volumes of single trees
- polar coordinates	(3.8)	x					) permanent sampling	tariffs for species, quality classes, assortments
- layer	(3.9)			x			)	standing crop for forest compositions, potential yield
- crown class	(3.10)			x			)	damage and diseases
- damage	(3.11)			x			) social status	
- diameter at 7 m	(3.12)	x						
- tree height	(3.13)	x						
- quality	(3.14)			x			3.14 for two 4 m sections	species, prognosis of pot. yield
Regeneration								
- enumeration and classification for: species, size-classes, health cond.		x		x			enumeration and classification of all the plants taller than 0.3 m (terminal bud) and smaller than DBH 12 cm	regeneration conditions tree numbers, game damage and measures of protection
Stand stability			x	x			qualitative assessments	estimation of stability conditions ev. analysis and regress. models
Forest road network survey on the maps					x		Updating and classification of the road network relevant to forestry statistical assessments	density of road network transport distances, accessibility of potential yield

- How is work organized?

In the period 1983-85 the field work was being carried out in three regions between March and November. 10 to 15 two-man teams worked full time, and each working area normally covered a whole forest district. Three coordinators at the headquarters supervised the field work. Each field team worked independently within its own region. The observation of the NFI instructions was supervised by the coordinators at the headquarters on the one hand, and on the other hand 8% of all the plots were resurveyed by control teams. Every 6 to 8 weeks meetings were organized that served for on-the-job training and the discussion of actual problems.

b) Data controlling

Control sampling in the NFI consists of an independent second survey of approximately 8% of the regular sample plots. Its purpose is:

- To check the measurements, enumerations and qualitative assessments with regard to systematic and random errors.
- To detect uncertainties in the application of the NFI instructions.

The survey of the control sample plots was carried out approximately 1 to 3 months after the first survey. Four field teams were assigned the task of control sampling (besides their regular field work). The analysis of the control data was done at intervals. The results were immediately communicated to the field teams. On the drawing table the sample plot situation was reconstructed by superimposing the results of the first and second surveys. In this way differencies were easily detected. Besides all the measured and enumerated data there were also approximately 60 types of qualitative data to be compared. The most important results for 752 compared sample plots are:

- Sample trees of first survey: 9'264
- Sample trees of control survey: 9'263
- Random error of DBH-measurement: 0.4 cm
- Random error of D7-measurement: 1.2 cm
- Random error of H-measurement: 1.1 m

c) Data storage and processing

Field data are recorded in coded form and sent to headquarters, where they are loaded into microcomputers (digitized) and later transfered to a computer center. The stored raw data have to undergo a stringent plausibility test. The tested raw data are transformed into interpretable data and supplemented with other (derived) variables.

The EDP-team of the NFI developed several programs for analysis of the data. These programs allow presentation of the data in the form of tables, histograms, pie charts, bar charts or thematic screen maps. The programs are very flexible, allowing every possible combination of characteristics to be analysed. This way even with well defined requests from the user can be met.

5. Identification of newly-emerging needs

In connection with this year's disaster in the alpine region the **protective functions** of the forests have been placed into the foreground. The Federal Railway, for example, is asking the NFI for information about the condition of the forests that protect their installations.

Among the non-wood functions of the Swiss forest the protective function is undoubtedly the most important one. Therefore the NFI intends to devote more attention to that than to the other functions.

It is a fact that every forest exercises protective functions in some way. In most cases **no external objects** (e.g. man-made constructions) profit from the protection, always, however, there are **inner objects** (e.g. forest soil, forest flora, forest fauna) in need of protection. Danger and stress are impending everywhere - nowadays more than ever.

The NFI will have to restrict itself to those protective functions arising from human needs, i.e. from external objects to be protected. In these cases man expects from the forest that it will absorb or at least diminish the forces that might be set free by a certain event. In many cases the protective ability of the forest may be considered to be too low and additional measures may be taken.

In any case it is demanded that forests suitable to protect man-made constructions should permanently be in a condition that guarantees maximum **protective ability.** Consequently these forests have to be managed according to certain criteria, and that means their **productive function** will be **cut back.** The expansion of the settlement area brings along a certain "conversion" of former productive forests into protective forests with diminished productive functions. An optimization of these and further forest functions must be found in land use planning.

During the first NFI, observations of traces due to land slides, erosion, rockfalls etc. were recorded. One could say these forests have exercised a certain protective function against natural forces, that in turn caused damages to trees and soil.

Characteristics suitable for describing the protective ability of a forest stand are difficult to assess quantitatively. One will probably have to restrict oneself to a rough classification (e.g. low, medium, high protective ability). The protective ability has to be assessed separately for different dangers or stresses, (e.g. high protective ability against snow movement may be coupled with a low protective ability against fire.

Objects to be protected that are situated outside the forest have to be registered and classified in collaboration with other inventories (e.g. land use statistics). Likewise possible dangers and stresses can only be identified with the help of other surveys (e.g., Swiss Federal Institute for Snow and Avalanche Research).

During a test period in the NFI, investigations will be made concerning the application of aerial photographs for certain aspects of the protective functions (e.g. topographical measurements).

6. Publications containing results of the NFI

- **First Swiss National Forest Inventory 1986: Results**

  This standard work of approximately 400 pages is to be published at the beginning of 1988. Each of the following subjects is dealt with in a separate chapter:
  - Forest area and ownership
  - Growing stock
  - Forest site
  - Stand structure
  - Regeneration
  - Forest condition
  - Forest road network and exploitation

- **Manual for NFI survey** (to be published in 1988)

In the near future accessory publications covering the following topics will also appear:

- Method and execution of aerial photo-interpretation in the first NFI
- Test of the combined inventory
- Control sampling in the NFI
- Control system for completness and plausibility of the NFI-data
- Documentation of the NFI variables
- Program for analysis of NFI-data in tabular form
- Assessment of road network in the NFI

7. Other aspects

a) Expediture of work

During the operational phase of the NFI, i.e. between 1983 and 1985, approximately 100 man-years (1 man-year = 2000 man-hours) of work were expended altogether.

- **Aerial photo interpretation:**	man-years
measuring program	1/2
copying photographs	2
digitizing passpoints	2
orientations, interpretations	2 3/4
others (selection of stereo-pairs, plotting, management of data and photographs, field days etc.)	1 3/4
total	9

- **Field survey:**	man-years
sampling (according to payroll)	59 1/4
control sampling	4 1/4
management, public relations	10 1/4
others (map survey, management of soil samples, guide-book for tree species, secretary etc.)	3
total	77

- **Data processing:**	man-years
transfer of data	1
control of data (plausibility)	6
programming	4
analysis of control sample, construction of tariff functions etc.	2
total	13

b) **Collaboration with other inventories**

- land use statistics

Land use statistics is a project of the Swiss Federal Office of Statistics that employs a sampling method using aerial photographs for the classification of about 40 land-use categories. The method for this inventory that also uses permanenet sample plots has been developed with the help of the NFI team. For the category "forest" the definition of the NFI is applied. Instruction was given by the NFI team.

- Forest damage inventories:

The national forest damage inventory, conducted by the NFI utilizes a subsample (4x4 km) of the NFI sampling grid. Costly time-consumption for locating the sample plot center is saved, since these points are permanently established. With the help of lay-out plans drawn by the NFI survey teams the plot centers can always be easily relocated.

There are also several cantonal forest damage inventories that use the NFI sample plots as well, sometimes employing a denser grid. Instruction of the survey method as well as evaluation of the data is done by the NFI team.

Birmensdorf/Switzerland, 6 October 1987

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NATIONAL REPORT: U.S.A.

by
James T. Bones

History

In 1928, the U.S. Congress passed the McSweeny-McNary Forest Research Act that directed the U.S. Forest Service to establish a forest inventory program to conduct Forest Surveys throughout the Nation. The work began in several regions almost simultaneously in 1930. The forest inventory program first contributed data to a national assessment that was published in 1933 (the Copeland Report). National assessments have been compiled at approximately 10-year intervals since then in 1945, 1953, 1963, and 1970. These periodic national assessments provided the U.S. Congress, and others engaged in national forestry planning, with an understanding of the current and future timber resource situation.

In 1974, the Congress passed a new law, the Forest and Rangeland Renewable Resources Planning Act (RPA), which made periodic national assessments a legal requirement of the Department of Agriculture. This Act, and some that followed, have amended and broadened the previous acts to include all renewable resources of forest and rangelands, not just timber on forest land.

National Assessments

The most recent national timber statistics were compiled in 1976 for the 1980 national assessment. These statistics were incorporated in Appendix 3 of

Forest Resource Report No. 23, "An Analysis of the Timber Situation in the United States, 1952-2030". The appendix contains 128 pages of tables arraying land, forest land, and timber area statistics by ownership, forest type, productivity class, and stand-size class; timberland volume statistics by class of timber, species and species group, ownership, and diameter class; and growth, removals, mortality, and timber products output statistics. Also included in Forest Resource Report No. 23 are converting factors (Appendix 5) and a glossary of terms (Appendix 6).

Plans are now underway to update the 1976 statistics to 1986 as part of the current 1990 national assessment. The 1976 compilation was conducted by completing a series of state-level forms and forwarding them to the Forest Service National Computer Center in Fort Collins, Colorado for key punching, verification, and processing. A computer software package called FINSYS was used to develop the statistical tables from the state-level resource inventory data sets. The growth and mortality estimates were developed using TRAS (Timber Resource Analysis System), a computer program that calculates growth by 2-inch diameter classes. This program was also used to update the state-level inventories to a common year and to make projections of timber supply to 2030.

In order to provide timber resource information for the 1990, and subsequent RPA timber assessments, a permanent data base management system has been set up at the Fort Collins Computer Center. The system contains plot, stand, or stratum level data from 9 U.S. Forest Service Administrative Regions and 7 Experiment Stations across the Nation. Each of these 16 individual data bases have a common data structure (identical codes and data formats) and are stored within the System 2000 (S2K) data base management software. A program, written specifically for managing the databases has been developed to interface with System 2000 and the Computer Center's UNIVAC 1100 operating system. The program has a menu of 10 options, including addition and deletion of records, creation of tape backups, and initiation of a S2K session to use existing reports or to

develop new ones. Contributing Regions and Stations will have access to their data base for analysis purposes, for editing data, and for updating the contents when new inventory information becomes available. Users will also be able to generate their own summary reports. If the Regions and Stations continue to update their respective data bases throughout the next decade, the majority of the timber data required for the next assessment will already be available.

The Forest Service is presently using Data General minicomputers to provide communication and other office and management functions within the organization. This equipment will be used for entering and editing data, creating batch files at the Fort Collins Computer Center, and as a networking link among the 9 Regions and 7 Stations and Fort Collins. A data entry package called "RPA" has been developed for the Data General equipment.

For the 1990 resource assessment the Timber Resource Inventory Model (TRIM) will replace the TRAS system that was previously mentioned. While TRAS is a stand-table projection model, TRIM is an area-based, yield-table system that projects acres by detailed strata for periods consistent with inventory stand-age classes. In TRIM the inventory is represented by an array of acreage cells classified by region, ownership, management type, site productivity class, stocking class, management intensity, and age class. Acreage is shifted among the cells, and volume and growth estimates are derived from acreage movements through assumed yield tables.

New Developments in Inventory Procedures

Multiresource Data Collection - The U.S. Congress has directed the Federal inventory to collect information on resources other than timber, including range, wildlife, and fisheries, water, and recreation. A vegetative profile

has been incorporated into the field data collection which determines vegetative horizontal and vertical distribution, density, diversity, and composition of the tree and other vegetation associated with forested ecosystems.

Tree Biomass Estimation - Use of wood for energy and development of the technology for engineered board products have made it necessary to inventory the entire tree mass. Tree biomass estimation procedures have been incorporated into the forest inventory field units that cover the United States.

Electronic Data Entry - Most of the inventory field units have, or are switching to, electronic data recorders. With these devices, plot data can be entered directly while working in the field, and the data can be sent by telephone to the base equipment in the office.

Data Base Management Systems - Inventory field units rely either on large mainframe computers at universities, or purchased micocomputers that are dedicated to supporting the inventory task. Day to day computer use includes data capture, editing, data reduction, statistical analysis, graphics, digitizing, and processing LANDSAT data. Customized data retrieval systems have been developed to generate standard and special tables of statistics. A long-term goal is retrieval and assembly of compatible sets of tables from several forest inventory work locations.

Testing New Methods - The Alaska Integrated Resource Inventory System (AIRIS) was developed to test a multiphase sampling design within which remote sensing products are tested and evaluated for gains in sampling efficiency. AIRIS makes use of LANDSAT, high altitude photography, large-scale color infrared

photography, and some new concepts in capturing ground data from a type map sampling frame. The results of the analysis will be reported soon.

Growth Estimation Procedures - Periodic timber inventories in the Southeastern United States indicate that net annual growth of softwood timber has turned downward. Because growth reductions and high mortality have been experienced in Europe and other regions, forest inventory planners have asked for a review of current growth estimation procedures. A joint investigation has been initiated by the two forest inventory units in the Southern United States.

Final Observations - Many of the techniques and developments mentioned in this paper are being evaluated, and those that prove useful, will be incorporated into the current Federal forest inventory system.

NATIONAL REPORT: YUGOSLAVIA

by
D. Orescanin

A. Brief description of the scope and coverage of the latest national forest inventory

The latest forest resource inventory in Yugoslavia was taken in 1979. Its aim was to collect data for the needs of organizations of associated labour in the field of forestry and the timber industry, and make it possible to deal with forestry problems in a scientific manner. The obtained data are the foundation for pursuing a policy in this field and for the long-term planning of forestry development, as well as of the development of the dependent timber industry.

The data on the growing stock obtained in 1979 were gathered on the basis of a common methodology drawn up by the Federal Statistical Bureau.

Forests with management plans were inventoried by the method of self-registration, while the method of assessment was used for forests without such plans.

Data from management plans were used to determine the area, volume of wood, increment of the volume of wood, types of trees, form of silviculture, age, i.e. diameter class, communications. Data from cadastral registers were used for assessing forest area (where it was not otherwise determined).

The assessment method was used for forests without management plans or for those for which data on the volume of wood (or other data) were obsolete, or, for any other reason could not be used.

The subject of the inventory was forest area, the volume of wood and increment, for all forests regardless of the manner in which they were created, the form of silviculture or ownership. In addition to forests, the subject of the inventory were also all unstocked forest areas managed by organizations of associated labour. An inventory was also taken of plantations and intensive plantations of deciduous and coniferous species, as well as of permanent forest communications and public roads passing through forests.

The number of registered species of trees is smaller than in the 1961 inventory. Those species which account for a small percentage of the total volume of wood or are of small economic importance were excluded (e.g. all types of oak are listed under one heading, while locust, elm and ash are listed under "other deciduous trees".

The following terms were established during the inventory: A forest is every forest area exceeding 500 m2. Cultures established by planting seedlings or sowing seeds of forest species older than 3 years and areas evenly covered with natural new growth of forest species older than 5 and more years are also considered forests.

Hedgerows, parks in settlements, forest nurseries and groups of trees on areas smaller than 500 m2 are not considered forests.

According to their purpose forests are classified into:

- economic forests
- protective forests
- special purpose forests (national parks, picnic grounds and others).

According to the form of silviculture, forests are classified into:

- high forests
- high even-aged forests and
- high uneven-aged forests
- coppice forests
- other categories (brush, maquis, scrub and browsing forests).

Plantations and intensive plantations are forests raised from selected plant material with the application of modern agro-technical measures, with short rotation and intensive increment.

Unstocked forest land includes land in public ownership which due to its natural features yields the best results if forests are grown on it.

The obtained data were processed according to a common programme in the Automatic Data Processing Sector of the Federal Statistical Bureau.

B. Plans for the next inventory, including changes introduced as a result of changing information needs, technology, etc.

A decision has still not been brought on taking the next full inventory of forests in Yugoslavia . It will probably be made in 1995.

However, changes in the area under forests are registered every year. Data on these changes are published by the Federal Statistical Bureau.

The data covered by the inventory are considered sufficient for the time being.

In addition, full data on felling, not only in forests according to category of ownership and types of stands, but also on felling outside forests are gathered and published on an annual basis.

C. Main users of inventory data and how and for what purpose they use the data

The values of forests are calculated on the basis of the forest resource inventory, according to quantitative and qualitative features.

The data are used as the basis for the policy of forestry development and the development of timber industries. The Yugoslav policy of forestry development attaches increasing importance to the other uses of forests.

Yugoslav forestry and timber industries give a considerable contribution to exports.

Growing stock data have significant applications in policy, practice and science.

D. Brief description of the methodology and equipment (including computers) used for (1) data collection (ground-based, remote sensing), (2) processing, storage (3) mapping.

Inventorying is done on the basis of the customary classical methods. Surveys are made by means of trial strips and circles covering 5-10% of the area in high and at least 1% of the area in coppice forests. In some valuable forests (forests of faculties, old oak forests) surveys of all the trees are made. The collected data are processed by computer. Aerial photographic estimates of forests are not made. The scale of general maps is 1:10.000 (more rarely 1:25.000). General maps of private forests on a smaller area are made on a 1:5000 scale. Pursuant to legislation forest management plans are revised every 10 years.

E. Identification of newly-emerging needs for inventory information and steps being taken or considered to meet those needs, e.g. data on non-wood products and services, total biomass, changes over time, forest health and damage.

The data collected through the 1979 inventory are considered adequate for the time being. Nevertheless, it is necessary to assess the other uses of forests and total biomass. Certain assessments already exist, but were not collected by official statistics. The data on total biomass in forests and trees outside forests were assessed by Dr. Oreščanin. The data were officially submitted within the Study "The Forest Resources of the ECE region". Data on forest by-products are collected regularly (on an annual basis) but they should be more detailed (e.g. include data on mushroom picking, etc). Data on hunting are very detailed and are collected by official statistics. Data on damage in forests

are also regularly collected (damage caused by people, diseases, natural elements, fires, etc). Official statistics do not collect data on damage in forests caused by excessive air pollution. Changes of areas under forests are regularly registered, collected and published by official statistics. We will be in the position to give accurate data on areas under forests for the world forest inventory (in 1990).

F. Publications containing results of national inventory work

Data on the forest inventory were published by the Federal Statistical Bureau in the form of publications entitled "Inventory of the Growing Stock in 1979", and "Statistical Bulletin" No. 1480, Belgrade 1985. Data on changes in the growing stock, felling, production, forest by-products (hunting), damage to forests, forest protection, soil protection against erosion and torrents, consumption of forest products and foreign trade, are published annually in the "Statistical Bulletin" of the Federal Statistical Bureau. The Federal Statistical Bureau collects numerous other data in the field of forestry and the timber industry. Some of them are published in various other bulletins, and conveyed to the concerned users. The Federal Statistical Bureau publishes data for the whole country. Data are also separately published by the republican i.e. provincial statistical bureaus.

G. Other aspects, e.g. costs, manpower requirements, relationship between forest inventories and other land surveys, and as geographic information systems.

The costs of the 1979 inventory were defrayed by forestry-economic organizations, in view of the fact that they are obliged to prepare forest-economic management plans within their regular activities. Assessments and inventories of forests without management plans are made by forestry experts within communes as part of their regular tasks. If public forests are in question, and no management

plans exist for such forests, assessments are made by the organization managing the forest within its regular operations. Final data processing is done by statistical bureaus as their regular activity. During the 1979 inventory several retired forest experts were engaged to control the collected data. Cooperation with geodetic surveying organizations is well organized. The same is true of other research organizations.

NATIONAL REPORT: ZAIRE

by
Ipalaka Yobwa

1. INTRODUCTION

Situation: The Republic of Zaire is situated in central Africa

Climate: Temperature is that of tropical countries, 25°C is average
The annual rainfall exceeds 2,000 mm
Humidity averages 85 %

Area: Zaire is a vast territory covering more than 2,345,000 km^2

Forest area: 129,000,000 ha approximately 55 % of the country
47 % of the African tropical forest
6 % of the world tropical forest
The "cuvette centrale" makes a compact block of 100,000,000 ha of forests in which half has a very big potential for development
However, the utilization of that natural resource has scarcely started, commercial extraction during the last year was about 500,000 m^3
Copper represents 70 % of revenues of Zaire
That is to say, the present contribution of the forest sector to the national economy is not equivalent to its potential.

The big question:
How to use this important natural resource?
The answer is the main objective of management of Zairian forests

2. MAIN OBJECTIVE OF MANAGEMENT

The aim of planning can be summarized as being rational use of resources so that the maximum sustained income can be obtained from them. To achieve, the forest incomes must be improved in a way so that people can live in a healthy environment.

HOW TO REACH THE MAIN OBJECTIVE

At first, I will tell you how forests are classified in Zaire.

1. The map shows different types of forests
2. "Forestry classification chart of land" is the classification in use for forest inventories and management
3. The following chart shows the different classes of use of land

Category of utilization	Area
Productive forests	106,991,000 ha
Classified forests and reserves	753,000 "
National park	8,050,000 "
Game reserves and	13,091,000 "
Afforestation	112,000 "
Botanic and zoological gardens	3,000

2.1. Strategies to reach the main objective

- Forests must be known by forest inventories
- Management of forest must be done in order to guarantee a rational use of resources
- Amelioration of administrative and institutional structures

In order to reach the first two objectives: forest inventories and management, the "SPIAF" "SERVICE PERMANENT D'INVENTAIRE ET D'AMENAGEMENT FORESTIERS" has been created in 1977 with Canadian cooperation

The mandate of "SPIAF" is as following:
- inventory of the whole Zairian forest;
- to prepare plans of forest management
- to train Zairians about techniques of inventories and management

2.1.1. Forest inventories

INPUTS Qualified personnel;
Inventory norms;
Base maps with scale of 1:50,000;
Aerial photos approximative scale 1:40,000;
Satellite images;
Computer

OUTPUTS Inventory results;
List of species;
Forest thematic maps

TECHNIQUES Techniques are based on statistical methods of using sampling
- The methods makes use of a systematic and stratified sampling
- Errors are +/- 10 to +/- 15 % for 95 % confidence level
- Volumes are obtained by volume functions based on tree samples following the logarithmic formula

$$V = a\ D^b$$

V = volume m^3
D = diameter at breast height
a and b are coefficients of regression

Inventory data are computerized. A processing system has been adapted for specific conditions of Zairian forest inventories

The first results of inventories can be summarized as following:

1. Nonforest and unproductive forest categories cover the average of 50 %
2. Species inventoried are more than 700
3. Gross average volume of timber in inoperable forest is 250 m^3/ha
4. In inoperable forests, gross merchant volume of trees of more than 60 cm diameter of marketable species represents an average of 50 m^3/ha
5. The same volume in operable and disturbed forest is 16 m^3/ha

A forest map of the country is going to be made. The scale will be 1:1,000,000 Another thematic forest map will cover each of 9 regional areas of Zaire with a scale of 1:200,000.

2.1.2. Management

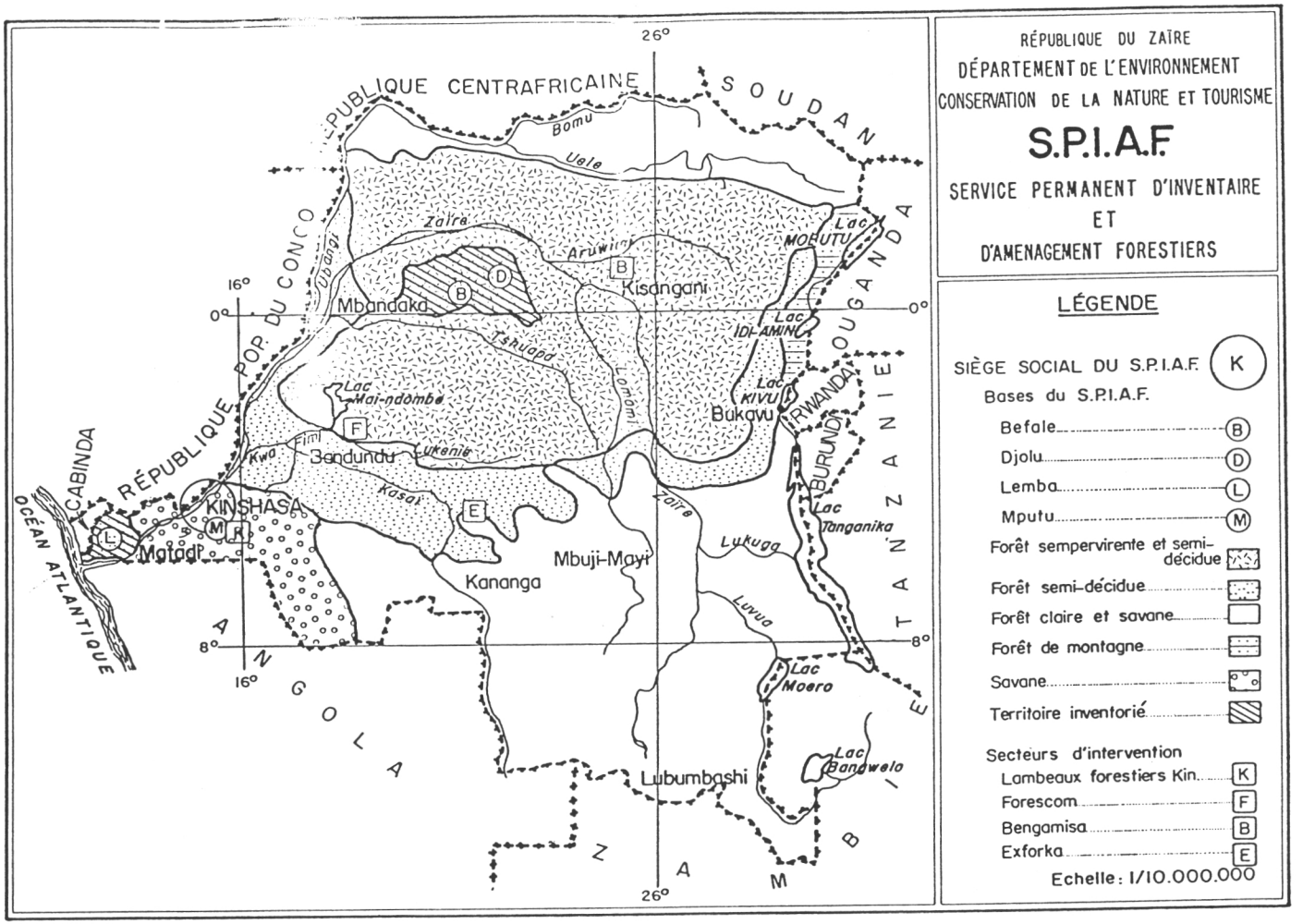
The "SPIAF" produced the following plans of management:

1. Plan of management of operable and disturbed forest that prescribes
   - extraction of volume of timber that authorized,
   - land use plan

2. Management plan of inoperable forest that prescribes the type of exploitation suitable for this forest and fixes the rotation
3. Main plan of management of biospheric reserve
4. Plan of management of suburban areas that prescribes silvicultural techniques of managing disturbed forest around the urban, and afforestation of this area, in order to produce charcoal and protect the environment

2.1.3. Improvement of administrative and institutional structure

- Activate the forestry institutions
- Re-organize the forestry administration
- Assure participation of forestry in the overall regional land use planning and development
- Build up an adequate cadre of foresters at all levels - professionals to technicians
- Secure the proper place of the forestry sector in the national economy


RÉPUBLIQUE DU ZAÏRE
DÉPARTEMENT DE L'ENVIRONNEMENT
CONSERVATION DE LA NATURE ET TOURISME
S.P.I.A.F.
SERVICE PERMANENT D'INVENTAIRE
ET
D'AMENAGEMENT FORESTIERS
LÉGENDE
SIÈGE SOCIAL DU S.P.I.A.F. K
Bases du S.P.I.A.F.
Befale B
Djolu D
Lemba L
Mputu M
Forêt sempervirente et semi-décidue
Forêt semi-décidue
Forêt claire et savane
Forêt de montagne
Savane
Territoire inventorié
Secteurs d'intervention
Lambeaux forestiers Kin. K
Forescom F
Bengamisa B
Exforka E
Echelle: 1/10.000.000
26°
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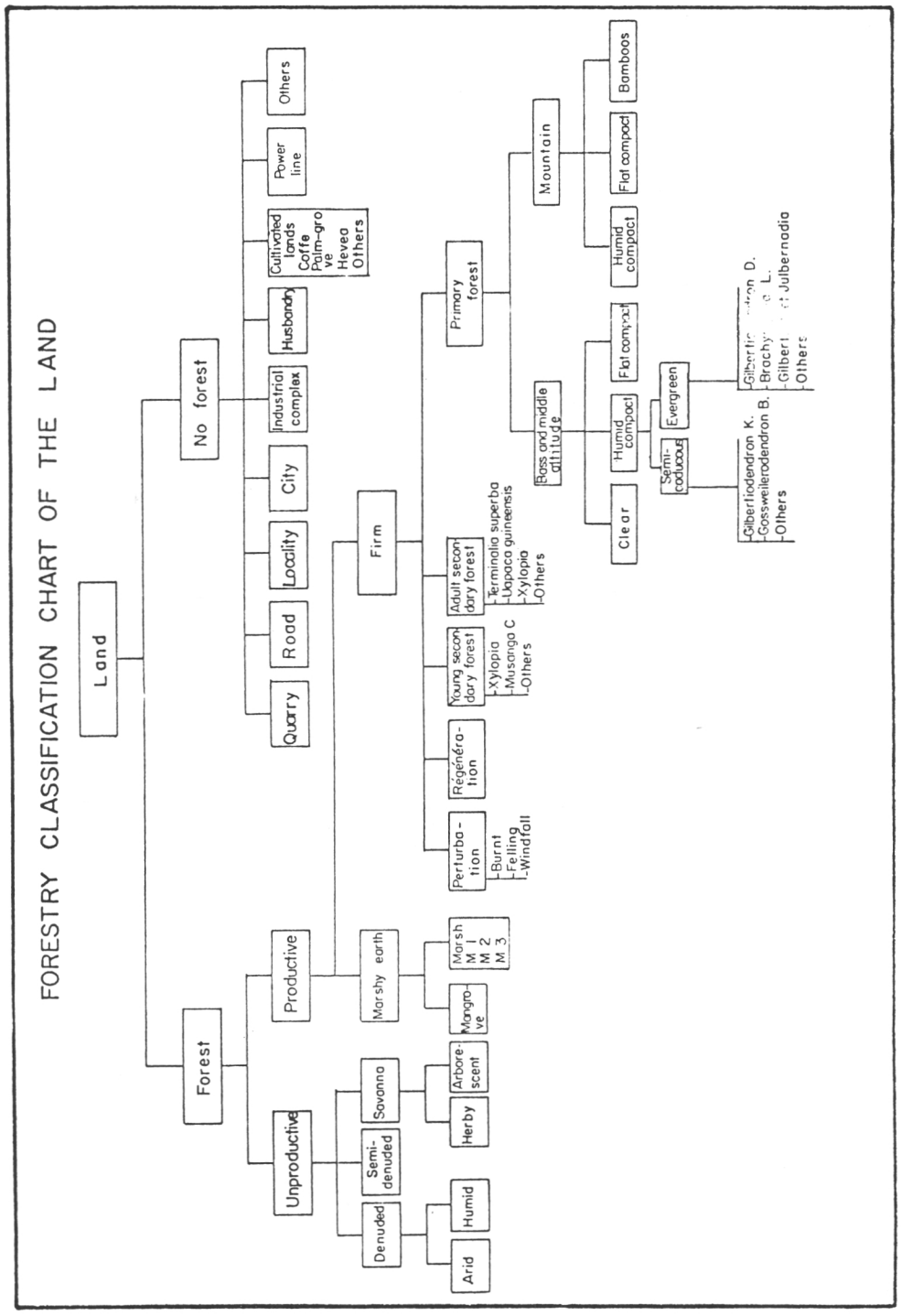
8°
RÉPUBLIQUE CENTRAFRICAINE
SOUDAN
Bomu
Uele
Zaïre
Aruwimi
Ubangi
Mbandaka
Kisangani
Lac MOBUTU
Lac IDI-AMIN
Lac KIVU
Bukavu
RWANDA
BURUNDI
OUGANDA
TANZANIE
Tshuapa
Lomami
Lac Mai-ndombe
Kwa
Fimi
Sandundu
Lukenie
Kasai
KINSHASA
Matadi
CABINDA
OCÉAN ATLANTIQUE
Mbuji-Mayi
Kananga
Lukuga
Lac Tanganika
Luvua
Lac Moero
Lac Bandwelo
Lubumbashi
ANGOLA
ZAMBIE


FORESTRY CLASSIFICATION CHART OF THE LAND
Land
Forest
Unproductive
Arid
Humid
Denuded
Semi-denuded
Herby
Savanna
Arbore-scent
Productive
Mangro-ve
Marsh M 1 M 2 M 3
Marshy earth
Firm
Perturba-tion
Burnt
Felling
Windfall
Régéné-ration
Young secon dary forest
Xylopia
Musanga C
Others
Adult secon dary forest
Terminalia superba
Lapaca guineensis
Xylopia
Others
Primary forest
Mountain
Bass and middle altitude
Clear
Humid compact
Semi-coducous
Evergreen
Flat compact
Humid compact
Flat compact
Bamboos
Gilbertiodendron K.
Gossweilerodendron B.
Others
Gilbertiodendron D.
Brachystegia L.
Gilbertiodendron Julbernadia
Others
No forest
Quarry
Road
Locality
City
Industrial complex
Husbandry
Cultivated lands
Coffe
Palm-grove
Hevea
Others
Power line
Others

Part III

INVITED PAPERS

Estimation of Fellings and Total Drain in Sweden

by
Göte Bengtsson

1. Introduction

Information on fellings and removals is essential for formulation and follow-up of forest policies. In a country or region such information may be needed for sub-regions, various ownership categories and cutting types. Further there can be a need of detailed information on cutting patterns as concerns types of stands that are clear-cut, performance of thinnings etc.

Estimates of total drain are needed in a forest balance. According to Kuusela (1983) a "forest balance is a comparison between growing stock volume at the beginning and end of a balance period, and increment and drain of growing stock during that period". The relationship can be expressed in the following way:

Initial volume + increment - drain = volume at end of the period.

One purpose of making such forest balances is to check the consistency of various estimates from a forest inventory. As is stressed by Kuusela (op. cit.) all components of the forest balance must be expressed in the same unit, e.g. total stem volume over bark from stump height to top.

In countries with intensive forest management, detailed information on the extent and structure of fellings is also needed for comparison with earlier cutting plans and the assumptions made in previous analyses (prognoses) of long-term timber yields. Such comparisons can be a means for improving the realism of forecasting models as concerns the specifications of management programmes.

Comparisons between estimated past drain and calculated possible (sustained) drain can show in what regions and for which ownership groups there is a possibility to increase the total cutting level and in which cases the cut must be reduced.

Schmid-Haas (1983) gives a comprehensive review of methods for estimating drain, and discusses also methods for assessment of areas of cuttings.

In the present paper the problem of estimating drain and fellings is discussed mainly based upon experience from Sweden.

2. Concepts and overview of methods

The following standard concepts and relationships are use here:

(1) Drain = fellings + unrecovered natural losses

(2) Fellings = removals + harvesting losses.

Harvesting losses include also trees felled in silvicultural operations and left in the forest.

Basically there are two alternative methods to estimate removals:

- by forest inventories, by means of measurements of stumps from recently felled trees on temporary plots or by means of repeated assessments on permanent plots, or through a combination of these methods

- by studies of the consumption of roundwood in the forest industry and for other purposes or by using cutting statistics collected in other ways.

Harvesting losses are normally to be estimated by forest inventory, or by means av separate investigations in logging areas. Natural losses can be estimated only by forest inventories.

3. Stump inventory in Sweden

Since 1953 the annual cut in Sweden has been estimated by means of the stump inventory, being a part of the National Forest Inventory (NFI). Stumps from the latest felling season ("last year") are recorded. This inventory provides information on areas of various types of cuttings, on the volume felled - fellings - and on the volume of trees that are felled but left in the forest, including trees felled in silvicultural operations - harvesting losses. It also provides detailed information on cutting patterns, in fact the best information available for qualified analyses of these important questions.

Some major advantages with this method are that the total fellings can directly be calculated for subregions and owner categories, that an accurate species distribution is obtained and that the fellings are measured in the same unit (total stem volume over bark) as the growing stock and the increment. Further, the existence of data from the stump inventory faciliates the calculation of increment on trees that have been cut during the latest five years, which means increased accuracy of estimates of gross increment.

The check inventory shows that the stump inventory underestimates the true volume felled by about 5 %. This is due to the well-known problem of correct dating of the cut in some cases and the problem to find all stumps. However, our experience is that the stump inventory method works fairly well under Swedish conditions. Another, perhaps the most severe short-coming of the stump inventory is the low statistical precision of the estimates of one year's cut. The reason is that only a very small proportion of the total area is cut every year. Because of this we normally have to use data from a five year period (five years' inventory) to achieve

reasonably precise estimates. And even in that case sampling errors can be substantial in some of the sub-populations for which estimates are desired.

To sum up: Although there are some problems involved, the stump inventory provides, indeed, valuable information for various kinds of analysis. The results have greatly influenced Swedish forest policy during the last two decades. The recently introduced permanent sample plots of the NFI will from now on provide estimates of the cut over five year periods that are less biased. The stump inventory is being continued as earlier on the temporary plots, mainly because the permanent plots alone would not give results that are precise enough.

At two occasions, in 1975 and 1980, a complementary assessment has been made by the NFI of certain kinds of harvest losses, which are not recorded in the ordinary stump inventory. These components were tops, butt-offs, exceptionally high stumps and logs that had been left in the forest. (Walldén, 1982.)

A comprehensive study of fellings in Sweden based on data from the stump inventory is presented by Fridh, Svensson and Toet (1987).

4. Estimation of natural losses

The estimation of unrecovered natural losses is problematic and estimates are often very uncertain, although the losses in a country like Sweden are small compared to total fellings and increment. Many inventories do not at all provide data on annual natural losses (mortality).

In the Swedish NFI, annual mortality is estimated on temporary sample plots since the beginning av the 1970's on the basis of a subjective judgement of which of the dead and wind-thrown trees that have died during the last or last three years.(Bengtsson, 1983.) These data and data on the amount of cut dead and wind-thrown trees according to the stump inventory are used for an approximate estimate of the volume of unrecovered natural losses. The average figure for these losses for all the country has been in the order of 5 % of the gross increment.

Data from the repeated inventories on the new permanent sample plots in our inventory will gradually yield much more accurate data on total and especially on unrecovered natural losses, although some problems will remain.

5. Estimating removals from data on wood consumption

The other method regularly used in Sweden for estimating total removals is by studies of roundwood consumption with conversion of trade measures into corresponding units of standing volume (total stem volume over bark, i.e. the same unit as used in the NFI). The problem is to get hold of all parts of the consumption, no more, no less, and to convert them correctly. These calculations are made by the National Board of Forestry.

In short, the calculaltions are based on routine official statistics on wood consumption in pulp mills, sawmills etc. with more than five employees. Corrections for each year are made with regard to foreign trade with roundwood and changes of roundwood stock at the industry, also on the basis of official statistics.

Consumption of roundwood otherwise, i.e. in small sawmills, in medium size heating plants, in small size heating (individual houses) and other autoconsumption, is estimated by ad-hoc enquiries, partly on sampling basis. Such enquiries are made with intervals of 3-8 years. This part amounts to only 5-10 % of the total wood consumption in Sweden.

To calculate total fellings one has to add the volume of harvesting losses reported by the NFI.

The accuracy of this type of estimate of the total annual cut is much higher than of the corresponding estimates from the stump inventory, as concerns periods of one or a few years. The accuracy of all the components and steps involved in these calculations is not known, but the overall bias is believed to be small. As an average for a fairly long period this method has given 5 % higher annual removals than the stump inventory. This difference is of the same order as the probable underestimation in the stump inventory.

Using the method based on wood consumption it is not possible to estimate directly the removals in various sub-regions of the country or to give accurate estimates for various owner groups. Nor can the removals be divided by cutting types or species.

6. Other information on annual cut

Besides what has already been described above there are also other kinds of information about the annual cut. Forest owners of all categories have to report to the County Forestry Boards all clear-cuttings larger than 0.5 hectares planned for the coming year (but not necessarily performed). This information is regularly compiled by county and owner category and for the whole country and can be used to study trends in logging activities.

Some of the County Forestry Boards do themselves produce statistics on the annual cut in their own county, based on enquiries to large forest owners, local knowledge of activities among private owners and other sources. The quality of these assessments is a matter of discussion.

Finally, it could be mentioned that attempts have been made to divide the estimated total removals in the country into subregions (counties) and owner groups by means of official statistics on the number of employees in logging operations.

7. Discussion and conclusions

As discussed above there are two standard methods in Sweden for estimating removals and fellings, the stump inventory and the calculations based on roundwood consumption. Both methods have advantages and shortcomings, but they complement each other in a good way.

The experience of the stump inventory method is rather positive in Sweden. However, the value and accuracy of stump inventories are often questioned in other countries. For instance this method has now been abandoned in the Austrian national forest inventory.

Svensson (1983) presents an example of a forest balance over a ten year period and discusses the accuracy in estimates of the various balance components. He concludes that the problem of bias probably is not very serious, after an adjustment of the estimate of fellings according to the stump inventory by 5 % to compensate for the probable underestimation. Except from the mentioned underestimation of fellings, the analysis therefore indicates that the various balance components on the whole are consistent.

Swedish experience as regards the applicability and accuracy of methods for estimating drain, especially by stump inventory, can of course not be generalized. Some conditions in Sweden are in favour of the stump inventory method. For instance the short and distinct vegetation period faciliates the determination of the cutting year. We have very few tree species. Our trees (conifers dominating) normally have a very regular form and accurate volume functions are available. The growth of weeds after clear cutting is not as abundant as in some other parts of the world. Conditions in many other countries are less favourable in these aspects. Further, one must remember that it is necessary to survey the whole country each year if the last year's cut is to be estimated. This means increased costs which in many cases may not be justified, if there are not other important reasons to carry out field inventory work every year all over a country.

It has been pointed out above that the introduction of permanent plots in the Swedish NFI will give more accurate estimates of total fellings, of area that has been cut and of natural losses, compared to the situaton up till now. They will also give more detailed and new information on the trees and stands cut, for instance as regards increment and damage. Hence, it will be possible to make deeper analyses of the utilization and dynamics of the timber resources.

However, the problem with the low statistical precision in estimates of the annual cut in various subregions cannot be solved only within the present design of the NFI.

Especially there is an urgent need to try to reduce sampling errors of the estimates of clear-cut area and volume. The use of satellite imagery might be a solution to this problem. Previous studies in Sweden have shown that new clear-cut areas can be identified and the area estimated with an acceptable accuracy. The potential and the costs of this method for large-scale application should be further explored.

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The IUCN Tropical Forest Programme and its Linkages with the Fao Tropical Forest Resources Assessment

by
N.M. Collins

IUCN and the Tropical Forest Programme

The International Union for Conservation of Nature and Natural Resources (IUCN) is a network of governments, non-governmental organisations and conservation experts, joined together to promote the protection and sustainable use of living resources. Tropical forests, collectively the world's most important living resource, are at present subject to greater abuse and mismanagement than any other key global resource. All of IUCN's six Commissions (with a membership of over 3000 experts), its Centres for Environmental Law, Conservation Monitoring and Conservation for Development, as well as many of IUCN's members, are actively involved in efforts to conserve and sustainably manage tropical forests. Through a generous grant from the government of Sweden, these activities are coordinated by an office at the IUCN Secretariat into a comprehensive Tropical Forest Conservation Programme.

Priority aims of the IUCN programme are:

- Improving protected areas systems to shield more tropical forest sites more systematically;
- Encouraging conservation-conscious land-use in areas adjacent to parks and reserves;
- Promoting sustainable utilisation of natural forests, in tune with conservation of biological diversity and ecological processes;
- Urging re-establishment of natural vegetation in degraded areas;
- Constructing regional networks of tropical forest research and management institutes.

Monitoring - the Foundation of the Programme Structure

In achieving these aims, IUCN uses an information-gathering process based on IUCN's worldwide network and focused on the IUCN Conservation Monitoring Centre (CMC) in Cambridge and Kew Gardens, UK. CMC has, for the past six years, gathered and analysed data in four broad subject areas: threatened animals, threatened plants, wildlife trade and protected areas. In the Tropical Forest Programme efforts are underway to integrate forest-related elements of these databases in order to identify key geographical sites for the conservation of wildlife, vegetation and ecological processes in tropical forest regions. Many such "critical sites" are already under protection, but others are not. A flexible approach is adopted, pressing for full site

protection where possible, but encouraging conservation-conscious land-use patterns and sustainable utilisation of forests where a compromise is needed.

This site-related approach to conservation keys more easily into integrated land-use planning strategies, and thus to the whole process of development in tropical forested countries. IUCN is working in collaboration with the development agencies to ensure that critical sites for conservation are recognised and respected in aid review missions, aid packages and national development programmes. An important forum for the dissemination of this information is the six-monthly meetings of Forestry Advisors in the context of FAO's Tropical Forestry Action Plan.

Protected Area Systems

Protected areas are at the heart of natural resource conservation. For over 40 years IUCN has been involved in siting and supporting protected areas, and during this period a unique approach to monitoring and field action has evolved. The IUCN approach includes a strategically coordinated series of activities:

* Preparation of directories of existing protected areas.
* Critical review of protected area systems.
* Production of Action Plans for protected areas and threatened species.
* Development of National Conervation Strategies.
* Implementation and management of on-the-ground conservation projects.

These activities run in parallel and, during the six years since CMC was formed, have begun to come to fruition. To explain in more detail how the process works, the example of IUCN's work in the Afrotropical region will be described in more detail.

Protected Areas in the Afrotropical Region

1. The Directories
   The recently published "IUCN Directory of Afrotropical Protected Areas" is a compilation of reviews for Africa's protected areas. It does not claim to be complete, there are certainly gaps in our information on many sites, and systems of Forest Reserves, for example, have not been reviewed. Nevertheless, with over 1000 pages of text and over 600 protected areas reviewed, this is by far the best analysis available. The data are stored on a computerised database and are constantly being updated and developed into a variety of other outputs, such as reports on national protected area systems or individual protected areas, for application in a multitude of different ways.

2. The Protected Areas System Review
   The protected areas database has been used as the basis for a "Review of the Protected Areas System in the Afrotropical Realm", published in December 1986. In essence, this is an assessment of the coverage of vegetation types and biological diversity by national parks and other protected areas. The main conclusions of this review are as follows:

   a. Of the 17 distinctive vegetation types of Africa, only four have adequate protection, and even these have shortcomings. Four in particular need much greater conservation effort - all of them in tropical forest areas:

* Guinea-Congolian forests
* East Malagasy forests
* West Malagasy forests
* Afromontane forests

These areas are some of the most biologically rich anywhere in Africa, with very high levels of species endemism.

b. Analysis of the protection of indicator groups of species (primates, ungulates, certain birds) confirms the picture derived from the vegetation analysis. Lowland rain forests of West Africa and Madagascar, and montane forests of East Africa, harbour many rare and endemic species that are at risk because of inadequate protected area systems. In addition, wetland sites such as lakes, marshes and rivers are neglected, polluted and over-exploited throughout Africa.

c. Country action requirements are clearly identified for every nation. Shortcomings in protected area management are highlighted, and attention is drawn to the need for improved training activities.

The protected areas systems reviews draw particular attention to the need for ecosystem monitoring, by remote sensing as well as by indirect indices of conditions, eg. tree cover, bioproductivity and species richness. In Africa much of the early emphasis on big game species has resulted in the neglect of critical habitats for biological diversity in general, and particularly for the maintenance of ecological processess such as water and nutrient cycles. This problem is most serious in the forested countries.

3. The Action Plans

The IUCN Commission on National Parks and Protected Areas (CNPPA) prepared the "Action Strategy for Protected Areas in the Afrotropical Realm" using the expertise of park managers and planners across the whole of Africa. The Action Plan embraces and extends the results of the protected area system review, giving detailed recommendations for in-country actions. The practicality of the recommendations was ensured by consultation and review by experts at two international meetings: first the International Symposium on African Wildlife, Uganda, 1986, then the 28th Working Session of CNPPA in Niger, 1987.

Action plans for species are also prepared, through the offices of IUCN's Species Survival Commission (SSC). For example, the SSC Primate Specialist Group has prepared a very detailed programme in the "Action Plan for African Primate Conservation: 1986-90". The Group has identified 11 distinct regional communities of African primates, each with individual conservation needs. All of these lie in forested regions of Africa, eight of them in the Guinea-Congolian forest block of west and central Africa.

4. National Conservation Strategies

The "World Conservation Strategy" developed by IUCN in cooperation with UNEP, UNESCO and WWF requires no introduction. Its philosophy of conservation in partnership with economic development is accepted the world over as a fundamental cornerstone for development planning. Implementation of the Strategy at the national level is spearheaded by IUCN's Conservation for Development Centre (CDC), based at the IUCN headquarters in Switzerland. African countries in which national conservation strategies are undergoing development include Sierra Leone, Uganda, Zambia and Botswana.

Action on the Ground

IUCN achieves its conservation objectives through projects, the majority of which receive support from outside funding agencies. The Tropical Forest Conservation Programme officer in Switzerland promotes and coordinates projects which address forest conservation issues. The increase in forest-related projects in the two years since that office was set up has been dramatic. They include:

* Agricultural development and environmental conservation in the East Usambara mountains, Tanzania.
* Management strategy workshop for the Korup National Park, Cameroon.
* Conservation of species and ecosystems in Madagascar.
* Project development at the African Wildlife Colleges at Mweka, Tanzania and Garoua, Cameroon.
* Conservation and national utilisation of the forest resources of central Africa.

Linkages with the FAO Tropical Forest Resources Assessment Project

The 1981 reports of FAO's Tropical Forest Resources Assessment Project have been of fundamental value in ascertaining IUCN's priorities in tropical forested countries. For those countries in the closed forest sector in particular, intelligence on the extent of natural forests, and the rate at which they are being depleted, is essential for strategic planning. For example, in a country with very restricted forest resources and rapid deforestation, such as Nigeria, protective conservation efforts must be focused quickly onto key sites before it is too late. The FAO results for 1980 have revealed nine countries whose closed forest resources will be exhausted by 2010, and a further 13 whose resources will be exhausted by 2035. Conversely, in those countries with extensive forest and a low depletion rate, such as Zaire, there is still time to carry out an overall land-use strategy based on a more rational compartmentalisation of the forest resources. Demands on the forest that need to be met and integrated with a protected area system include:

land for agriculture,
land for indigenous people,
forests for soil protection
forests for sustainable production of timber and non-wood products.

Now that FAO has decided to undertake a second assessment of forest resources, this time on a global scale, the opportunity has arisen to review the methods of assessment and presentation of the forest resources data, with a view to indicating ways in which the value and usefulness of those data could be improved. Naturally, IUCN's purpose in collaborating with FAO in this way is primarily to improve the forest resources assessment project as a tool for conservation planning in forest regions, primarily in the closed, broadleaved forest of the tropics. How could the assessment be made even more useful ? The answers lie in two broad categories:

* the way in which the data are collected;
* the way in which the data are presented.

Data Collection

Forests worldwide are gazetted by governments into a wide range of protection classes. These range from Strict Nature Reserves (where natural processes are

allowed to take place without human interference) through Managed Nature Reserves (where human manipulation of the environment is necessary for species management) to Biosphere Reserves (where a range of human, ecological and biotic needs are met in an integrated way) and Forest Reserves (where, in reality, the natural vegetation is often replaced by exotic species in monoculture). All of these categories of forest have a conservation value, but some detailed information is needed if that value is to be correctly assessed. In particular, IUCN/CMC needs data on Forest Reserves, with an assessment of the extent to which they are intended to achieve conservation by maintenance of natural or semi-natural vegetation cover. FAO is in a position to gather this information.

In the 1980 assessment, conservation areas and forest reserves were combined into the category "Unproductive, for legal reasons". In assessing the coverage of forested countries by a system of protected areas, this category (now re-named as "Inoperable, for legal reasons") has the potential to be of very great importance as a measure of the proportion of forest set aside for conservation. In practise, however, the category was too vague to be used in this way. With very little extra effort, reporting countries could give details of the sites they include in this category, with an assessment of the level of forest management taking place there. This need not be reported in the assessment publication, for reasons of space, but it would open up the possibility for IUCN to collaborate with FAO in carrying out a detailed analysis of a land-use category that is of growing importance and significance - the conservation of biological diversity and ecological processes.

The 1980 assessment reported deforestation statistics for both productive and unproductive forests. This raises the important problem of illegal deforestation in (theoretically) protected lands. IUCN has urgent need of site-related data on encroachment of protected areas. IUCN's analyses of the efficacy of protected area systems will be reduced to nothing if, in reality, protected areas are being deforested. Would it be possible for reporting countries to indicate where deforestation or logging has taken place inside protected areas? Given this information, IUCN would explore ways to provide technical planning assistance in redressing the problem, possibly by the formation of a buffer zone, providing plantations for fuelwood or building timber, or other means of meeting the needs of the local people in ways that do not threaten the integrity of the reserve.

Data Presentation

In any global analysis there are severe constraints on methodology and presentation caused by the variety of data being compared. FAO has produced, in its first assessment, an unparallelled status report on the world's forests. No doubt future assessments will strive towards greater detail and improved presentation. Two key issues limit the ability of IUCN to utilise the reports: 1) the lack of maps, and 2) the broad categorisation of forest types.

1. Maps

For IUCN's purpose a thorough knowledge of the location of reserves in relation to the main blocks of logged and undisturbed forest, and deforested land, is vital. At the Conservation Monitoring Centre IUCN is gradually adapting its databases to a GIS capacity, with the eventual aim of producing computerised maps suitable for overlay of protected areas, critical unprotected sites and other locations of conservation concern. UNEP, through its GEMS/GRID programme (currently nearing the end of its pilot phase), has been digitising the major vegetation maps of the world, and is increasingly

able to utilise satellite imagery to analyse the status of the world's forests. Any efforts by FAO to collect and prepare maps showing forest distribution, areas of exploitation or deforestation, protected area systems and forest reserve systems would be in step with current IUCN and UNEP initiatives.

2. Forest Categories

Within the category "closed forest" there are numerous forest types of very limited distribution that may be of particular conservation concern. In the Far East for example, these include forest over limestone, kerangas forests and peat swamp forests. Should FAO be able to obtain more detailed forest resource data of this type, even if it is only for certain countries of the world, ways should be explored of disseminating and analysing those data.

In conclusion, I should like to draw attention to a problem that has arisen over the way in which the FAO results have been interpreted in some quarters. The Forest Resources Assessment Project reached two conclusions that have had an over-riding impact on forest resource use planning. Firstly, the large rain forest blocks of the world are not under immediate threat, although their edges are being eroded. Secondly, the main cause of deforestation is agricultural expansion, particularly in Africa and Latin America. In some circles this latter conclusion has given the impression that FAO, with its strong connections to the timber markets of the developed world, is unjustly accusing impoverished, landless people of all the ills affecting the tropical forests, whilst absolving logging companies of any responsibility. Those who have read the FAO reports in detail are aware that this interpretation is incorrect and that FAO repeatedly pointed out that logging irresponsibly creates access to forests for agriculturalists, that logged-over forests are only very rarely managed properly, that logging in stands with high densities of utilisable timber can be particularly destructive, and that cooperation by logging companies in post-harvest treatment is minimal.

Clearly the activities of logging companies and agriculturalists in exploiting forests are closely intertwined, with a need for improved methods and careful planning in both sectors. FAO should continue to report objectively on these problems and, wherever possible, intensify its efforts to find ways of meeting the needs of all those people who depend upon the forest for their livelihood, while avoiding unnecessary forest degradation and deforestation.

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Area Change

by
F. Houllier

In France, area change estimation may be carried out by using two different procedures:

- one is based on global statements resulting from the direct difference of independent successive area estimates (see § 1);
- the second is based on a detailed analysis of land use changes for permanent photo point samples (see § 2).

1 - Global analysis of area changes

1.1 - General remarks

On may 1987 the 1st, the successive results of the 2 survey cycles are available for 59 (over 96) departments, which represent around 3 fourth of french forests.

Since photo point and field plot samples were independent for the first 2 inventories, the changes are usually estimated by the direct difference of successive survey results. The statistical error for area change estimates is therefore higher than the error for area estimates of each inventory.

At the department level, the order of magnitude of the error is around 2% for area estimates and around 3% for standing volume and volume increment estimates. At the national level, a rough approximation indicates that the error is around 0.2% for area and 0.3% for volume and increment.

Between the two successive inventories, some definitions had to be modified. It must also be stated that the time delay between the two cycles varied according the departments, so that national results do not feature the situation at a fixed point of time. On the contrary, they issue from the aggregation of data gathered between 1960 and 1980 for the 1st cycle and between 1977 and 1986 for the 2nd cycle.

All these remarks indicate clearly that rough global departmental or national comparisons (as those of next paragraph) should be carried out and interpreted cautiously.

1.2 - Area change

For the 59 departments which have been surveyed twice, the total closed forest area (exploitable and unexploitable) grew up from 9 969 338 ha to 10 259 675 ha, representing an increment of 290 437 ha (i.e. a relative increment of 3%). Though relatively small, this change is highly significant (but let recall the general remarks of § 1.1).

- In 18 departments, the estimated absolute area change for closed forest was less than 2%; these departments are the following: 01, 04, 18, 21, 26, 30, 37, 40, 47, 52, 53, 57, 58, 69, 70, 71, 79, 88 (see appendix 1).

- The estimated area decreased in 11 departments:
  * either sensibly (more than 10%) in: 32, 46;
  * or feebly (between 2 and 10%) in 9 departments: 10, 16, 17, 29, 38, 55, 64, 82, 89.

- The estimated area increased in 30 departments:
  * either sensibly (more than 10%) in 8 departments: 09, 11, 22, 23, 34, 63, 65, 81;
  * from 4 to 10% in 14 departments: 02, 05, 07, 12, 15, 19, 26, 33, 42, 43, 48, 49, 85, 87;
  * or feebly (between 2 and 4%) in 8 departments: 24, 39, 41, 44, 54, 59, 72, 90.

1.3 - Change in standing volumes

Considering the sole exploitable closed forest estimated standing volume increased sensibly with a 23 % increment: the increment was 25 % for the broadleaved species and 20 % for conifers. The strong increase of broadleaved volume may be attributed to coppices which remained uncut (coppice volume change was + 53 %, while broadleaved highforest volume change was only + 15 %).

1.4 - Change in gross annual volume increment

The mean annual volume increment is estimated as the mean annual increment during the 5 years which precede the survey (diameter bore increment measurements and height increment estimates). It also increased sensibly: + 38 % in the whole with + 34 % for broadleaved species and + 43 % for conifers.

2 - Detailed analysis of area changes

2.1 - Method

This method has been developped and applied in some of the 59 departments, which have already been surveyed twice. Its aim is to complete the global comparison issuing from rough difference of successive area estimates by estimates of area transfers between the different land uses (i.e. to analyse and "explain" the differences stated by using the global method described in § 1).

This method considers every land uses. It is based on a detailed (point by point) comparison, which is carried out on the 2 successive sets of aerial photographs (one set of photos for each cycle; photo points are sampled in the first phase of the inventory):

- photo points of the 1st cycle are located on the photos of the 2nd cycle and reciprocally;
- this is done for all points belonging to closed forest and to other wooded land and for a subsample of points belonging to agricultural and non productive land uses.

These comparisons allow to establish a transition (or transfer) matrix, which provides analytical estimates of area changes (see the following example).

This method is obviously time-spending, but it turns out to be necessary if a detailed analysis and an explanation (at least temptative) are required.

The generalization of the digitalization of forest maps (with a 1 / 25 000 or 1 / 50 000 scale) could be a good but quite expensive tool for solving this problem (such numerized maps are already available for 2 departments and are being established for some others; they could be used for the next survey cycle in order to estimate area changes for land uses but also for forest stand types).

Such maps could also be used to get further details about area changes within forest land use (i.e. from one forest type to another). At this very detailed level the evolution of definitions (implicit and explicit evolutions) and the effect of human classification (maps are drawn from interpretation of aerial photographs) would however limit drastically the apparent accuracy of such estimates.

2.2 - Example

This example concerns the department 48 (Lozere) in central southern part of France. The 2 field inventories were carried out in 1969 and 1979. But the actual time lap between aerial photographs was 14 years (aerial photographs are generally taken some years before field survey).

The following table provides the estimated transition matrix for area changes between the different land uses recorded by NFS service (unit is hectare).

2nd survey / 1st survey	Closed forest	Other wooded land	Agricultural land use	Non productive land and water	Total T1 1st survey
Closed forest	189 800	1 600	600	300	193 300
Other wooded land	12 400	108 000	5 600	300	126 300
Agricultural land use	3 900	6 400	167 000	7 900	185 200
Non productive land/water	0	0	0	13 900	13 900
Total T2 2nd survey	206 100	116 000	173 200	22 400	517 700
$\frac{T2 - T1}{T1}$ (%)	+ 7.2	- 8.2	- 6.5	+ 61.2	

Lines are: distribution of total area at 1st survey (total 1) according to their use at 2nd survey time.
Columns are: distribution of total area at 2nd survey (total 2) according to their use at 1st survey time.

For each land use (i.e. closed forest, other wooded land, ...), the diagonal box provides the area which remained unchanged: it will be furhter noted UA(i)=TA(i,i) (for ith land use).

The other boxes are noted TA(i,j) and contain the estimated transfer of area from ith land use to jth land use.

For ith land use the gains of area are recorded in ith column; their sum is noted GA(i).

For ith use the losses of area are recorded in ith line; their sum is noted LA(i).

$$GA(j) = \text{Sum}\ (\ TA(i,j)\ ) \quad \text{(with i different from j)}$$
$$T2(j) = GA(j) + UA(j)$$

$$LA(i) = \text{Sum}\ (\ TA(i,j)\ ) \quad \text{(with j different from i)}$$
$$T1(i) = LA(i) + UA(i)$$

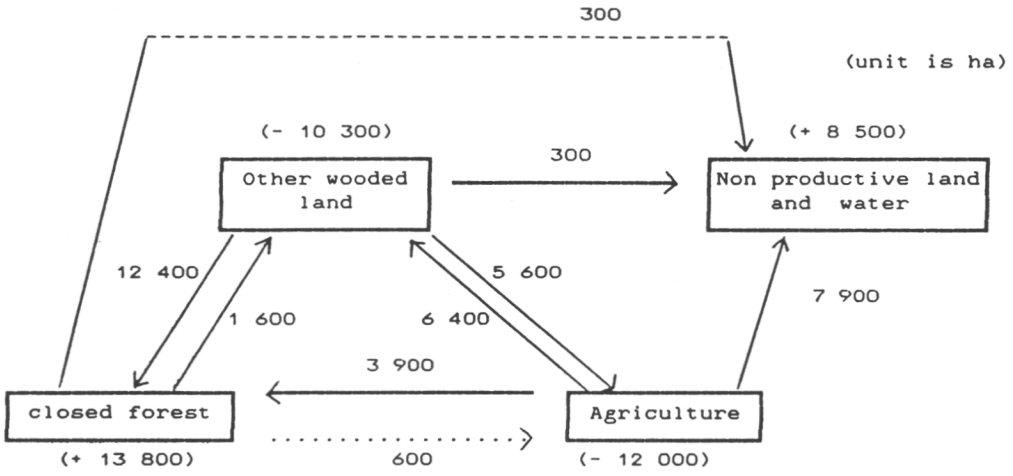
and $T2(i) - T1(i) = GA(i) - LA(i)$

The figures contained in this table are of course subject to sampling variation and also to all uncertainties related to any human classification. This last point affects sharply the "non productive and water land uses", because:

- these uses represent generally a fairly small area (around 2% of the total area of the department in this example);
- the photo interpretation of points belonging to such uses is not subject to any field control.

The order of magnitude of the relative sampling error on T2-T1 is generally around 10% but the uncertainty due to human classification cannot be estimated.

If these sources of variation are neglected, the main tendancies featured by this table may be represented by the following scheme:



Closed forest area increment is mainly due to natural and artificial (i.e. plantations) colonization of other wooded lands and, to a smaller extent, of agricultural lands;

Closed forest extension is partially balanced by losses which benefit mainly to other wooded lands (i.e. deforestation following either clearcuts without regeneration or some accidents like storms or fires) and, to a smaller extent, to agricultural uses.

Assessing Information on Non-wood Products and Services from Forests

by
Klaus Janz

1 Background, history

As long as man has existed he has used the forest in many ways. During very long time he could do so without influencing much on the forest. Therefore he did not either need to bother much about measuring the size of forest resources. But we human beings increased in number and we became more demanding. We started depleting our forests by changing them into agricultural croplands, by letting our domestic animals graze in them and by harvesting increasing volumes of wood. At some time in the last few centuries wood shortage became imminent more commonly in Europe. The need of actively managing the forest resource emerged and with it the need for forest resource inventories. In fact there was a shortage of forest cover for soil protection and for other reasons, as well as a wood shortage, at least in Southern Europe. But as we know the forest resource inventories that were developed and used were almost exclusively concerned with questions related to wood production.

However, environmental awareness grew, leisuretime grew and pollution grew. Sometimes in the 1960s one could notice that both foresters and people in common were increasingly speaking of other roles of forests than wood production. (I say this without forgetting the apparent awareness of many people at much earlier times.) Even politicians and scientists started paying more attention to what we here and now call the non-wood functions of forests. This development was reflected in numerous studies and surveys as well as agricultural and forestry legislation of the last, say, twenty years.

It was quite natural for FAO, with its global coverage, and for ECE to make efforts, at an early stage, in order to include non-wood goods and services in the scope of their repeated forest resource inventories. After a period of thinking and rejecting and new thinking it happened in December 1981. The FAO/ECE secretariat distributed its first Forest Resource Enquiry in which there was a separate part on "The role of the forest in supplying environmental and other non-wood goods and services". The results have been published in 1985 in the publication "The forest resources of the ECE region". Even other international bodies within ECE (the European Conference of Statisticians) and outside have dealt with the non-wood functions of forests or with environmental questions related to forests in general. OECD has carried out a major enquiry on "the State of the Environment" with a separate part on Forest.

Against this background I would like to take up the question where to go in the forest resource surveys carried out by FAO/ECE with our non-wood functions. What is done so far has given us knowledge and experience, but it does not imply any commitments for the future. The field is open for new ideas. There is need for further development and for new thinking. In the process of such developing work many should participate. You are invited to contribute and to communicate your views to the secretariat in Geneva or to me.

It should be said at this point that all I can do here is to give you an account of the experience made and to present my own personal views. What is done so far is quite tentative. There is certainly a need for further development and for new thinking. In the process of such developing work many should participate. You are invited to contribute and to communicate your views to the secretariat in Geneva or to me.

To be specific we could formulate two questions

- what information is needed on the national and on the international level

- how can we make such information available.

2 Type of information needed

Forestry serves many purposes. It produces goods such as wood, berries, game etc and services such as soil protection, recreation, filtering of air and water etc. It is the task of forest policy to ensure that the various functions of the forest are fulfilled in a well balanced mix. What is a good balance depends on the needs for the various goods and services and on the capacity of the forest to produce the same. The needs can be local (fuelwood, greenbelts around a city) or distant (conservation of a rare insect, balance of trade for a nation). The forest policy of which we speek can be an enterprise policy, a national policy or an international policy.

If we can agree upon this basis we can try to derive the information requirements for such a multi-purpose forest policy. It should be mentioned here that our discussion is limited to temperate zone conditions.

A first step should be the identification of major non-wood products and services. The recent study of FAO/ECE has used the following list of functions, which can serve as an identification of non-wood products and services.

1 Recreation, including the picking of berries and mushrooms
2 Hunting and trapping
3 Protection
4 Nature conservation
5 Range, grazing

Country replies suggest that the water supply function be taken up as an additional function. In the study it was included ander protection. Otherwise the experience was good and I have no further suggestions for change.

The next step should be to inducate, for each function, the information required as a basis for management and policy making. Obviously the corresponding information is needed for the wood production function since all functions have to be considered in one context.

Table 1 represents an attempt to list information requirements in a systematic way. Although the approach is theoretic I think there is some value in clarifying our thinking as it is done here. It helps us to make up our mind as to what we should aim at and it may also be a good basis for discussion. But we all know that we are very far from having access to the rather advanced type of knowledge that is asked for in some of the cells of the table.

Table 1. Information requirements within each function of the forests

Validity Variable	Present status	Trends	Prospects	Estimated consequences of specified action
Production = consumption				
Productive capacity				
Needs				

The columns of the table are to indicate that decision makers will need information on where we stand today (status) and on the direction and speed of movement

(trend). Furtheron they will need a synthesis of likely developments in the near future (prospects). Finally there should be evaluations of the consequences of optional action programmes (what will happen if we apply a certain management scheme of policy?).

The lines of the table do basicly ask for actual and potential production and consumption. If we take the first line as an example, we may there ask, how much recreation is produced = consumed at present, what the trend has been, what changes we can expect during the next few years if present trends of urbanization, motorization, income and available leisure time continue, and what will happen in the long run, if our forest management schemes will imply a lower share of forest older than 80 years, if gasoline prices rise significantly etc.

In addition to the information on actual production and consumption it is also important, in certain cases, to have at least indicative information on the potentials, i.e. productive capacities and needs. There may be no production = consumption of soil protection since there is no forest with the capacity to produce it. But there is an urgent need for such protection. This type of information can be entered in lines 2 and 3 of the table.

The examples lead us to what is perhaps the most crucial question: How can we quantify production and consumption of recreation, nature conservation etc? This problem will be dealt with below.

The table is so general in character that it can be applied at all from the enterprise level to the international level. As a modification on the enterprise or local level one may wish to distinguish between local and distant needs or con- sumption. This could apply e.g. to industrial wood, which in most cases serves distant needs and is used to satisfy distant goals such as national welfare and balance of trade. In this meeting, however, we are mainly concerned with the international level. A major justification for the compilation of statistical or other descriptive information on this level is, that policies and conditions of one country will affect the people of or conditions in other countries as well. Examples of such international interdependency may be wood products availabilities and scarcities, international tourism, threatened species of flora or fauna, air and water pollution.

But there is a good reason for an international working group to discuss even national information needs regarding the non-wood goods and services from forests. A group like the Working Party on Forest Economics and Statistics has also the task of promoting the exchange of ideas and experiences and of encouraging positive developments. After all our thinking in this field is rather immature yet, available information is scarce and our inventory methods are rather undeveloped. Therefore I think it is right that we in this meeting also ask ourselves what information needs there are on the national and local level regarding non-wood products and services and how we can fill them.

3 The quantification problem

In the preceding section we assumed that forest policy has to achieve a well balanced mix of the various functions of the forest. When discussing, which information decision makers will need to this end we noted that such information has to be quantified, since the idea is to balance various production goals against one another.

Considering the list of functions that was specified (recreation, nature conservation etc) it becomes obvious that both quantity and quality are important. Taking recreation as an example, quantity can be measured in visitor hours, but the value of the recreation produced depends also on the quality, not only on the number of hours. Nature conservation can to a certain degree be quantified in hectares of national parks and nature reserves. But certainly one hectare does not produce the same nature conservation as the other.

If we are able to assess quantities and qualities of non-wood products and services in hours and hectares and whatever unit it may be in a commonly agreed way, our policy makers will still have difficulties. They have to compare various functions and would - strictly speeking - need quantifications in a uniform unit of measurement for all functions.

Monetary units would fulfil such a requirement, and attempts have been made to express production and consumption of non-wood functions in monetary units. I am sure, however, that our decision makers will be better served, if they get information in the physical terms in which they are originally assessed. The formal uniformity that is achieved with monetary units will lack all reality. If we express production, consumption, capacities and needs in physical units, or even just verbally it will be easier for the users of such information to understand relationships and to accept restraints in relability. With all its lack of uniformity such information can still be used as a background in policy-making.

To sum it up we have noted a need to quantify the production and consumption of various products and services from the forest in some way. This need includes a description of qualities. In my personal view, quantifications should be expressed in physical terms and verbally. In a foreseeable future descriptions in monetary terms will not serve the purpose.

In the recent FAO/ECE enquiry areas were distinguished, in which the various functions of forests have high, medium or low importance. Quantifications were given in the guidelines of the enquiry in order to specify, for each function, what is to be considered as high, medium or low importance.

4 How to assess information on non-wood products and services

Under this heading we can distinguish two problems: One is the assessment of original information in local or regional surveys, the other is the collection of existing information in enquiries such as the one carried out by FAO/ECE in connection with the latest forest resource enquiry for the ECE region.

With respect to the problem of assessing original information there is considerable experience, in certain fields, from studies carried out in recent years. Sometimes there are regular statistical records. There is, however, little homogenity, and most studies cover only minor geographic areas or only certain aspects of one function. If the matter is considered important we would need activities for the exchange of experience within and between countries with the aim to arrive at common approaches as far as this is possible and suitable. It goes without saying that not only foresters should participate in this exchange, but also experts from various interested parties. A major step in developing common approaches would be to reach agreement on a comprehensive view regarding aims and information requirements. One version of what this could look like is the outline I have given in sections 2 and 3 above.

With respect to the problem of collecting existing information in enquiries the ultimate limitation is what exists. Another limitaiton, quite severe in practice, applies specially to international enquiries: Those who prepare the replies do not always know what information exists in the country or in the region covered. This is an administrative problem. To overcome it FAO/ECE has made good experience with country correspondents. These can be of great help provided they are interested, have good contacts, know the context in which the enquiry is made and remain in their function for some time for the sake of continuity.

A practical difficulty is that the relevant information is available in varying form in different countries/regions. Coverage, definitions, class limits etc. may differ. Furtheron, much relevant information cannot readily be put in tables and figures. Therefore, enquiries have to be very flexible and one has to face the workload of compiling heterogeneous replies.

The difficulties can be avoided if the designers of enquiries first find out what information fills the two requirements of being related with the problem and being available in relatively uniform tables and figures and then restrict the queries to such information. There are examples of enquiries in which this approach has been applied. To my mind such enquiries are in the best case worthless. A large part of the information collected is not relevant, and relevant information has not been asked for since it was too troublesome, maybe also because there was no real evaluation of information requirements.

To illustrate what I mean, I will give you two examples of information collected and published in international enquiries covering environmental questions:

- Changes in growing stock since the year 1900 have been asked for and the replies published without further comments. An increase has been shown for many European countries. Is an increase good or bad for recreation, hunting, the protection of a threatened insect, etc.?

- The area of forest reserves and national parks has been shown countrywise without further comments on management prescriptions, aims, needs, etc. Is the country with 25 % of its forests in such reserves doing a better environmental work than the country with only 2 %? Or is the management of normal forests in the 2 %-country so close to nature that no reserves are needed, or ...?

The examples illustrate that international enquiries are no simple task and cannot be based entirely on easily available statistics.

The above-mentioned FAO/ECE-enquiry tried to sort out what is relevant information and faced the difficulties in dealing with such information. It was a first attempt. In certain parts I think the enquiry was successful, however, many questions were not answered.

5 Conclusions

What next? From what I have said we might conclude that the most urgent thing to do is to develop our thinking and to work for common approaches regarding the assessment of original information. Second would be to really collect original information. Such a thing costs of course and should be done only if it is deemed important enough. We can all contribute to the thinking in this field and to the decisions whether or not we should spend money on assessing information about non-wood products and services. And we should contribute, since we need a serious discussion among many parties. Also activitites of our international bodies do have a stimulating effect. One example could be the report of this meeting.

A practical question is what FAO/ECE should do in its next forest resource enquiry sometimes towards the end of the decade. As a follow up to the recent Timber Trends Study (ETTS IV) the FAO European Forestry Commission and the ECE Timber Committee discussed policy consequences for the next two decades. One of the most important consequences identified was that the demand for non-wood benefits will increase faster than the demand for wood.

I believe in this and am convinced that in the forest resource enquiries of FAO/ECE the part dealing with non-wood products and services will take a permanent place. Today I have no ready-made proposals as to how the next enquiry should be designed in this field. And I should not present anything ready either, since the concept described in sections 2 and 3, above, should first be exposed to critical

discussion. Later on, the experience from the previous enquiry should be thoroughly scrutinized and used, together with inputs from other sources, in the preparation of a new version.

Resource Assessment for Predicting Timber Production

by
Kullervo Kuusela

BASIC CONCEPTS AND GENERAL INFORMATION TO BE ASSESSED

The prediction of timber production involves an assessment of the future development of forest resources. The assessment is based on the results of estimations and other information concerning the growth of trees and tree stands on land available for production.

The key variables to be assessed and projected are:

- Area of forest land by site quality classes including possible future changes in site quality.

- Growing stock, its tree-species and timber assortment composition and structure by age and development-stage classes.

- Increment of the growing stock as a result of tree and tree-stand growth processes.

- Drain from the growing stock as a result of timber harvest, silvicultural measures, and natural mortality.

- Past and future management and silvicultural regimes.

Initial resource conditions at the beginning of the projection period refer to the time of the assessment. Resource variables are projected by management periods, each of which usually covers 10 years, in best growth conditions possibly 5 years. In order to quarantee the long term continuity of production, the projection period should cover approximately the time needed to grow tree stands from their stage of establishment to the time of final harvest; i.e., the projection period should cover the average stand rotation.

FOREST LAND

Forest land, expressed in area units, e.g. in hectares (ha), is of a quality suitable for profitable production of timber, and is available for that purpose. The definition of forest land varies according to economic conditions. In Finland, it is of that quality on which the mean annual gross increment of a tree stand under optimum silviculture and with prescribed rotation is at least 1 m3/ha.

For management purposes forest land is divided into site quality classes. Site quality is determined by soil parent material, type of soil, nutrient and water regimes, and climatic variables, e.g. the sum of the effective temperature during the growing period or the number of days in the growing period, and the annual amount and distribution of precipitation. Latitude and altitude are also used as site factors.

Direct methods for the estimation of site quality are usually too expensive in an industry as extensive as forestry. Indirect methods can be based on the ground vegetation, e.g., on the Finnish forest site types, or on the height/age relationship of trees and tree stands.

A method much used in site classification is based on site-index curves showing the relationships between stand age and dominant stand-height at different levels of site quality. The site-quality levels give the potential yield of sites under stands composed of different tree species. E.g., if the dominant height of a Scots pine stand is on the curve of the height-over-age which reaches the height of 28 m at the age of 100 years, the potential yield of the Scots pine stand on this site is a given amount cubic metres.

Such an index, however, should be called a site-stand index and not site index. This is because the potential yield is determined by both the site quality and the tree-stand quality, i.e., the genetic qualities of the stand trees are involved. It should also be kept in mind that the site-stand index can be used only in those conditions where there are established tree stands with undisturbed height development.

Site classification for prediction purposes involves several forest land categories:

- Sites with established tree stands possessing undisturbed height/age relationship.
- Sites with established tree stands possessing a disturbed height/age relationship.
- Sites with seedling stands where height/age relationship has not yet stabilized.
- Sites which are treeless, either regeneration areas or lands to be afforested.
- Sites where quality may degenerate during the projection period. E,g., afforested sites where the nutrient reserves accumulated during treeless period may be exhausted under tree stand.
- Sites where quality can be improved by artificial drainage, irrigation or fertilization.

GROWING STOCK, INCREAMENT AND DRAIN

Growing stock at the beginning and end of the projection periods and increment and drain during the periods can be expressed by the volume of green or dry weight of the total tree biomass or of the part of the biomass being of economic interest. In this paper the unit of measure employed is the stem volume, from stump to the top of trees, over bark (o.b.), in solid cubic metres (m3). The minimum height of trees included in the growing stock volume equals the height at which the breast height diameter (DBH) is measured. Often, the volume comprises the stem from stump to a minimum diameter, sometimes also the branch wood to a minimum diameter.

Whatever the unit used for the growing stock, the same one is also used for increment and drain measurements.

There are two concepts of increment, gross increment and net increment. Gross increment is the total increase of the growing stock volume caused by the growth of trees during a year of a period of years. It includes the volume increase of the trees which belong to the growing stock at the beginning of the calculation period and which grow during the period. Part of them are in the growing stock at the end of the period and part of them are cut or die for natural causes during the period. An additional part of the gross increment is the volume of those trees which exceed the breast height during the calculation period. Their volume can be called ingrowth.

Net increment during a period is gross increment minus the volume of those trees which die from natural causes and are left as natural losses to decay in the forest.

Drain during a period includes the fellings, the volume of those trees which are cut through harvesting and silvicultural measures, and natural losses. Fellings are divided into removals of timber products and logging and silvicultural losses left to decay in the forest.

Growing stock and drain are divided into timber assortments, and logging and silvicultural losses. The sum of timber assortments in drain is called removals.

The following equations are valid during a projection period:

Initial growing stock + gross increment - drain = final growing stock. Drain = fellingts + logging and silvicultural losses + natural losses. Fellings = removals by timber assortments + logging and silvicultural losses. Net increment = gross increment - natural losses.

The structure of the growing stock is described by treespecies composition, age and development-stage class-, etc., proportions.

MANAGEMENT REGIMES IN PRODUCTION PREDICTIONS

Management and silvicultural regimes are a part of the basic information for projecting the stand-wise production of timber. Growing stands composed of trees at all growth stages and sizes have their own regimes. In this paper the main emphasis is on standwise regimes because they are most often used in timber production proper.

The term management regime refers to the combination of tree species and site quality, stand establishment method, thinning sub-regimes and prescribed rotations.

During a projection period new tree stands will be established on different site qualities. There should be advanced specifications of tree-species composition for each site type as well as of stand-establishment methods and silvicultural treatment for the seedling stands. A new stand can be established by natural seeding from existing mature trees, or by artificial seeding or planting. In artificial seeding and planting the origin of the seeds and the qualities of the seeds and plants, improved by breeding techniques, should be known.

The thinning sub-regime determines the stand age at the first thinning and the type, cycle, intensity and weight of thinnings. The type describes the qualitative nature of the treatment, e.g., high or low thinning, etc. The intensity is the average annual volume per unit area removed over a period of one or more thinning cycles. The weight is the volume per unit area removed in a particular thinning. The cycle is the number of years between successive thinnings. Stands of different treespecies compositions on different site types have their own thinning sub-regimes.

The rotation is the length of time between the stand establishment and the final harvest. The length of the rotation depends on tree-species composition, site quality and thinning sub-regime. In the case of regeneration by natural seeding from the mature stock, the new seedling stand is often established under the mature trees harvested in two or more stages and the successive rotations overlap by a number of years.

Stands composed of trees of different ages and sizes are often grown in park and protection forests and possibly in tropical rain forests or in conditions where the trees can not form a closed canopy. The management regime for uneven-aged stands can be specified by the tree-species composition, stem-diameter distribution, growing stock per hectare and size of mature trees.

The management regimes to be applied depend of the function of the forest. If the commodity and timber function dominates, the principal aim is to produce timber and possibly other subsidiary commodities by profitable management regimes. There are conditions where the protective function of forest dominates, e.g., against erosion and avalances. In post-industrial welfare societies, the social function may dominate, i.e., the notion of forest as an integral part of the landscape and of the living, working and recreating environment, or the cultural function including nature conservation and the symbolic and aesthetic values of the forest.

In timber production, the criteria of the management regimes are economic and applicable in the technological and marketing conditions in question. When protective, social and cultural functions increase in importance, other criteria are increasingly taken into consideration.

Whatever the values and aims determining the management regimes to be applied in projecting the production of timber, an absolut rule should be kept in mind, except in the forest reserves to be protected outside all human disturbandes: If the increment of the growing stock is not harvested by man, nature will do it by mortality, thereby jeopardizing the function the forest is expected to carry out.

THE ROLE OF FOREST DAMAGES

During any period of time, trees die from different causes and those dying or dead trees which are not harvested form natural losses decreasing the removals. Therefore the causes of natural losses are of utmost importance to production projections.

In natural forests free of human disturbances, the death of trees is caused by the competition for growing space, i.e., by self-thinning in over dense stands, and by old age. Density limits above which self thinning begins and age limits over which trees start to die are a part of management information.

In addition to stand density and age, the death of trees is caused by insects and pests. The final killing of trees which have lost their vitality through over-density and over-age is caused by these agents. Therefore the susceptibility of tree species to insects and pests, and the probable losses should be known.

Wind throw, snowbreaks, droughts, floods, forest fires, and animals such as elk, deer, moles, etc. cause natural losses which in their "regular" amounts should be a part of production projections. Catastrophic losses are difficult to predict but their possibility should be kept in mind.

The probability of wind throw, snowbreak, forest fire, etc. depends much on geographical, terrestrial and climatic conditions. Therefore information of these variables may be needed.

Finally, there is evidence of increasing damages and production losses caused by the air-borne pollutants, especially in the neighbourhood of energy producing and industrial centres. The composition, amounts and effects of the direct fumes and precipitation of air-borne pollutants are an essential part of basic information for production projections in many areas and countries.

PROJECTION METHODS

From the technical point of view, there are two kinds of projection methods: the tree-stand method and the single tree method. In the stand method, the basic information includes the variables concerning total stands or compartments, or the stand or stand class variables are measured by sample plots.

In the stand method, the stands at different development stages and new stands established by afforestation and regeneration after final harvest are the projection units. In the tree method the individual trees, usually representing a group of similar trees, are the units.

The calculation technique in the stand method is less complicated than in the tree method. In the case of the stand method, the estimates of timber assortments in the future removals are only approximate. With the tree method, the development of stem diameter distributions can be projected and the estimates of timber assortments in the removals are more accurate. There is a possibility to construct functions to convert stand-wise variables into stem diamter distributions and single tree variables. For example, in Finland a tree method based on the results of the national forest inventories is used in projections for regional and national planning purposes and the same method, in applied forms, is used on the basis of standwise information for management planning purposes in the cases of administrational forest units of different ownership categories.

ASSESSMENT METHODS

The number, quality and accuracy of the forest resource variables available for production projections depends on the assessment method. Correspondingly, a projection method anticipates an assessment method which provides the desired information concerning the variables to be used.

A traditional method in yield information, e.g., in the form of yield tables, is to measure sample plots and construct development series of tree stands by tree species, mixtures of species and site qualities. Regular yield information usually excludes disturbing factors such as non-homogeneous sites and stand structures, as well as the effects of forest damages. Therefore they are not representative for large forest areas and they often overestimate production. If used for projection purposes, the yield information should be adjusted by empirical correction factors.

Representative and unbiased information can be obtained by sampling inventories. Even a summarized review of all available sampling methods and designs is not possible in this connection. It must be emphasized, however, that the size and number of sample plots, on which the information is measured and observed, should correspond the statistical accuracy specified.

Temporary sample plots have been used in most of the inventories so far. They can be used to advantage where the periodic increment of sample trees is measurable and where the natural losses are not excessive. Permanent sample plots measured at least two, and preferably more times, would be ideal from the point of view of the production projections. Permanent-plot information includes the actual development of the plot - stands increment, fellings, natural losses and ingrowth. For example, in the current Finnish and Swedish national forest inventories there are both temporary and permanent sample plots. The first remeasurement of the permanent plots will be carried out in the near future.

CASE EXAMPLES OF PROJECTION CONDITIONS AND DATA REQUIREMENTS

To illustrate the data required for production projections, some case examples are now described:

- Plantation forestry at its initial stage. Plantation starts or the planted area is extended. The prescribed rotation is 10 to 20 years.
- Plantation forestry in the stage of a going concern. All land available is planted. Rotation is 10 to 20 years.
- Standwise forestry in the boreal and temperate zones.
- Forest with stands composed of trees of different ages and sizes.

PLANTATION FORESTRY AT ITS INITIAL STAGE

The aim of the resource assessment is to estimate the land area, by quality classes, available for growing trees, as well as to determine the possibilities for improving the site quality under the existing planted stands by artificial drainage, fertilization, irrigation, etc.

Projections of stock development and production are usually made by the stand method on the basis of the planting programme and yield information of the tree stands composed of different tree species on different site types.

Results of the assessment comprise little or no empirical information as to how the tree stands will grow. Prediction is based on the standwise yield information measured under similar conditions. This kind of yield information should be thoroughly checked against assessed information. Assessed variables should include all indicators which might tell how the fertility and drainage conditions will develop under the planted tree stands, and whether the trees have tendencies to insects, pests or other causes of damage.

There have been cases where the site fertility decreases under planted stands or the water resources are insufficient for the stands at the stages of greatest increment. If this happens as a surprise, the resource assessment has been inadequate.

PLANTATION FORESTRY AT THE STAGE OF A GOING CONCERN

All the land available is planted. The oldest stand have been harvested and regenerated. All age classes are represented.

In addition to the data described above, the resource assessment is expected to give information on how reliable the earlier yield-table projections have been, and to give empirical, unbiased bases for the new projections.

STANDWISE FORESTRY IN THE BOREAL AND TEMPERATE ZONE

Conditions may be characterized by the existing growing stock of natural origin, or the stock may be composed of stands established by silvicultural measures. Material for studying the development of tree stands and yields on large land-areas during decades or centuries is available. If the forest area is increasing by afforestation, these new stands represent conditions described above.

Either stand method or tree method can be used in projections. As an example of variables required, the following variables are used in the Finnish Mela-projection system, in which single trees representing groups of trees are calculation units, are assessed:

Tree data:

- number of trees
- tree species
- diameter at breast height
- height
- age at breast height
- age from seed
- height of pruned stem
- type of establishment (natural, seeded or planted)
- sequence number.

Tree stand data:

- time of assessment
- land area
- multiplier from plot area to stand area
- cartographical y- and x-coordinates
- number of stand
- elevation above sea level
- sum of effective temperature during the growing season
- ownership category

- land class
- forest or mire site type
- reduction of site quality due to abundance of stones, paludification etc.
- taxation (site quality) class
- condition of drained peat land
- quality of mire for artificial drainage
- need for immediate regeneration
- time of artificial drainage
- time of fertilization
- time of site preparation
- usability of natural seeding
- time clearance of site after final harvest
- development-stage class BOB
- time of seedling-stand improvement
- time of pruning
- time of last cutting
- stand treatment region
- type of cutting.

Projections so far prepared have covered time periods of at least 50 years. They have been used to study the alternative production of varying levels of intensity of silviculture, forest improvement and harvesting regimes. At the moment, a system to up-date the forest resource assessment on the basis of the earlier assessment and statistics of silvicultural and cutting measures, is being operated. The projections will be compared with the results of the new assessment. Repeated projections and resource assessments are the most reliable basis for planning and executing timber production.

FOREST WITH STANDS COMPOSED OF TREES OF DIFFERENT AGES AND SIZES

For a forest where the stands are composed of trees of different ages and sizes, and where stand treatment comprises simultaneous harvesting, thinning and silvicultural measures, projections can be carried out by the single-tree method described earlier. In tropical and sub-tropical conditions the increment can be measured only by permanent plots and repeated measurements. Tree-wise increment functions will need to be based on the tree and stand variables.

The classical middle-European control method for management and projection purposes is based on repeated enumeration of the growing-stock trees, their stem-diameter series, and harvesting statistics. Results of assessments repeated many times, together with harvesting statistics, are a reliable basis for projections of the future production and development of the growing stock towards its desired state.

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Classification and Definitions

by
J.J. Lowe

1. Introduction

I was asked to present a brief report leading into a longer discussion. This report therefore generalizes rather than provide long lists of examples.

Everything in the report comes from first hand experience, and can be illustrated more completely in response to questions.

2. The Canadian-ECE/FAO Similarity

Most major national forest inventories are based on independent sampling designs.

Canada is a confederation of provinces which are autonomous with respect to resource management. We have elected to produce the national inventory by aggregation of provincial inventories -- this decision has practical, political, and technical advantages, with some technical disadvantages.

Presumably international inventories could in theory use the first approach of independent sampling, but will in fact use the second approach by aggregating from source inventories of each country.

Canada has a history of federal cooperation with provinces to help improve their information; this also applies to FAO and other international agencies in their relationship with certain nations.

Canadian provincial inventories have developed with different needs, resources, approaches, technology and terminology, all fermented with the yeast of chance. As provincial and federal foresters communicate with each other (eg. in the Canadian Forest Inventory Committee, CFIC), as similar modern technology becomes available, and as the inventories become better able to satisfy basic requirements of modern forest management, the provincial inventories tend to become more compatible in terms of product (if not procedure). This process may be slow, but it is a trend and is one that the federal government tries to encourage. Notice that I speak of 'compatibility' rather than 'standardization'. I am sure the international experience will be similar, but starting from larger differences and operating more slowly.

We also recognize that information needs intensify from the top down. A philosophical approach is to ask why, if the provinces do not yet see fit to acquire certain information at their levels, do we need it yet at the national level? A test of how badly we need it might be: how much effort are we prepared to make to help the provinces or to survey by independent sampling? If the extra effort can not be justified one must do the best with the information available, accept holes where certain data do not exist, and limit universal statements to the lowest common denominators. I assume that the same philosophy can be taken from the Canadian to the international scene.

In both situations resource modellers and similar data hungry disciplines must, in the short term, make the best of a bad job. In the mid term they can fill the holes with their own approximations and do sensitivity analyses to show which data are needed most urgently. In the long term they can add their arguments to the quest for better inventory information.

In the next 3 sections I will write in the Canadian context, but I think it can generally be read in the international context. In the last section I will deal specifically with the link between Canadian and international inventories.

3. Terms and Definitions

In Canada we have been quite successful in standardizing forest inventory terms and definitions in English, and most recently with French equivalents. The third edition of Forest Inventory Terms in Canada will be published in both languages as a CFIC-CFS cooperative effort in 1988.

Local usage may differ, but that tends to work out with time.

Definitions are generally not quantified, because the numbers vary with management and utilization practice.

International glossaries of forestry terms were not always suitable expressions of Canadian usage, and in many cases the Committee had to write their own definitions. The French terms and definitions are as approved in Quebec.

Standardization of terms has been given a high priority by the CFIC because it enhances their communication across Canada. It has been extremely helpful in writing specifications for Canada's Forest Inventories.

4. Standardization of Inventory from Autonomous Sources

Certain categories of information are common to most modern Canadian forest management inventories. Not all categories are appropriate to a national inventory. Some categories are appropriate but may not be available from all source inventories, especially from the oldest and least intensive. Such categories may be used with holes in the data, or may be dropped for the time being. Foreseeable client requirements contribute to these decisions.

The national specifications are finally negotiated with the CFIC using standard Canadian terminology. In some cases specifications are not quantified (eg. productive forest is as defined in the source inventory). Other specifications must be quantified (eg. age class) where source data must be allocated to the nearest fit.

Within a province there has usually been evolution of their specifications through several "phases". For each existing phase of inventory in each province a "conversion table" is generated. This is a two-way table that provides the best fit between national specifications and pertinent provincial specifications. The fits are not always perfect, but recognize the realities of the situation. The previous negotiations concerning national specifications were done individually with each province and then ratified collectively by CFIC, so serious misfits do not occur.

These conversion tables are used to guide the recoding of provincial data into the standard national format. They contribute to the documentation of the national inventory and are invaluable for judgment calls on the use of the inventory.

5. Relationship Between Disciplines

Because Canada's Forest Inventory is in a GIS (geographic information system) it is assumed that other disciplines can be overlaid with ease. This is true up to a point, but there are several obvious limitations:

- adjustments must be made where polygons do not coincide;
- the spacial resolution of the product is limited by the coarsest input theme;
- thematic linkage is only possible where attributes are compatible (this applies with or without a GIS).

The 1986 Inventory will be combined with several other themes. Some of these are in the prototype stage and some are only in the planning stage. All are possible to some level of satisfaction. Some examples are:

- acid precipitation;
- forest pest damage;
- forest productivity;
- economic wood supply factors;
- policy constraint on timber harvest;
- stocking levels of 'unquantified' forest (described in the inventory as 'cutover', 'burn' etc.);
- forest regions and sections

Canada's Forest Biomass Inventory (1984) also resides in the Canadian Forest Resource Data System (CFRDS). It is similar in many ways to the 1981 Forest Inventory, but reports biomass rather than merchantable volume. We are exploring ways of reporting some meaningful relationships between the Biomass Inventory and the 1986 Forest Inventory.

6. Canada-ECE/FAO Equivalences

You will recall the 'conversion tables' mentioned in Section 4 to establish the relationship between specifications of the national inventory and each source inventory.

Similarly we will explore and record what specifications are equivalent between Canada's Forest Inventory 1986 and major clients such as ECE/FAO.

With these tables our responses will be consistent until either side changes its specifications.

Note that our responses will vary with time as new editions of data come available, even though the specifications may not change. As I have warned elsewhere, such differences may not be reliable estimates of real change. If estimates of change are required at the national or international level then some completely different type of survey will be required.

Canada will also have difficulty reporting some other topics such as management intensity (however defined) and forest health. It is interesting to note that the cellular characteristics of our national data could provide a sampling framework for themes not presently available.

Some international classification terms and definitions do not seem to fit at all with Canadian usage. 'Closed forest' and 'other wooded land' are the most obvious example; 'productive' and 'unproductive' forest land respectively may prove to be the best fit, but what about temporarily 'non-stocked' productive forest? Further discussion between those familiar with their own specifications is obviously necessary to identify what 'equivalences' are possible and what are not.

Forest Inventory Data Bank (FIDAB) into the Forest Resources Assessment

by
J. Malleux

The lack of an adecuate information system for forest resources, is one of the most serious dificulties wich avoids a good planification and control, of the forestry plans on the developing countries.

The statistical information about forest products, production, logging, wood stock, standing volumen, deforestation, shifting cultivation and others, comes usually form estimations, are frecuently obsolets and, in many cases, full of mistakes; with this source of information is not possible to organice and administrate correctly the developing plans for medium and long terms, the enterprises does not have enough and valid information in order to take decisions, and the govern is frecuently in a enbarrazed situation every time he needs to provide information for local or international agencies.

One field in wich the statistical information is absolutly necesary but, not yet well organized, is the Forest Resources, (land, types, volumes etc). During the last two decades, a considerable number of forest maps at the national or regional level were produced, at the same time the forest inventories at different levels areas, and precisions were executed for every country, but infortunatly, the mayority of this information has been not used for planning propourses and is not well stocked, the diferent methodology utilized for the data registry, process and compilation, and specially the quite differents out puts (data lay out) does not permite to compare, extrapolate and resume this information, so a real system of data stocking

for forest inventory is urgent, in order to sumarize, standarice and stock this information, in such a way that his disponibility were inmediate and complete.

Some countries in the tropical region of South America, are starting compiling the information of forest inventories using microcomputers, as Bolivia, Perú and Colombia, but they don't - have yet a complete methodology for that, and the software are still in way of preparation.

In order to colaborate and support these iniciatives, the Regional Project "Management of Tropical Forest Resources in Latin America" has programed for 87-88 a project for compiling and stocking the information from forest inventories, and to prepare a project for a Data Bank for forest inventories information, this activity was programed for Bolivia, Colombia , Ecuador, Perú y Venezuela.

The system of the Data Bank will be stablished once the data were collected, sumerized and stocked, so the procedure will be as follows :

1) Collection of forests inventories repports.
2) Summary of repports, according to a standarized form.
3) Data registry in diskets, using a special program.
4) Development of a data treatement program, for out puts or displays.

Attached figure, shows the scheme of the operating system.

The data to be registered, is shown in the attached form, which represents the summary of all the main information, interesting for the forest inventory data bank.

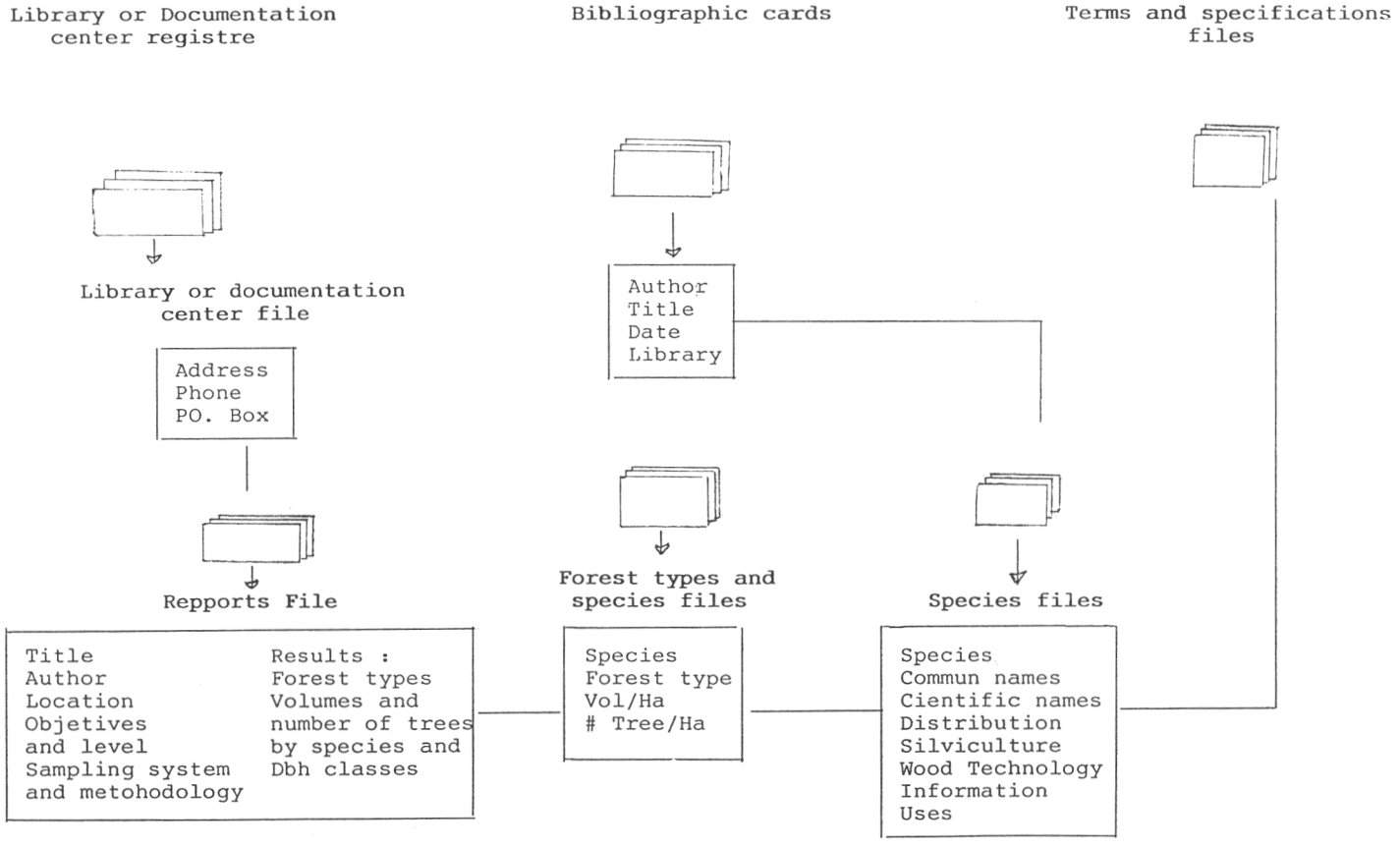
The other objetive of this project is to improve the data collection itself, that means the way or procedure how the data is collected in the field, and how in must be procesed or - treated before it were introduced in the data bank, for this propuse two activities are programmed :

1) Improvement and standarization of sampling methods, including capacitation.
2) Improvement the Forest Inventory Data Procesing System, using computers and better statistical procedures. This activity includes the promotion of the FIDAPS, adapted to microcomputers.

Finally, the project goal is to prepare, if possible, a regional project for operating the nationals Data Bank systems and to stablish a regional network for forest resources information.

October, 1987

FOREST INVENTORY DATA BANK
OPPERATIONS SYSTEM



FORMATO ESTUDIOS DE RRFF

CODIGO DEL TRABAJO

TITULO DEL TRABAJO

EJECUTOR(ES)

INSTITUCION

AÑO PAGINAS CLASE DE TRABAJO BIBLIOTECA

UBIC. POLITICA: REGION(ES) DPTO(S)

PROVINCIA(S)

UBIC. CATASTRAL: BLOCK(S)

ENTRE Latitud Longitud Y Latitud Longitud

ALTITUD de a m.s.n.m. SUPERFICIE Has.

ZONAS DE VIDA

TIPOS DE BOSQUE ESTADO DE P.

CARTOGRAFIA - Esc 1/ Año - Esc 1/ Año

(usada) - Esc 1/ Año - Esc 1/ Año

- Esc 1/ Año - Esc 1/ Año

DISEÑO DIAM. MIN. cm

UNIDAD DE MUESTREO Has. No. MUESTRAS TAMAÑO MUESTRA Has.

INTENSIDAD %

RESULTADOS

VOLUMEN (m3/Ha) Y NUMERO DE ARBOLES/HA

VALOR COMERC.	(80 cm-mas) Vol	#	(41-80 cm) Vol	#	(21-40 cm) Vol	#	(menor 20) Vol	#	TOTAL Vol	#
ALTO										
MEDIO										
BAJO										
POTENC.										
OTROS										
TOTAL										

OBS.

INICIALES FECHA

FORMATO OCURRENCIA DE TIPOS DE BOSQUES

CODIGO DEL TRABAJO

VOLUMEN (m3/Ha) Y NUMERO DE ARBOLES/HA

TIPO BOSQUE	(80 cm-mas) Vol	#	(41-80 cm) Vol	#	(21-40 cm) Vol	#	(menor 20) Vol	#	TOTAL Vol	#

8.- 15 ESPECIES DE ALTO VALOR COMERCIAL

VOLUMEN (m3/Ha) Y NUMERO DE ARBOLES/HA

CODIGO ESPECIE	(80 cm-mas) Vol	#	(41-80 cm) Vol	#	(21-40 cm) Vol	#	(menor 20) Vol	#	TOTAL Vol	#
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

FORMATO OCURRENCIA DE ESPECIES

CODIGO DEL TRABAJO

A.- 25 ESPECIES MAS ABUNDANTES

VOLUMEN (m3/Ha) Y NUMERO DE ARBOLES/HA

CODIGO ESPECIE	(80 cm-max) Vol	#	(41-60 cm) Vol	#	(21-40 cm) Vol	#	(menor 20) Vol	#	TOTAL Vol	#
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
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21										
22										
23										
24										
25										

RELACION DE LAS 100 ESPECIES MAS ABUNDANTES (EN ORDEN DE ABUNDANCIA) EN EL TROPICO HUMEDO PERUANO (SELVA CENTRAL)

No. de Orden	NOMBRE COMUN	NOMBRE CIENTIFICO	FAMILIA	No. Arb./ Ha
1	SILIMBILLO	Inga nuiziana	Mimosaceae	3.87
2	SAPOTE	Quararibea cordata	Bombacaceae	3.86
3	CUMALA	Virola sp.-Iryanthera sp.	Myristicaceae	3.38
4	CAIMITILLO	Pouteria sp.	Sapotaceae	2.81
5	MACHIMANGO	Eschweilera sp.	Lecythidaceae	2.54
6	MOENA		Lauraceae	2.52
7	REQUIA	Guarea guidonia	Meliaceae	2.48
8	CHIMICUA	Pseudolmedia laevis	Moraceae	2.29
9	MASHONASTE	Clarisia racemosa	Moraceae	2.21
10	COPAL	Protium sp.	Burseraceae	1.76
11	UBILLA	Pourouma cecropiaefolia	Moraceae	1.70
12	PASHACO	Schizolobium sp.	Mimosaceae	1.67
13	SHIRINGA	Hevea sp.	Euphorbiaceae	1.55
14	CARAHUASCA	Guatteria sp.	Annonaceae	1.37
15	HUAMANZAMANA	Jacaranda copaia	Papilionaceae	1.08
16	MACHIN ZAPOTE	Quararibea bicolor	Bombacaceae	1.03
17	CHONTAQUIRO	Diplotropis sp.	Papilionaceae	0.96
18	MAQUISAPA	Apeiba membranacea	Tiliaceae	0.90
19	CETICO	Cecropia sp.	Moraceae	0.89
20	CAIMITO	Pouteria sp.	Sapotaceae	0.89
21	CACHIMBO	Couratari sp.	Lecythidaceae	0.86
22	QUINA QUINA	Pouteria sp.	Sapotaceae	0.76
23	ZANCUDO CASPI	Alchornea triplinervia	Euphorbiaceae	0.75
24	QUILLOBORDON	Aspidosperma vargasii	Apocynaceae	0.71
25	CATAHUA	Hura crepitans	Euphorbiaceae	0.69
26	TUSHMO	Pouteria sp.	Sapotaceae	0.64
27	SHIHUAHUACO	Dipteryx alata	Papilionaceae	0.63

2.-

No. de Orden	NOMBRE COMUN	NOMBRE CIENTIFICO	FAMILIA	No. Arb./ Ha
28	MARUPA	Simarouba amara	Simaroubaceae	0.60
29	ESTORAQUE	Myroxylon balsamum	Papilionaceae	0.59
30	RENACO	Ficus sp.	Moraceae	0.58
31	PALTJIL RURO	Celtis schipii	Ulmaceae	0.58
32	TORNILLO	Cedrelinga cateneaeformis	Mimosaceae	0.57
33	QUINILLA	Manilkara bidentata	Sapotaceae	0.54
34	SACHA UBILLA	Coussapoa sp.	Moraceae	0.53
35	TANGARANA	Triplaris sp.	Polygonaceae	0.53
36	ALMENDRO	Caryocar glabrum	Caryocaraceae	0.53
37	COPAIBA	Copaifera reticulata	Caesalpiniaceae	0.51
38	SAPOTILLO	Quiáaribea sp.	Bombacaceae	0.49
39	LUPUNA	Chorisia integrifolia	Bombacaceae	0.48
40	URCO SHIMBILLO	Inga sp.	Mimosaceae	0.48
41	CASCARILLA	Cinchona, ladenbergia	Rubiaceae	0.47
42	HUAYRURO	Ormosia sp.	Caesalpiniaceae	0.45
43	YACUSHAPANA	Terminalia sp.	Combretaceae	0.45
44	HUIMBA	Chorisia sp.	Bombacaceae	0.45
45	UCHUMULLACA	Trichilia quadrijuga	Meliaceae	0.39
46	TAMAMURI	Brosimum lactescens	Moraceae	0.39
47	LECHE CASPI	Couma sp.	Apocynaceae	0.39
48	SHIRINGA MASHA	Sapium sp.	Euphorbiaceae	0.37
49	ANONILLA	Annona sp.	Annonaceae	0.36
50	CAUCHO MASHA	Sapium sp.		0.34
51	PACHO	Aspidosperma sp.	Apocynaceae	0.34
52	YUTUBANCO	Heisteria sp.	Olacaceae	0.34
53	CEPANCHINA	Sloanea sp.	Elaeocarpaceae	0.34
54	PALISANGRE	Pterocarpus sp.	Papilionaceae	0.32
55	APACHARAMA	Hirtella sp.	Chrysobalanaceae	0.32
56	HUALAJA	Zanthoxylum sp.	Rutaceae	0.27

3.-

No. de orden	NOMBRE COMUN	NOMBRE CIENTIFICO	FAMILIA	No. Ark./ Ha
57	TAMARA	Leonia glycycarpa	Violaceae	0.27
58	HUINGO CASPI	Buchenavia sp.	Combretaceae	0.27
59	MOENA AMARILLA		Lauraceae	0.26
60	CUMALA BLANCA	Virola sp.	Myristicaceae	0.26
61	TAHUARI	Tabebuia sp.	Bignoniaceae	0.24
62	LUPUNA COLORADA	Cavanillesia hylogeiton	Bombacaceae	0.24
63	PASHACO BLANCO		Mimosaceae	0.24
64	CAPIRONA	Callycophyllum spruceanum	Rubiaceae	0.24
65	UBOS	Spondias mombin	Anacardiaceae	0.23
66	OJE	Ficus sp.	Moraceae	0.21
67	CAPINURI	Naucleopsis sp.	Moraceae	0.21
68	OROPEL	Erythrina sp.	Papilionaceae	0.20
69	ESPINTANA	Oxandra xylopioides	Annonaceae	0.20
70	HUACAMAYO CASPI	Sickingia sp.	Rubiaceae	0.19
71	PACAYA COLORADA		Mimosaceae	0.19
72	CUMACEBA	Platimiscium sp.	Papilionaceae	0.19
73	CUMALA COLORADA	Iryanthera sp.	Myristicaceae	0.18
74	PALOMETA HUAYO	Protium sp.	Burseraceae	0.17
75	CHUCHUHUASI	Heisteria sp.	Olacaceae	0.17
76	AGUANO MASHA	Huberodendron sp.	Bombacaceae	0.16
77	CEDRO	Cedrela odorata	Meliaceae	0.15
78	MACHETE VAINA	Bauhinia sp.	Caesalpiniaceae	0.14
79	PINO	Alseis peruviana	Rubiaceae	0.14
80	BELLACO CASPI	Himatanthus sp.	Apocynaceae	0.14
81	PUNGA	Pachira sp.	Bombacaceae	0.14
82	ACHIOTE CASPI	Bixa platycarpa	Bixaceae	0.14
83	CHARICHUELO	Rheedia floribunda	Guttiferaceae	0.14
84	YANCHAMA	Poulsenia armata	Moraceae	0.13

4.-

No. de Orden	NOMBRE COMUN	NOMBRE CIENTIFICO	FAMILIA	No. Arb./ Ha
85	YAMBO PASHACO		Caesalpiniaceae	0.13
86	BALATA GOMOSA	Pouteria sp.	Caryocaraceae	0.12
87	ISHMA MOENA		Lauraceae	0.12
88	PASHAQUILLO		Mimosaceae	0.11
89	CAUCHO	Castilla ulei .	Moraceae	0.11
90	PALO PAPAYA	Jacaratia digitata	Bombacaceae	0.11
91	TANGARANA NEGRA	Triplaris sp.	Polygonaceae	0.10
92	ANONA DEL MONTE	Annona sp.	Annonaceae	0.10
93	AZUCAR HUAYO	Hymenaea sp.	Caesalpiniaceae	0.10
94	PUMAQUIRO	Aspidosperma macrocarpon	Papilionaceae	0.10
95	LAGARTO CASPI	Calophyllum brasiliense	Guttiferaceae	0.10
96	PASHACO NEGRO		Mimosaceae	0.10
97	ALCANFOR		Lauraceae	0.10
98	ATADIJO	Trema micrantha	Ulmaceae	0.10
99	CARAPACHO		Euphorbiaceae	0.09

OTRAS ESPECIES DE INTERES ECONOMICO

NOGAL	Juglans neotropica	Juglandaceae	
CAOBA	Swietenia macrophylla	Meliaceae	0.02
BOLAINA	Guazuma crinita	Tiliaceae	0.03
CASTAÑA	Bertholletia excelsa	Lecythidaceae	0.09

Assessment of Woody Biomass Changes in Forestland

by
J. Malleux

The concept of biomass is relatively new related with the tropical resources; we know something about the commercial woody volume or about the total standing volume but very little about biomass (in terms of volume or weight), so we know much less about changes in biomass.

Changes in biomass van be evaluated as quality or quantity changes, but usually we are evaluating only the quantitative one without paying attention to the qualitative problems. The reasons or factors influencing the changes are several; some are well known and others are less studied, in summary the more important are:

A. Reducing the quantity or quality of biomass
   1. Deforestation for shifting cultivation and grazing
   2. Commercial exploitation (selective exploitation)
   3. Erosion
   4. Diseases
   5. Drying problems
   6. Forest fire

B. Increasing the biomass
   1. Reforestation or plantations (very limited compared with deforestation)
   2. Natural growing or natural regeneration (very slow and low quality)

   in both cases the management is absent

According to the ecological conditions of the different zones, these factors have also different impacts.

The savans or open forest formations, represent the lower level of woody volume or biomass, and are much more sensitive to any factor and, in some cases, are affected by some factors that do not occur in rain forest formations, for instance fire and drying problems. The situation of the rain forest is different, in this case the fire and drying are not so important but the deforestation is the most important.

The modifications or changes of woody biomass can be work in both directions, the vertical and the horizontal; the vertical changes are a consequence of a degradatory process which reduce the stock or volume of the high stratas, due to the selective cuts, the weakness of the soil eroded, or simply by the loss of natural regeneration capacity of the vegetation, becoming more and more low productor of biomass, or by the total elimination of some species belonging to the height canopy. The horizontal changes are represented by the changes in area and density, the first one is due to deforestation, over exploitation or fire; the second one is due to over exploitation, selective exploitation and diseases.

Both, the vertical and horizontal changes produce modifications in terms of quality and quantity, according with the conditions in which each one is presented.

The quantitative changes are the most known and, several studies in this respect have been done in different areas, in some cases with very accurate results and, a balance of the actual stock of woody biomass is possible to carry out in a relatively simple way, regarding losses and gains (income) as show in the attached table.

The changes due to the shifting cultivation are without doubt, the most important and the most dangerous ones, a general estimation of that, at the regional and country level has been made by the FAO/UNEP project, estimated for 1980 and projected to 1990; but the problem still remains in the lack of complete and performant methodology for following or monitoring this process, some efforts are in the way but the results are not yet definitive. For the rain tropical forest the estimations give averages between 1.0 to 1.5 ha. deforested per family and per year.

The over exploitation for sawn wood or fuelwood is other of the main problems but it is more problematic in semi-arid zones, where the loss of biomass and the degradation of extensive areas takes out more than 2 or 3 cubic meters for

ha/year (5 to 10 % of the biomass), creating great trouble for the biomass stock. The case of the rain forest is different, the actual average of exploited wood for sawing or fuelwood is more or less 3 cubic meters/ha/year, which represents only 1 % of the total biomass.

The forest fire is present in almost 100 % of the forest area in the semi-arid and arid zones, in some cases does not destroy the total standing volume or biomass but a great quantity of wood is consumed by fire, especially the natural regeneration; in wet areas the fire is not dangerous for the wood stock, but it is for the quality of the soil and the environment into the shifting cultivation process.

Diseases are probably the less known factor affecting the woody biomass, in natural forest it is not important (so far) because of the accurate stability of the vegetation mass, but in forest plantation it is the most important problem.

Diseases are affecting more the quality of wood, instead of the quantity, according to some studies and estimation done in Peru, approximately 5 % of the commercial volume is affected by disease problems.

We can say that all factors are creating important changes in the quality of the biomass like fire, diseases, selective exploitation, soil degradation, etc. so the problem of woody biomass changes are not only related with the quantity of wood but specially with the quality, while we will not be able to solve this problem, through the management, silviculture and genetics.

What can we do in order to solve or at least to reduce the negative impact of these factors?
Very little has been done so far, but the best way to how to avoid these problems is to demonstrate that forest biomass is economically much more important than the people and the government think. Some practical activities we can develop are:

- management and improvement of the forest fallow and exploited areas
- monitoring of deforestation/degradation problems
- permanent and continuous forest resources assessments
- organization of forest resources information

			Million m^3
INCOME			
- Plantations F.	2050 ha x 20 m^3/ha/year		41
- Natural growth or regeneration	106'431 ha of forest fallow x 10 m^3/ha/year		1,064
		TOTAL	1,105
LOSSES			
- Fuelwood and charcoal			345
- Rural housing and local uses (*)			160
- Commercial exploitation			90
- Reforestation (shifting cultivation) (4' ha x 300 m^3/ha)			1,200
		TOTAL	1,795
STOCK			
- Close forest			89,662
- Open forest			8,590
- Fallow			3,725
		TOTAL	101,977

BALANCE

- 1795 + 1105 = - 690
  Deficit annual = 690 m^3
  Actual stock = 101,977
  Annual rate of losses = 0.676 % with a 3.0 % increment for year

(*) Estimation

Compatibility among previous Assessments and Proposals for 1990

by
Luis Carlos Molina

Any methodological proposal for classifying area and volume of tropical forests should take previous work, the users' requirements, trends, methodology and current technology for this type of assessment into account, as well as information available in the region for this purpose.

Some general considerations, such as topics for discussion that may later contribute to establishing a methodology, are presented below:

1. Basic documents considered

Basic documents that are indispensable are:
- Tropical forest resources FAO-PNMA 1983
- Format and Guidelines for collection of data for forest resource assessment - Asia - Pacific Region (Field Document 3 FAO, 1986).

A rapid study of these documents brings up the subject of the compatibility that should exist between methodology to be used and background. The first study includes in its short and long term objectives the initiation of monitoring activities on tropical forest cover, definition of a methodology and the necessary means for a continuous updating of this first assessment, objectives that complement those of this meeting, which intends to establish methodological bases for estimating changes in tropical forest areas since 1980, assess the extent of forest degradation and improve base line data from 1980.

2. Trends, needs and current methodology for assessing tropical forest resources

Tropical Forest Resource Assessment

The forest assessment of tropical forests in Latin America tends to take place within the concept of land evaluation which implies an integrated analysis of information obtained; for example, data from forest inventory as such (stock enumeration), categories and types of vegetation, classification and types of terrain, types of soil and fertility rating and land use classification, as well as in terms of infrastructure (use, ownership and access to location).

Assessments carried out within this framework allow for a response to urgent information requisites in order to make decisions and establish policies in the field of forestry.

3. Cartographic Base and Cartographic Synthesis

Forestry and vegetation assessment based on compiled reports using different methodologies, present serious difficulties, in addition to a considerable lack of precision, and it is therefore, convenient to base regional or global assessments on results obtained from cartographic compiling of studies done on a national or regional basis.

Taking into account that almost all of the tropical countries in this region have vegetation, land use, forest and ecological maps, a standardization of scale could be recommended for the compiling and publication of forest maps.

A recommendable scale for compiling national maps would be: 1:500,000 - 1:1,000,000 and for publication from 1:1,500,000 to 1:2,000,000. Lesser scales do not provide reliable and useful information on a national basis.

Results from classification of forest types and land use obtained in this way would facilitate updating and monitoring in a systematic and automatic way.

Likewise, the cartography obtained in this manner could be digitalized, thus facilitating application of a geographic information system for joint analysis of forest assessment results.

Cartographic synthesis could be presented on a scale of 1:4,000,000 - 1:5,000,000, which are scales that may not provide sufficient information for technicians or decision makers, but are valuable for stimulating national activity and in providing a framework and a methodology.

Use or remote sensing techniques

Remote sensing technology for purposes of forest assessment are well known and considered to be an indispensable tool that is widely applied. Likewise, the process of visual interpretation of images for estimating areas and forest inventory is a well developed technique. Digital processing and classification of tropical forest images is undergoing development, and important applications have already been achieved.

The SPOT and LANDSAT (TM) remote sensing systems currently operating allow for monitoring of forest resources in an efficient way with temporal, spatial and spectral resolution adequate for this activity.

In the short term at least, radar imagery, from satellites is perhaps the most useful remote sensing technique for continuous monitoring of tropical forests, principally in areas with harsh climatic conditions. Aircraft radar systems such as SLAR, in spite of their geometric improvement and spatial resolution, have limited monitoring usage given the high cost.

Area and volume classification criteria

The considerations that are presented below are limited to the results of a preliminary analysis of indispensable information and comparison with the results of forest assessment in Colombia and other Andean countries.

Available reference work prepared by the FAO mentioned above has been the basis for the concepts expressed below, which, of

course, require greater depth and clarification based on the results of joint work that will be done during this meeting.

Classification of natural lumber vegetation (FAO 1982) following UNESCO classification guidelines has a fundamentally physionomic structure with supplementary ecological information integrated into the different categories. It is a little known system in tropical Andean countries and for this reason the results of national forest assessments carried out make an adaptation to the global system difficult.

Comparing the FAO (1982) study with the FAO proposal (1986) "Format and Guidelines for Collection of Data for Forest Resource Assessment" (Pacific Asia Region) and some existing studies on the region (Latin America) it can be concluded that:

- It is possible to use these guidelines for forest assessment of areas on a national and regional level in tropical America. The tables and charts proposed may be used with some slight complementation, variation and clarification.

In order to follow an orderly sequence in commenting on the FAO proposal (1986) for Asia-Pacific the same order of presentation used in Chart A will be followed.

Land use categories

It would be convenient to add a new category to the division of LAND AREA that corresponds to special types of vegetation in order to group within this category graminoid highland vegetation, swamp, arid and/or dry zones, deciduous shrub, sub-desert and desert shrub, colonization areas and shifting cultivation.

Chart B: Forest and vegetation types.

- A new type of vegetation should be included within the proposed divisions in order to group special formations such as: savannas, shrub savannas, graminoid savannas, coleria wood savannas and arboreal shrub savannas.
- In the part that corresponds to forest, it would be convenient to establish sub-divisions according to altitudinal levels.

For example: Basal level forests (0 - 1000 m.s.n.m.)
Andean level forests
Premontane (1000 - 2000 m.s.n.m.)
Montane (2000 - 3000 m.)
Andean (greater than 3000 m.a.s.).

Within each altitudinal level a sub-division can be established according to climatic factors. For example, three categories - hygrophytic, mesophytic and xerophytic.

Chart C: Forest management classes.

The class called OPERABLE could be sub-divided into sub-classes according to the type of relief of physiographic region, given that this information is important with regards to management and utilization, in addition to the fact that almost all

the classification systems in the Andean countries include these concepts.

Chart D: Forest Plantation.

In addition to the growth classification, a sub-division of relative age classes could be included. For example:

- Young - up to 5 years
- Middle age - 5-15 years
- Mature - more than 15 years.

Adjustment of UNESCO Classification FAO 1982 Report for Tropical America

Without pretending to present definitive changes in the classification of vegetation types and areas, some suggestions are presented for discussion:

- To group the tropical ombrophilous lowland forest types under a single name: Basal level ombrophious forests (0 - 1000 m.s.n.m.) thereby quantifying the concept of "lowland" and grouping together all types of forest corresponding to that level.
- To establish more closely defined climatic limits according to regional parameters. For example:

  Ombrophilous tropical forest of a pluvial basal level (precipitation over 6,000 m.m.)
  Ombrophilous tropical forest of a very humid basal level (4,000-6,000 m.m. precipitation)
  Ombrophilous tropical forest of a humid basal level (2,000-4,000)

- For mesophytic and xerophytic formations the same system could be followed, including them within the basal level.
- To include graminoid formations found in tropical America in the basal level under the name of savanna with its respective type.
- To include a separation in the sub-classes according to physiographic regions.
- Similar treatment could be given to the montane and sub-montane divisions.

Volume classification

- Volumes can be classified based on the categories established in FAO work from 1982-1986 expressed according to average commercial volume per hectare by type of forest and occupied surface.

  It is convenient to include the volume of the corresponding grouping in the commercially valuable species in order to have a general idea of forest potential from the exploitation point of biew.

Scope and Methodology of TFRA

by
Marcio A.R. Nahuz

The scope established for the 1980 assessment of forest resources covered a great number of information needs, particularly in the tropical countries. The proposed scope for the 1990 tropical forest resources assessment reflects the adequacy of the 1980 assessment framework and incorporates substantial improvements.

It would therefore be presumptuous of me to suggest any major changes since, as we say in all football-loving countries, "one should not change the team that's winning!".

However, as a contribution, I would like to comment on some points:

Volume data

* VOB defined as volume overbark of all species up to 10 cm dbh is likely to underestimate the actual commercial volume since industrial raw-material, particularly that originated from man-made forests, includes material of up to 7 cm dbh.

* VAC (Volume actually commercialized) will remain difficult to estimate since these are not always accurately reported, to avoid taxation.

* Woody biomass above ground estimates represent a major improvement since few inventories so far have been able to supply such data, which are increasingly on demand, especially in the tropical countries which rely so much on wood as a source of energy. The methodology though can be tricky: either the interaction of multispectral bands of MSS LANDSAT images to determine a vegetative index is called for or extensive equation and correlation work will have to be done.

Change data

* Area deforested in natural forests is definitely one of the most important parameters to be assessed. A 10-year interval however seems to be too long, especially in countries such as Brazil, in which deforestation rates have reached 1.64 million ha per year between 1975 and 1978, and 2.13 million ha per year between 1978 and 1980.

* Still under change data on natural forests, it would be desirable that the 1990 TFRA looked into the natural regeneration of areas which have been logged-over or abandoned in the process of shifting cultivation. Such segregation would require new technology to classify forest covers in relation to density and alteration.

* Forest degradation, either by fire, fungal or insect attack, and atmospheric pollution, threatens not only the supply of forest products and services but also the protective role the forests play toward communities, soil and watersheds. As such, forest cover degradation should be closely monitored, especially in areas which show a tendency to desertification. Would these aspects be contemplated under Forest Degradation Risk?

* Forest plantations are practically the only means of forest accretion and as such are duly contemplated in the 1990 TFRA, in six utility and 5-year age classes. Considering that in a number of tropical countries, coniferous industrial plantations may include both fast growing trees such as pines, and slow growing genera such as Araucaria, it would be desirable to recognize such differences.

  A further suggestion would be to treat plantation by genera since species might be not too easily separated in satellite images, e.g. Eucalyptus grandis, E. saligna and E. urophylla, and some of the tropical pines.

Finally, a last suggestion in terms of general methodology would be to procure and use data from the existing forest inventory reports, publicly or privately carried out, to provide information on species occurrence and distribution, total or commercial volumes or any other available data. Properly treated, these forest inventories would play the role of sampling units in the Global Forest Resources Assessment.

UNEP's Role and Activities in Management and Conservation of Tropical Resources

by
G. Naumov

The Problem

Even though the depletion of forest cover is not a recent problem and some regions of the world have seen their forests heavily reduced in the previous centuries (Europe, China, North America) the situation of the forests in tropical countries has been aggravated in the last few decades.

Without counting the effects of acid deposition in temperate forests which has affected more than 50% of the forest cover in some European countries, tropical forests alone are being depleted at an average rate exceeding 11,000,000 ha. per year with unmeasurable consequences in genetic losses, soil degradation, flooding, disruption of economic development alternatives and immediate social effects.

From mangroves protection in the coastlines to highlands forest ecosystems, they provide a wealth of goods and services of which timber and firewood are only a minor proportion of their contribution to human welfare. At the global level, environmental significance of forest cannot be underestimated (reference to the global level significance of forests)

The continuous degradation or destruction of this complex ecosystems will affect soils, climate, the genetic banking capacity of the system, the

access to its products and "decapitalize" mankind. Some countries are depleting their tropical forests at rates reaching as high as 4.5 to 7% per year which means that they will lose their resources in less than 15 to 25 years if pressure is maintained.

Tropical forests, including "closed forests", "open forests", shrubland, and "forest fallow" - areas cleared for agriculture and in various stages of re-growth - cover merely 3,000 million hectares world-wide. An area roughly equivalent to about one-fifth of the worlds closed and open tropical forests has been cleared for shifting cultivation over the past tenty years. In tropical regions, deforestation rates have exceeded reforestation by 10 - 20 times in recent years.

In Brazil, for example, only 2% is left of the original Atlantic coastal forests - the "Mata Atlantica" and the State of Sao Paulo has lost more than 95% of its forests in little more than one century.

The international trade of the few selected species currently marketed are producing urgently required hard currency to several developing countries such as Malaysia, Indonesia, Gabon or Cote d'Ivoire, reaching annual volumes of export of 1,378 million cubic meters per year in Gabon out of a total production of 2,706 million (industrial wood + fuelwood and charcoal).

Cote d'Ivoire exports 2,156 million out of 12,190. The biggest exporter of tropical forest wood products is still Malaysia with a figure of 17,245 million cubic meters out of a total production of 40,212 million, that is 16.66% of the world exports of tropical industrial wood exports and 4.15% of fuelwood and charcoal. (Canada, to compare, produces a total volume - non-tropical - of 161,005 million cubic meters, exports 5,739 million and imports 4,127 million).

Most of the world forests are not consciously managed for the sustained production of timber or for any other purpose. Management plans covered about 1 billion hectares in 1983.

Developing countries manage less of their forests than developed countries do. Of 1.2 billion hectares of tropical closed forests in developing countries only 42 million hectares (4.7 per cent) are under some level of management.

Planners and developers are still considering tropical forests as marginal lands and do not have sufficient elements for assessing its real value in the short and long term. Farmers are still needing more or new lands for their crops and floods, fires and pests are still destroying important areas.

The increasing global concern on the situation of tropical forest ecosystems has found its expression in a long series of national and international initiatives involving several UN organizations and international bodies such as FAO, UNCTAD, UNESCO, IUCN, IUFRO, WRI, UNDP, the World Bank and many others.

UNEP's role and activities in tropical forests management

Since its inception UNEP initiated action in forest ecosystem, forest resource assessment and management, conservation of genetic resources, and wildlife and protected areas which were based on the Stockholm Conference mandate and on future UNEP Governing Council decisions. Its action has normally been developed in close coordination with other UN bodies; specialized organizations and governments, as well as with a series of NGOs.

In 1973 a project with FAO set the base for the formulation of Tropical Forest Cover Monitoring which was later on followed by the forest cover assessments of Togo, Benin and Cameroun. This was further developed into the Tropical Forest Resources Assessment published by FAO and UNEP in 1981 and which still constitutes the most comprehensive global assessment available.

The FAO/UNEP assessment surveyed the moist tropical forests of 76 countries on a national basis. This seemed the best approach at the time (1978-1980), since virtually all available data were expressed and presented at aggravated national statistics. Data for the study were collected from research institutes, correspondence with the forestry services of most of the countries, visits to national forestry, land use, and survey institutions in some of the major forestry countries and to FAO regional offices; photographic surveys of all or part of five countries; satellite imagery of 18 countries and side-looking air-borne radar surveys of four additional countries. Three countries (Burma, India and Peru) prepared their own national reports. In many cases data were adjusted to fit common definitions and to correspond to a base year of 1980.

Based on resolution UNEP GC. 7/6 (1979) two expert meetings on tropical forests were jointly organized with FAO and UNESCO in Nairobi (1980) and Rome (1982) setting the base for the formulation of the Tropical Forestry Action Plan. Since its launching in 1985 UNEP has actively participated in all organization activities. UNEP has established an internal Interdisciplinary Working Group for the Tropical Forestry Action Plan to ensure integrated and concerted approach when facing TFAP activities.

Recently we have contributed to the TFAP mission to Peru in April 1987 by providing a consultant on Ecosystems Conservation and we are studying current TFAP plans for more involvement which is intended to ensure that the environment aspects of these forests are really taking into account in any policy and management plans.

Since the UN Conference on Desertification held in Nairobi in 1977 and the approval of its Plan of Action by the UN General Assembly UNEP has been involved in integrating forestry activities closely related to deforestation control into national level actions.

UNEP has also contributed to the Regional NGOs meetings in Africa, Latin America and Asia in order to expand the role of NGOs in national forestry programmes. The feelings of NGOs on deforestation issues were fully documented in the background paper which was submitted to the Bellagio meeting in July 1987.

Organized by the World Bank, FAO, UNDP, the World Resources Institute and the Rockefeller Foundation, the Bellagio meeting was aimed at obtaining political support for implementation of programmes for conservation of tropical forests within the TFAP framework.

The Executive Director has organized informal consultations with the three countries owning nearly half of the world's tropical forests (Brazil, Indonesia and Zaire) to discuss options to ensure conservation of tropical forests ecosystems. This initiative was reported to the last Forestry Advisors Meeting in Rome and is seen as an additional complement step in the implementation of the Tropical Forestry Action Plan.

UNCTAD, in collaboration with FAO, initiated action for the preparation of a commodity agreement on tropical timber which was finally signed by the required number of producer and consumer countries and came into force in April 1985. UNEP was actively involved at the later steps of the formulation of the International Tropical Timber Agreement to ensure the inclusion of its text of environmental considerations necessary to the sustainable development of the forestry resources. This has now resulted in the creation of the Internaitonal Tropical Timber Organization (November 1986) based in Yokohama, Japan.

As a result of the First African Ministerial Conference on the Environment held in Cairo in December 1985 a Committee on Forests and Woodlands has been established for which UNEP is holding the secretariat. The first meeting of the Committee was held in Kinshasa, Zaire, from 23 to 25 March 1987.

The Cairo Conference had spelt out three priority areas for the work of the Committee:

(a) Design of a ten year plan for the general reafforestation of all the member countries of the Economic Community of West African States and the Central African Economic Community;

(b) Design of a ten year programme for reafforestation of the island countries;

(c) Implementation of a programme of research in forest areas.

The Committee made recommendations for the implementation of these projects which have now been approved by the Bureau during its meeting in Cairo from 31 March to 2 April 1987 as complementary actions to TFAP implementation.

Many other initiatives related to forests have been developed in the past.

UNEP has and will continue giving a high priority of its involvement in forest ecosystems management and conservation, maintaining its lines of collaboration with its traditional and new partners in the venture.

Forestry Study at IIASA - Experience on Timber Assessment Studies for Europe

by
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1. BACKGROUND

1.1 Existing Timber Assessment studies for Europe

Timber assessment studies based on dynamic models and carried out on national basis are well developed in some of the European countries since long time ago. Examples of countries with well established models and systems for long term planning of the forest resources on a national level are Finland, Norway, Sweden, United Kingdom, U.S. and some of the Eastern European countries (see for example Evju, 1979).

Timber Assessment Studies for entire Europe are more sparse. The existing studies for total Europe are not based on formal quantitative models. ECE/FAO Timber Committee has carried out 4 European timber trend studies (see United Nations, 1986). The first study was published in 1953. So far, the studies have been based on an approach where the member countries of the organization are invited to provide their own forestry forecasts on removals and development of growing stock based on the intimate knowledge of their countries' forestry situation and plans. The ECE/FAO secretariat analyses the replies and compiles the results in a consistent way. One advantage of the method is that the knowledge about policies concerning the forest resources in the individual countries automatically will be built into the analyses.

The drawbacks with the actual method are several:

- different methods are used in different countries for data collection and forecasting. Some countries have advanced analytical tools, other countries have simple tools and some countries are

completely lacking analytical tools. The basic forecasts for the different countries are produced by different people and people with different frames of reference. Therefore, there are inconsistencies in the results presented in the Timber Trend Studies for Europe.

- it can also be seen in this kind of studies, that countries with weak or nonexisting analytical tools, in their projections very often are just prolonging the historical development into the future.

- thus, for a number of countries the dynamic aspect of the the forest resources is missing.

The ECE/FAO secretariat and European experts in the field are since long time ago well aware of the situation discussed above.

Kuusela (1985) has presented a study on the future wood supply situation in Europe. The study is based on analyses of the individual countries in Europe. Even in this case the analysis is lacking a usage of a formal tool. Kuusela has during decades followed the development of the forest resources in the individually countries in Europe. He is regarded as the expert on European forests resources and has long and welldocumented experiences of forest management and policies in Europe. Based on his experiences and available data and anaysis produced in individual countries he has made estimates about the future development of the forest resources in Europe. This approach has one advantage in comparison with the ECE/FAO approach. The advantage is that the study for total Europe is carried out by one man and by a consistent method for all countries.

1.2 A dramatic change of the future wood supply in Europe?

1.2.1 Forest decline attributed to air pollutants

Forest decline attributed to air pollutants gained a wide publicity in the early 1980s. At this time the first quantitative estimates were presented in different countries. The presented results had a lot of uncertainties. But based on the available information, Nilsson (1987) has tried to make a quantification of the extent of damage attributed to air pollutants for 1984/86. The result is presented in table 1.

Table 1. Volume affected by air pollutants in Europe - expressed as average yearly harvests

Affected	Central Europe (including Eastern Europe)	4.8-5.9
	Nordic Countries	5.6
Riskgroup[1] (conifers)	Central Europe	7.3

1) The registered damage in this group cannot at present be regarded as certainly damaged by air pollutants. However, it must be regarded as a riskgroup, which easily can move to the group "Affected".

Thus, about 5-7 yearly average fellings in Europe are affected or stressed by air pollutants and other unknown factors. It means a total affected volume of 3-3.5 billion m^3 in Europe.

It is more or less impossible to make any statements or estimates on the future development of the damage due to the fact that we are lacking long enough time series about the development of the damage. The only thing, which can be said about the development is to describe the change between 1984 and 1986. The growth rates of damage during this period is presented in table 2. The growth rate is calculated in the following way. The extent of damage in year 1986 is divided by the extent in year 1984.

Table 2. Average alteration of forest damage in percent attributed to air pollutants between 1984 and 1986, expressed in percentage.

Affected	Central Europe	
	Conifers	7.7%
	Non-conifers	57.6 %
Riskgroup (conifers)	Central Europe	18.8 %

So far, the national timber markets have not been disturbed by the damaged timber. This is a result of actual employed policies in affected countries. The countries are trying to balance the increased harvests in damaged forest by decreasing planned harvests in undamaged areas. Another policy is to keep the damaged trees standing in the stands as long as possible. The philosophy is that even if the trees are damaged they can still act as filter to air pollutants and protect undamaged trees. But if the damaged volume will generate a break-out of insects and the growth rate of the damage will continue in the future as presented in table 2 there will be dramatic effects on the European timber supply and markets.

The figures above only deal with the visable damage. The damage registered in the national inventories is loss of foliage. A litterature review was made on the relationship between loss of foliage and loss of increment by Attebring (1986). This review indicates that a visible loss of foliage in the range of 20-60 percent could generate a loss in increment of 40-60 percent. This is valid at the time the damage is visible. However, the increment decline seems to start about 25 years before the damage is visible. Such a development will strongly influence the long term wood supply in Europe.

1.2.2 Changed agriculture policy in Europe

In the whole Europe there is a strong overproduction of agricultural products. Since a long time ago the agricultural production has been heavily subsidized by the governments in Europe. Today, in most European countries, investigations are made about how to reduce the overproduction and the very expensive subsidies. In these investigations strong discussions are held about transformation of abundant agriculture land to forestry land. Kreysa and Last (1986) have made a survey about the probability to increase the forest land by afforestation of less productive agricultural land in the EEC. They found a high probability to increase the size of forest land by this conversion in the following countries: Belgium, France, FRG, Greece, Ireland, Italy, the Netherlands, Portugal, Spain and United Kingdom. Similar results are also presented for other countries outside the community.

In Sweden it is estimated that 1 million ha can be converted from agricultural to some form of forestry land during the coming decades (Nilsson, 1985). This land has a very good infrastructure and a high productivity - about 7-8 m^3/ha per year at average.

Ireland has made a more advanced analysis of possible agricultural land for conversion to forest land (Bulfin, 1987). The result from this study is presented in table 3.

Table 3. Agricultural land as forestry potential in Ireland in ha

	Forestry Yield Class Category				
	Extremely limited	Very limited	Moderate to Good	Good	Very Good
Soils classed as agricultural land: (in ha)					
Extremely Limited	1 162 750	384 950	220 510	111 600	78 000
Very Limited	--	--	50 500	260 250	452 920
Limited	--	--	316 340	138 240	185 990
Total			587 350	510 090	716 910

This means a total potential of about 1.8 million ha for forestry production and an increased production of about 25 million m^3. This should be compared by the actual productive forest land in Ireland today, which is 0.35 million ha.

For total Europe, figures like 10-20 million ha are mentioned as possible for conversion from agriculture to forestry. Such an extent of conversion would dramatically change the long-term wood supply for Europe and the future international trade flows of forest products.

However, it must be remembered that this conversion is very difficult to implement (from political point of view) and also a very capital intensive process. Therefore, the process will take long time.

1.2.3 Improved and changed silviculture within existing forest resources in Central Europe

In the earlier cited report by Kreysa and Last the possibilities to increase the forest yield by improved silviculture were also investigated. They found that for the same countries in the EEC, as reported in the section 1.2.2, the yield could be significally increased by improved silviculture.

Kuusela has in a number of reports stressed the need of a changed silviculture management in Central Europe (see for example Kuusela, 1987). He has, among other things, illustrated the need for a changed silviculture by the situation in Bavaria. This is illustrated in table 4.

Table 4. Development of age-class structure of Bavarian forests, expressed as a distribution in percent (Kuusela, 1987).

	Age class						
	10	30	50	70	90	110	130+
All Forests							
1960	26	23	20	13	9	9	9
1970/71	18	17	19	18	13	8	7
1983	5	13	18	26	19	9	10

This development during the last 15 years means that the thinnings have been delayed and rotation periods extended in comparison with the 1960s. During this period the fellings have been at least 20 percent smaller than the net increment. Kuusela stresses that this is a very common picture in the whole of Central Europe and that this is one of the major reasons for the existing extent of forest damage attributed to air pollutants. The forests are under natural stress by a too high standing volume per ha.

The consequences of a practise where fellings are kept permanently smaller than the growing-stock increment, increasing density and age of stands and the accumulation of mature and over-mature timber stock, will be noticeable in Central Europe. Fellings will be increased

sooner or later. If silvicultural regimes are changed in order to increase the profitability of forestry, or if forest damage force an increase in fellings, the supply and demand situation in the European timber markets will be found in dramatic turmoil.

Kuusela's conclusion about the actual situation is "only a reliable advance knowledge, with alternative projections and analyses of the growing stock development, can guarantee a future staying in man's full control".

2. OBJECTIVES OF THE IIASA FORESTRY STUDY

By the background presented in Section 1, IIASA decided early 1986 to set up a Forestry Study at the Institute. The objectives of the study are:

- to build a dynamic system - with a tailormade database - for long term European Timber Assessment Studies.

- the analyses should especially take into consideration
  - the dynamics of the forest resources in Europe
  - how changed silviculture regimes will influence the dynamics of the forest resources
  - the effects on the future wood supply in Europe of the forest damage attributed to air pollutants
  - the effects on the future wood supply in Europe of changed agricultural policies.

- concerning the effects of air pollutants and changed agricultural policies, not only the effects on the long-term wood supply should be illuminated but also the consequences on the total forest sector, international trade and society in general.

- finally, the Timber Assessment Study for Europe should generate a recommendation to internationel organizations and individual countries on improved data collection about the forest resources in Europe.

3. METHODS USED FOR TIMBER ASSESSMENT STUDIES

Before describing the method used for timber assessment studies in the Forestry Study at IIASA, it can be worthful to make a short presentation of methods used so far in other cases.

First, the degree of sofistication of Timber Supply Studies can be different. One way to describe different degrees of sofistication is:

- Describe future development of growing stock (G.S).
- Describe G.S + future possible harvesting level (P.H.L).
- Describe G.S + P.H.L + future distribution of quality and diameter (D.Q.D).
- Describe G.S + P.H.L + D.Q.D + the economic wood supply.

The more sofisticated analysis, the more detailed and high quality data is required.

Independent of the degree of sofistication, two major groups of models can be used, namely simulation models and optimizing models.

The most advanced simulation model for national analysis of the long-term timber supply is probably the HUGIN-system in Sweden. This system can handle the first three degrees of sofistication presented above (Hägglund 1981, Bengtsson, 1984).

A good example on a simulation model dealing also with the economic wood supply is presented by Williams (1986, 1987) for British Columbia, Canada.

A classic optimizing model is the RAM-model in U.S. (Timber Resource Allocation Model, See Navon 1971).

Among dynamic programming models (a special group of optimizing models) concerning national analyses the most advanced may be models developed by Kilkki and Pökälä (1975) and Kilkki (1982).

4. CONDITIONS FOR TIMBER ASSESSMENT STUDIES FOR TOTAL EUROPE

To select a proper model or method for the actual Timber Assessment Study for Europe the actual conditions for the study must be investigated. The situation for Europe is the following:

- there are very big variations between individual countries concerning both data availability and -quality.

- environmental and social benefits of the forests are in the future gaining in relative importance in comparison with the industrial benefit. This will lead to conflicts between different functions of forests. The non-industrial benefits are very difficult to quantify.

- the threats from air pollutants and forest fires have a high degree of uncertainty.

- an increase in public interest in forest policy is foreseen.

- conversion of agricultural land to forestry land has a lot of political complications. The complications are difficult to estimate and quantify.

- the average size of the forest ownership is small in many countries in Europe. In many cases the owners are only marginally interested in the forest as a source of income. Therefore, it is difficult to estimate how these owners will react on a changed environment and consequently the effects on the future wood supply.

By the background given in section 3 and this section the following requirements can be established on a model for a Timber Assessment Study for Europe:

- the model structure must have the possibility to be employed in the analyses for all countries of Europe.

- the model must have the capacity to handle efficiently both countries with good data availability (and high quality) and countries with poor data availability (and low quality).

- the model must be easy to calibrate and to understand. This is especially true in the European case with many parameters difficult to quantify and many parameters with big uncertainties.

- from a policy point of view the structure of the model must be such that results easily can be explained.

Due to the conditions described above, the conclusion is that the model concept must be a simulation model on an aggregated level. Due to data availabiity and data quality in Europe the model can only handle two aspects of a Timber Assessment Study (the two first degrees of sofistication, discussed in section 4), namely development of growing stock and possible harvests. In the light of the data availability situation, even this level of ambition could be too high.

5. MODEL CONCEPT IN IIASA'S FORESTRY STUDY

The model concept choosen for the Timber Assessment Study was first developed for Swedish conditions and is described by Sallnäs, Hägglund and Eriksson (1985).

The model is an area matrix model, the forest area is distributed on a discrete set of stages of status. Transition between stages are performed in discrete time with a period length of five years. The transitions are regulated by transition probabilities.

The stages of status of the forests are determined by the values of the following parameters;

- geografical region
- owner category
- site class
- species distribution
- age class
- standing volume per hectare.

This lay-out is valid only for evenaged stands. Large areas in Europe are covered by uneven-aged stands (irregular stands, selection forestry). For these stands age classes can not be regarded as relevant characteristics. For such stands, one relevant description is

to use diameter distributions. Houllier (1987) has for the IIASA Forestry Study developed such a modification of the basic model. His model development is based on earlier work by Usher (1969) Pitard (1978) and Houllier (1986).

Thus, two different variants of the model are needed for the European Timber Assessment Study.

6. DATA BASES TO THE TWO MODELS

The data bases required to the models is described in a schematic form for evenaged stands in figure 3. These data bases are built by the Forestry Study at IIASA.

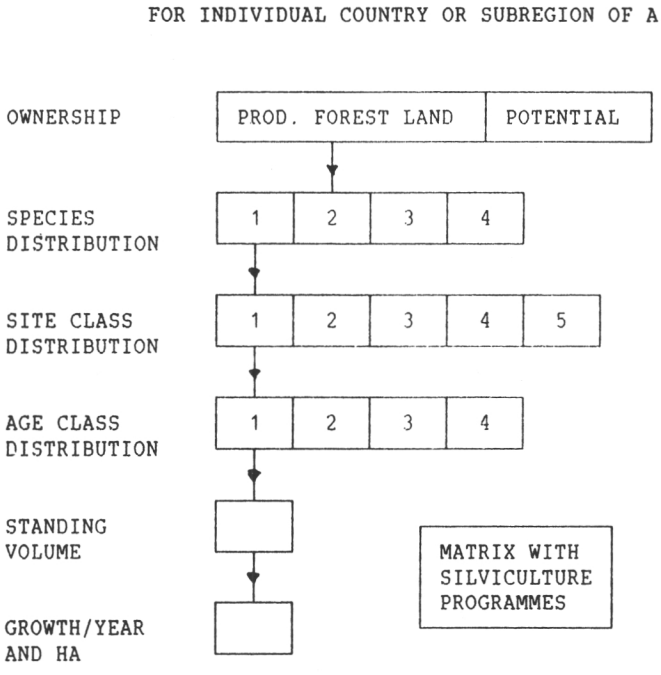

Figure 1. General lay-out of required data base for even-aged stands

The following text is making reference to figure 1. If there are different production conditions between subregions in a country, individual data bases are built for the subregions. Thus, a country with limited forest area or a country with homogeneous

production conditions is treated as one region and represented by only one data base. The productive forest land is described in hectares. If there is significant difference in production between different forest owners the information is divided into different ownerships. Potential land describes possible future conversion of agricultural land to forest land. The forest land is divided into a number of site classes. Within each site class a distribution on species composition is required. For each species an age class distribution is required. In each cell of the age classes and species distribution information is needed on the standing volume (m^3/ha) and growth (m^3/ha and year).

Finally, one matrix with existing and future silviculture programmes is needed for each individual region (database). In the same way a special matrix is required for damage caused by air pollutants.

In the database for uneven-aged stands the age class distribution (see figure 3) is replaced by a diameter distribution.

7. STATUS OF THE DATABASES

The actual status (end Oct 1987) of generated databases can be divided into 3 groups:

Databases ready for final analysis

Sweden, Finland, Norway

Denmark, FRG, France, Ireland, N. Ireland, UK, Portugal, Netherlands, Belgium, Luxembourg

Austria, Switzerland

Poland, Czechoslovakia, Hungary, Bulgaria, Yugoslavia

Databases under preparation

Italy, Spain, Greece

GDR, Romania

Missing basic information

USSR (except Lithuania) and Turkey.

8. EXPERIENCES GAINED WHEN GENERATING DATABASES AND ANALYSIS FOR EUROPE.

The following conclusions are based on the chosen model concept and the work done so far.

8.1 General conclusions

A lot of data concerning the forest resources is collected in many countries. However, these data are seldom collected with the purpose of serving as a base for dynamic modelling of the forests. Dynamic modelling raises demands on the choice of variables that differs from those needed for a pure static description of the forest. Dynamic modelling needs structural variables and information on the quality and growth of forest as well as figures on forested areas and standing volume.

In general the growth figures are poor or completely missing.

It should also be noted that existing data in many cases is non-accessible.

Another general remark is that the time for which data are valid, are sometimes poorly documented.

8.2 Data on young forests and bare forest land.

One essential part of the dynamic description of the forest is information on the new forests to come. Dealing with a time horizon of say, 50-100 years means that the new forest will in the later part of the simulations be the dominating part of the growing stock, especially if we are talking about short rotation forestry.

Information about the expected quality of the new forests as well as regeneration times is essential for long-run simulations.

8.3 Uneven-aged forests.

Uneven aged forests or rather forests without an age-structure are common in Europe. Data about these forests is, if it exists, in the form of diameter distributions. In most cases the data encompasses

only a very small number of wide classes, with no information about the growth in the different classes. Thus, modelling these forests is difficult since you can neither use an area based concept nor an approach based on diameter distributions.

8.4 Forest land.

There is no consistent definition of forest land. In some cases it is difficult to identify what is included in "productive forest land".

8.5 Potential forest land.

In many countries large areas are reported as non-forested forest land, scrubs, bushland etc. These categories can often be regarded as a potential for forestry. However, in order to incorporate this land into dynamic analysis it is essential with further information on potential productivity, recommended species etc. The same is valid for marginal agricultural land which is another possible base for afforestation.

8.6 Data on damage pattern.

By very obvious reasons, the available information about forest decline is limited. Existing information is valid only on a very aggregated level. Desirable would be data about decline differentiated on species, site classes and age classes, and more or less consequently on damaged volumes. Hopefully, in the near future there will be more knowledge about the relation between defoliation and vitality, for example in terms of growth.

8.7 Management programs.

Dealing with simulation of the kind that is used in the present study, one crucial question is raised - which management practices should be employed in the simulations. Should it be ideal management programs according to yield tables and scientific knowledge or should it be some realistic estimate of the management that can be expected to take place. Of course the program to use is dependant on what issues the analysis are aiming at. However, information about what management practices that in reality is practiced is very sparse. Even figures like annual harvest levels are in many cases poorly documented.

9. COMPARISON OF EXISTING FIELD DATA WITH REQUIRED DATA FOR ONE ACTUAL APPROACH.

In this section there is made a comparison between data required in line with the matrix in figure 1 and available field data collected by national inventory. The comparison is presented in table 5.

It must also be stressed that one comparison is based on the fact that data is collected in the field in such a way that the crosstables indicated in figure 1 can be generated.

In this comparison we are only dealing with the countries which are ready for final analysis in our study so far.

It can be noted from table 5 that data concerning growth - as well present growth levels as potential growth expressed by site classes are sparse.

In the cases of missing growth figures the growth must be estimated via yield tables.

Often it is not possible to differentiate the forest on separate owner categories. Since different owners can be expected to employ different management practices, the lack of differntiation creates a problem when management practices are implemented in the simulations.

TABLE 5.

Country	Possibilities to regionalize data	Possibilities to deal with different ownership	Satisfactory species distribution	Satisfactory age class distribution or diameter distribution	Satisfactory site class distribution	Satisfactory information as volume distribution	Satisfactory information on distribution of growth	Notes
Sweden	X	X	X	X	X	X	X	
Finland	X	X	X	X	X	X	X	
Norway				X	X	X	X	
Belgium	X	X	X[1]	X[1]		X[1]		[1] for softwoods
Denmark	(X)	(X)	X	X	X			
France	X	X	X	X	X	X	X	
FRG			X	X		X		Updated data. Latest national survey 1961.
Ireland	X	(X)	X	X	X			
Luxembourg			X	X				
Netherl.			X	X	X	X[2]	X[2]	[2] for some species
N.Ireland			X	X		X	X	
Portugal	X		X	X	X	X	X	
UK	X		X	X		X		
Austria	X	X		X		X	X	
Switzerl.	X		(X)	X	X	X		
Bulgaria			X	X		X		
Czechosl.	X		(X)	X	X	X		
Hungary			X	X	X	X	X	
Poland	X	X	X	X	X	X	X	
Yugosl.	X	X	X	X[3]		X	X	[3] for even-aged stands.
Lithuania	-		X	X	X	X	X	state forests

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Assessment of Drain and Uses of Drain Data: a review of Finnish Experiences

by
Matti Palo

1. Introduction

Finland has been known as a country rich in forest and with low population. Still, as early as during the 17th and 18th century a growing public concern was focused on the sustenance of her forests. An increasing number of forestry regulative acts were launched. In the middle of the 19th century the first permanent state forest administration was created and soon after that the first step in forestry education and research took place.

Gyldén (1853), in his handbook for forestry practicioners, made the first known estimate of national drain of timber from Finland's forests. He also presented an early method of forest inventory based on parallel inventory lines, originally introduced by a Swedish forestier af Ström in 1830. In the wake of the large expansion of forest industries a number of new, but more or less subjective, assessments of both annual increment and drain were made until the beginning of the 1920s. The inaccuracy of these estimates were known. During the same period the share of forest sector from the total exports had grown from 50 to 85 %.

A growing concern about the sustainability of Finland's forest resources under such circumstances was natural. Ultimately, a committee for a renewal of forestry taxation made a proposal to initiate the first national forest inventory which, accordingly, became implemented during 1921-1924 as a pioneering country in this respect. It was gradually realized that pure forest inventory results as such did not clarify adequately the basic problem of sustainability of forest resources. Parallel national data on timber drain had to be established on more objective basis than before. The purpose of this paper is to review the Finnish experiences in assessment of drain and major uses of drain data. This review may have some international interest due to the fact that Finland has, perhaps, the longest traditions in the world of objective assessments of both forest resources and timber drain (Figure 1).

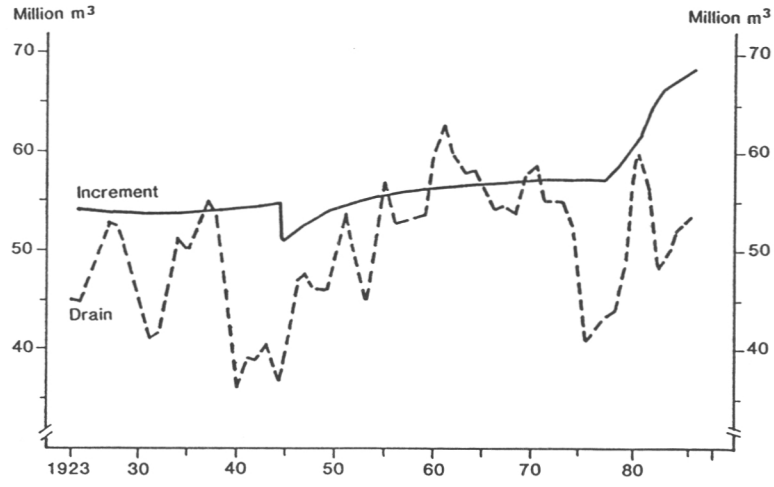

Figure 1. Development of increment and drain in Finland's forests from 1923 to 1985.

2. Uses of drain data

Timber drain data are mostly applied jointly with standard forest inventory data and with other statistics and research results. These joint uses are described in Figure 2. The primary function of an information system is to satisfy the information requirements of government forest sector policy. The secondary function is to serve the various agencies operating in a forest sector. The primary and secondary functions of an information system are depicted with dotted line arrows flowing left and below in Figure 2. The tertiary function of an information system is to transmit forest sector information to planners, decision makers and the great public participating in general socio-economic, political and cultural processes. The tertiary function is depicted with dotted line arrows flowing left and above in Figure 2.

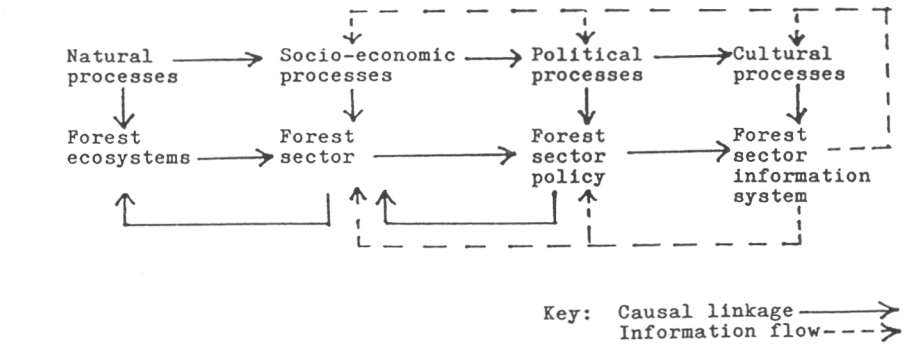

Figure 2. Functions of an information system in a forest sector and in a society.

The joint uses of inventory and drain data have been most frequent for various purposes of forest policy, forest taxation and general economic policy in the public sector. In the private sector the most important use has been in planning new investments of forest industries and in planning of purchasing activities of industrial roundwood as well as in design of peatland drainage, fertilization and other forest management intensification at national and regional levels.

A number of committees set up by the government have based their argumentations on comparisons of drain/potential cut and drain/increment relationships and on other relevant data. For instance, when the drain/increment-ratio was observed rather tight in the middle of the 1920s (Figure 1), the finding promoted launching new fundamental legislation for private forestry in 1928. A similar situation towards the end of 1930s catalyzed proposals to regulate roundwood exports. A committee on forestry planning during the 1950s and another on agriculture in the beginning of the 1960s widely applied these results. A strong threat for over exploitation in the beginning of the 1960s (Figure 1) mobilized a number of forest policy planning and financing (MERA-program) activities. An opposite situation after 1970 eventually initiated the recent "Forest 2000" -program.

Drain data jointly with relevant price statistics have been continuously applied in national accounting by the Central Statistical Office of Finland. The Office has recently been developing a new accounting system for natural resources, where drain and forest inventory data have been applied into this new framework as a demonstration for other sectors, but gradually that kind of use will also become continuous to facilitate formulating of general policies for natural resources. Also the Ministry of Environment has recently created various new uses for drain and forest inventory data.

While in Finland drain and forest inventory data are produced by the Forest Research Institute the most immediate use appears in conjunction with various research activities, particularly so within forest economics and specific forestry and forest sector planning models. It has been found most activating and dynamic to have both forest statistics production and forest research activities located at the same Institute as the case is in Finland. Researchers promote the development and maintenance of information and data systems. Statistics are readily available for research purposes. A lively interaction between the two functions has occurred. For instance, twelve doctoral dissertations have been made for development of various methods to assess drain and for forest inventory purposes.

3. Assessment of drain

The results from the First National Forest inventory were published by Ilvessalo (1924 & 1927). Finland was the first country in the world to complete a national forest inventory. A parallel requirement for drain data was realized. Saari (1923) made a pilot study on household utilization of

roundwood in a province in order to test a sampling method and observation procedure. The assessment of drain was decided to be based primarily on the phase of primary utilization of green roundwood. The first National Wood Utilization Survey was implemented during 1927-1934 by a large research team (Saari 1934). Such a survey was repeated in a rather similar way parallelly with the following two National Forest Inventories (Osara et al. 1948; Pöntynen 1962).

Saari (1929) realized that the Central Statistical Office, the National Board of Customs and some other state bodies collect annually statistics on industrial utilization of wood, on foreign trade of wood and on a few other wood uses. The annually collected data covered the most fluctuating part of drain. For drain estimation these data had to be checked and converted into commensurable measures. Saari proposed an annual follow up based on these components and periodic surveys of fuelwood and other roundwood utilization on farms and in buildings, by small sawmills not covered by the industrial statistics and on some other components. The plan became implemented.

Since the 1960s the share of non-industrial roundwood started to decline. For instance, the share of fuelwood from the total utilization of roundwood was estimated as 26 % in 1961, 20 % in 1971 and 10 % in 1981. This change became reflected in the respective surveys. The state was willing to allocate less resources to such activities. The last survey of farms and buildings based on book-keeping by the owners and on personal interviews was implemented towards the end of the 1960s with an improved method of two-stage, stratified random sampling (Ervasti et al. 1969).

A number of experimental surveys have been carried out in order to test alternative approaches to the assessment of timber drain. Osara (1936), Holopainen (1959) and Salo (1971) experimented roundwood production (removal) estimation based on a population of forest holdings (forest owners). Nyyssönen (1955) tested the assessment of drain from the population of stumps. However, insufficient accuracy and/or high costs remained problems.

Presently National Forest Inventories are executed by the Department of Forest Inventory and Yield, whereas the assessment of drain remains as the responsibility of the Department of Forest Economics. The two activities are closely coordinated and interrelated (Figure 3). The most problematic part in drain assessment lies in the periodic surveys (Huttunen 1980, Huttunen 1981; Mikkola 1972). A survey of fuelwood was implemented last time as a postal inquiry (Huttunen 1980).

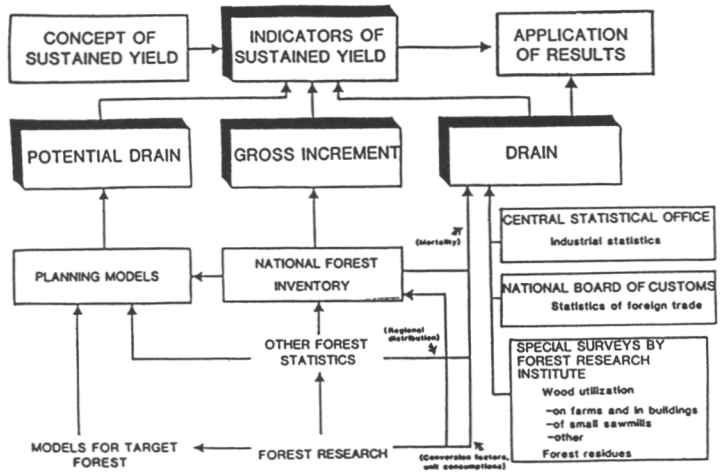

Figure 3. A scheme for production of sustained yield indicators and drain data.

The assessment method has appeared adequately accurate over a minimum of a business cycle (5-7 years). Comparisons between the growing stock volumes at the beginning and end of time period and the gross increment and drain during that period, have been convincing (Figure 4). A drawback in this kind of drain assessment has been timing and regional distribution of the national drain estimates. The triennial survey of removals of industrial roundwood (e.g. Mäki 1984) has been applied to identify a proper distribution of drain by districts.

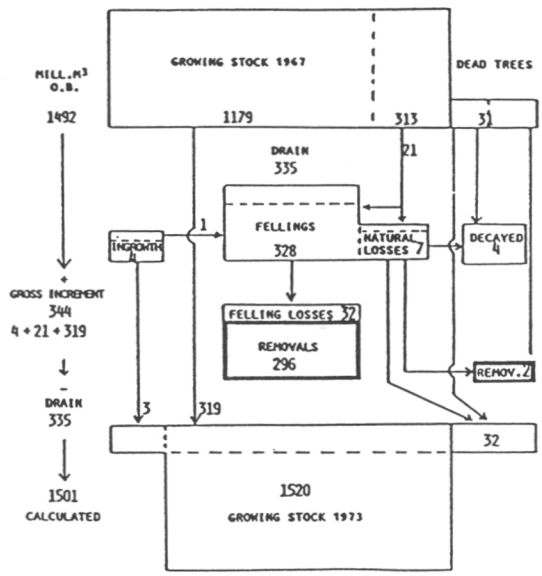

Figure 4. Comparison of inventory results and drain estimates (from Kuusela 1979).

4. Additional remarks

Palo (1969) developed a data system of industrial roundwood production based on stratified random sampling of roundwood buyers. The Department of Mathematics of the Forest Research Institute has been maintaining respective statistics. It was recently decided to use it in drain estimation instead of utilization statistics (industrial statistics and foreign trade statistics in Figure 3). This transfer was feasible only presently when the population of roundwood buyers have decreased and stabilized and the accuracy of these industrial roundwood statistics became improved also through a renewal in the administration of the statistics. This change eliminates the timing and regional distribution problems.

Seppälä (1971) developed a linked systematic cluster sampling for the estimation of roundwood production. The approach has been applied later on in Southern Finland from 1980 to 1986 (e.g. Karppinen and Hänninen 1986). A sample of forest holdings was both interviewed and an existing management plan (it any) updated or a new plan made. The approach gives a large amount of detailed drain data and related information but is an expensive one. A continuous system for a follow-up of private forestry is under design.

Jaatinen (1978) developed a material and energy accounting approach for a forest sector. Similar ideas was followed by Astorga (1977) and later on in connection with recent development of an accounting system for natural resources by the Central Statistical Office.

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Estimate of Increment

By

Josef Pollanschütz

In the period 1961 to 1980 the surveys of the Austrian Forest Inventory have been carried out on temporary survey-units (named "tracts") and cores have been taken from sample trees for the purpose of increment estimate. The figures for volume and increment per hectare in the high forest/commercial forest of the whole area of Austria calculated by linear equalization of the annual results prove a significant increase of these two indicators from 1961 to 1980, which is to be seen in the following table. The "values which are to be expected", calculated by linear extrapolation of the trend, are entered into this table for the years 1985 and 1990 (see also "Mitteilungen der Forstlichen Bundesversuchsanstalt", volume 154/II, page 245).

Indicator	Calculated values		Values which are to be expected		Annual increase
	Begin of 1961	End of 1980	1985	1990	
Volume per hectare cbm o.b. truncwood	233	273	283	292	+ 2
Current annual increment per hectare cbm o.b. truncwood	5.87	6.87	7.12	7.36	+ 0.05

Since 1981 the ascertainment of increment was made by periodical measurements on permanent sample plots arranged in a tract. The first statements about this kind of the ascertainment of increment can be given for the first time only for the inventory period 1986/90.

A comparison of the calculated average volumes of the period 1981/85 shows an additional and very significant increase of the indicator volume per hectare. The calculated volume per hectare on the average of this period amounted (for sample trees from 105 mm d.b.h. upwards) 283 cbm o.b. trunkwood and corresponds to the "value which had to be expected" according to the trend expolation only for 1985 onwards.

Increase of standing volume of management class high forest/ commercial forest and the findings of yield research (permanent plots and stem analyses in the course of temporary investigations) permit the assumption, that the current increment, similar to the standing volume per hectare, has also increased between 1981 and 1985 and reached a value about 7.12 cbm o.b. trunkwood per hectare.

For high forest/commercial forest therefore the following values are to be expected for the whole of Austria:

Area in hectares	2.939,000	(Result of the Austrian Forest Inventory 1981/85)
Volume in 1000 cbm o.b. trunkwood	824,346	- " -
Current increment in 1000 cbm o.b. trunkwood	20,925	"Derivated estimate"

Economic and Social Aspects in Forest Resource Assessment in Developing Countries

by
Päiviö Riihinen & Markku Simula

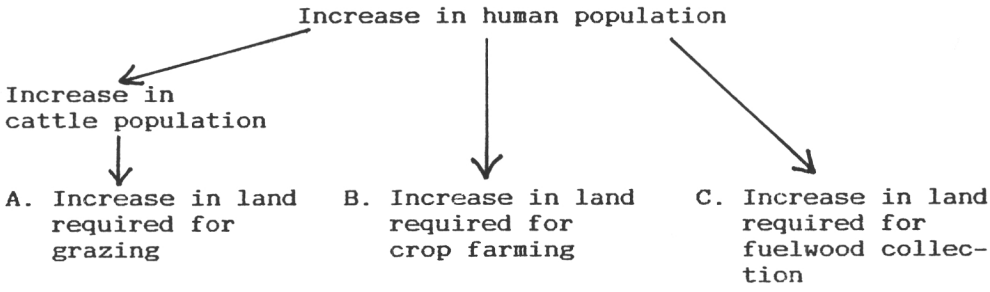
1. INTRODUCTION

1.1 Background

1.1.1 Forestry Problems in Developing Countries

The major forestry problem in developing countries consists of deforestation. It is estimated that about 11.3 million hectares of tropical forest is depleted annually (Lanly 1982). It is part of a burning social problem having a bearing on population growth, land tenure, grazing and agricultural practices, lack of alternative sources for fuel and construction wood, etc. The consequences of deforestation are not confined to forestry. Even more serious is the environmental degradation caused by floods, erosion and desertification (cf. Simula 1985; Riihinen 1986, 263).

The land use problems visible in a cross section are consequences of a process in which population increase plays an important role. Past experience tends to suggest that no massive imports of fertilizers (in as much as they can be used on tropical soils) and/or change in technology can produce a rapid relief. The process starting from population increase can be described as follows (Riihinen 1986, 263):



Consequently, the pressure on land required to satisfy human wants is an exponential function of population growth while land carrying capacity tends to decrease exponentially in relation to population (Figure 1).

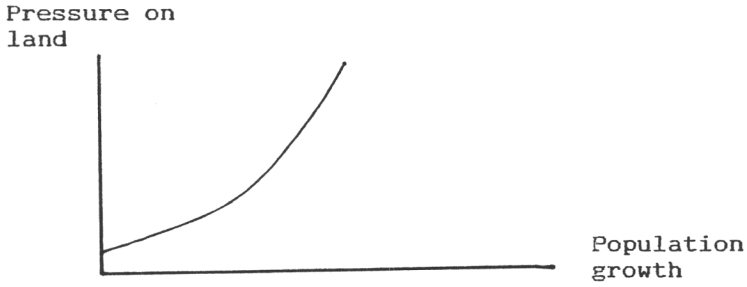


Figure 1

In addition, the land area required for food production is increased progressively by the fact that more and more marginal lands are needed to expand the agricultural area. Under these circumstances, the social opportunity cost of forest land other than marginal tends to be high and the same applies to that of capital there being more immediate short-term needs for capital. The opportunity cost of land tends to rise with increasing population and, thus, with time. It is, therefore, desirable for forestry departments in developing countries to gazette forest land for future forestry in time. This is necessary because of externalities in forestry, above all thanks to soil and water conservation, which often make other sources of livelihood possible. However, such "relief" for land scarcity may, from the standpoint of society, be apparent rather than real as squattering is difficult to control.

As far as the pressure on land as a function of population growth is concerned it raises a doubt whether a problem like this can ever be solved by a rationalization of land use in the vast problem areas. The amount of land is often too small at the moment, let alone in the future which seems still worse. Being somewhat less than ambitious, given certain conditions, we can reasonably expect that (Riihinen 1986, 264).:

(1) birth control brings relief to A, B and C, above;

(2) more intensive agriculture relieves the need for agricultural land (which need not increase linearly with population growth) (B);

(3) establishment of fuelwood plantations reduces the need to expand the area required for fuelwood collection (C);

(4) more organized grazing and pasture management reduce the pressure on grazing areas;

(5) agroforestry and other forms of farming systems combining agriculture and forestry provide a partial solution for A, B and C.

1.1.2 Productivity: a Bottleneck in Mobilizing Resources

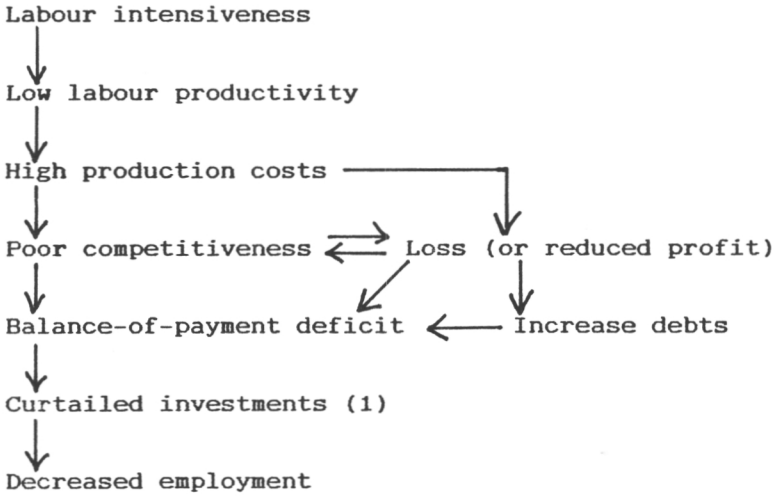
The scarcity of certain factors of production in developing countries is conspicuous and well known. Land and capital are often in short supply, whereas labour, especially unskilled, is abundant. Land may be marginal, hardly capable of agricultural development, but may provide the necessary forest land having a low or zero (or even negative) opportunity cost based on the agricultural production foregone. The opportunity cost of scarce capital, on the other hand, may be high. It is many times doubtful whether a combination of such capital with poor land is a viable investment. It may be equally doubtful whether labour with a low productivity can be profitably combined with land, especially with poor land.

Labour productivity considerations in connection with investments in general, and with land/labour combinations in particular, deserve more attention ever since social aspects (e.g. distributional effects in terms of employment, income, etc.) have become more emphasized in justifying development investments. It can be shown that labour intensiveness, with low labour productivity, is likely to result, in a longer term, in declining employment, as suggested in Fig. 2. Furthermore, low labour productivity tends to keep wages low. On the other hand, in subsistence production productivity considerations have a different interpretation, particularly if alternative employment possibilities are not available.

It is obvious that a low labour productivity can make an investment, even into a fertile and advantageously located land, unprofitable. Conversely, a high labour and capital productivity can compensate for deficiences in land quality (incl. location) to the extent that a forestry investment becomes profitable. It would in fact be interesting to find out the required increase in labour productivity in order to make certain forestry investments profitable.

The purpose of the above-mentioned productivity aspects is to emphasize the relativity of land quality depending on other factors or production. It also suggests that, with scarcity of physically productive forest land, its amount can be increased by improving the productivity of the other factors or production. Fig. 1 shows that productivity may be an important bottleneck in the way of forestry's development impacts. It is hence essential to obtain information on productivity, on desirable increase in productivity and its feasibility. This information has to be interpreted within the context of overall rural development and needs for the conservation of environment.

Figure 2.



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(1) This argument is based on the simple logic of equalities in a national economy:

(i) $X + I_d = M + S$;

where X = exports, M=imports, I_d = domestic investments, and S = savings

Balance-of-payments equilibrium:

(ii) $X - M = S - I_d$

Balance-of-payments deficit:

(iii) $M - X = I_d - S$

Hence, it is possible to decrease the balance-of-payment deficit by increasing savings or by decreasing domestic investments.

1.1.3 Choice of technology

Closely related with productivity is the choice of technology. Past failures in industrial development efforts have drawn attention to their desirability. Experience in introducing high and medium-level technology, with large unemployment rates and search for a more equitable distribution of income, have switched attention to low-level technology. This has affected the choice of emphasis on different major development options. Rural development is nowadays often preferred to industrial projects. The choice of technology, however, is a relevant question also within each development alternative. By selecting a technology one at the same time affects the attainable level of productivity, with consequences in the economy concerned as pointed out in Fig. 2. Despite the assumed highly desirable distributional effects of rural development projects in the short term, their overall productivity tends to remain low and, hence, their long-term economic development impact and employment effect small or nonexistent.

It is not very popular in development economics to focus on productivity and the choice of technology. However, failures in past and present investment efforts are a good reason to improve their development impact by higher efficiency in the utilization of resources.

1.2 Objectives of the Paper

The purpose of this paper is to contribute to the design of the 1990 World Forest Resource Assessment with reference to the developing countries. The viewpoint is that of the user of information to be produced. Data needs are discussed with a particular regard to sectoral planning and project design.

The emphasis is given to economic and social aspects to be taken into account in forest resource assessment as they may not have been sufficiently addressed in the earlier regional surveys.

An attempt will be made to suggest new variables in the next assessment and their possible classifications.

2. NEEDS OF INFORMATION

2.1 National

It is indispensable to improve effectiveness and efficiency of the public sector administration in developing countries if better development performance is desired. Information has a decisive role in these efforts.

On the central government level the main concerns are

- sectoral planning
- project selection

The first item includes formulation of development strategies, design of respective policies and programs, and allocation of investments by activity. During the past fifteen years, there has been a growing tendency in developing countries to prepare long-term sectoral master plans which serve as a framework for development programs. This tendency is likely to continue in the future in spite of the strengthening faith in market forces as development agents. It has only to be recognized that sectoral plans are indicative by nature in most situations.

Sectoral planning in developing countries has extensive data needs. It attempts to put forestry as a natural resource-based activity into national perspective. The main concern is the set of goods and services the sector should provide to society and the respective inputs.

Sufficient knowledge of forest resources in a country is a fundamental element in sectoral planning. It should also be known how the required forestry outputs in terms of quantity and quality can be generated from the resource base. Past planning efforts have focused on wood production but non-wood outputs should be equally considered. Their importance is hardly yet fully recognized in developing countries.

Forestry development cannot take place isolated from the other economic and social activities. There is an apparent need to understand development as an integrated intersectoral process where critical linkages (e.g. infrastructure) have to be explicitly addressed to at planning stage. Integrated programs are complex to design and difficult to implement but there is often no other alternative to develop rural areas in LDCs.

On project level, data needs are specific to particular locations and much more detailed than in sectoral planning. Traditional forestry projects have generally been aimed at wood production for industrial purposes or fuelwood, while new concepts emphasize forestry in watershed management, agro-silvipastoral systems, conservation of ecosystems, etc. (e.g. FAO 1985). At the same time it has become evident that traditional analyses of techno-economic viability are no more sufficient in choosing between projects. Decision-makers have to be also aware of social, economic and ecological impacts as well as institutional requirements of the planned activities. Project preparation is getting more complex, costly and time-consuming but previous ignorance on these aspects has proved to be even more costly. On the other hand, the expanded scope of evaluation is likely to favour forestry over other sectors because its externalities are generally positive.

It is well known that in developing countries land resources are under excessive pressure. The process is exponential leading to rapid depletion of the forest cover. There is an urgent need to monitor changes at shorter intervals than in the past. Ten years, for instance, is often too long a period to enable necessary rapid adjustment in policies. Monitoring should be designed in a way which would permit the preparation of reasonable projections on the extent of forest cover and the type and intensity of its utilization.

Based on this background, it is concluded that forest resource assessments, have to be appropriately designed to provide necessary data for sectoral planning in its broad sense including project identification, design and evaluation. The FAO/UNEP Tropical Forest Resources Assessment Project in 1980 indicated that the current information base in developing countries is far from satisfactory and further efforts are needed to support national authorities. The 1990 World Forest Resource Assessment should

(i) continue the development of classifications, definitions and methodology to be applied on assessment on national and international levels, and improve the standards of presentation

(ii) identify the main deficiencies in the existing information (coverage, quality, timeliness, monitoring of changes, etc.) and make recommendations how they can be eliminated

(iii) develop analytical methods to prepare projections on changes in key variables (e.g. forest cover)

(iv) improve the awareness of national authorities on the necessity of an adequate national data base on forest resources.

2.2 International

Developing countries are dependent on international trade in forest products, often through exports of sawnwood and plywood and imports of pulp and paper. Strategies based on export growth and import substitution will be required also in the future and the importance of foreign trade in forest forest products is likely to increase in many countries. Sectoral planning and policy formulation on national level cannot be carried out independent of other countries. Therefore, forest resource assessments should provide necessary information on the supply possibilities of wood and non-wood products.

There is an apparent need to transfer experiences in the formulation of development strategies and policies from one developing country to another. Many are interested in repeating success stories of countries like Brazil. Direct transfer of knowledge is, however, impossible and careful analyses are required. Forest resource data are an essential ingredient in such work.

There is an increasing need for better international cooperation and coordination in forestry in developing countries. Further efforts are needed to make the world community more aware of the ecological and socio-economic consequences of deforestation and to take necessary action. For these efforts, data should be assembled, analyzed and regularly updated on worldwide and regional levels.

International organizations, bilateral donors and lenders want to establish priorities between and within countries reflecting urgency of action. They also have to better coordinate their particular project activities to improve development impacts. In these efforts, adequate information on forest resources is fundamental.

3. CLASSIFICATIONS OF THE 1980 TROPICAL FOREST RESOURCE ASSESSMENT

The pathbreaking effort of FAO and UNEP to assess the world's tropical forest resources in 1980 resulted in a wealth of useful information. In the classification of natural woody vegetation, physical characteristics were the starting point:

- trees vs. shrubs
- composition by predominant species group (broadleaved, coniferous)
- density (closed forest, mixed forest grassland, bamboo forest)

Three concepts of volume were used, i.e. gross volume over bark of free bole, volume actually commercialized and gross annual allowable cut.

Five economic classification criteria were used within appropriate principal categories of natural woody vegetation:

- alteration by agriculture (forest, forest fallow)
- production capacity for industry (productive, unproductive)
- management status (with, without intensive management in productive forests)
- physical accessibility (for legal, physical reasons in unproductive forests)
- past logging (undisturbed, logged-over in productive forests without intensive management).

These criteria, even though useful, may not sufficiently consider necessary economic and social aspects in sectoral planning or project design in developing countries.

Plantations were divided into industrial and non-industrial, fast-growing and other, hardwood and softwood plantations. These characteristics only consider the wood production aspect. As for utilization, only industrial plantations are treated as a separate group which may not be sufficient for current planning purposes.

4. POSSIBLE VARIABLES TO BE INCLUDED IN RESOURCE ASSESSMENT

4.1 Land-Uses

As forestry as a socio-economic rural activity cannot be analyzed independently from agriculture it is suggested data on principal land uses be included in the world forest resource assessment. This would ensure the consistency of information and reveal e.g. what happens to the lost forest land. Such information would be useful in land evaluation for forestry at national and international levels (cf. FAO 1984).

As part of land uses, main watershed catchment areas could be identified and related to the existing forest cover. An increasing attention will have to be given to the management of these areas. Their management principles differ from those of production forests. Therefore, they would deserve a special treatment in forest resource assessment. (e.g. FAO 1983; McGaughey-Gregersen 1983; Asian Development Bank 1987).

Various land-uses are interrelated and they often overlap. Apart from agricultural land and watershed catchment areas, one should also know to what extent various combined agro-silvipastoral systems are carried out as these activities are likely to play an increasing role in sectoral planning and policy design.

4.2 Economic Aspects

From the economic point of view the following main characteristics of the existing forest resource are important:

- Type and volume of growing stock and its possible uses. The breakdowns into industrial and non-industrial, softwood and hardwood, logs for sawing and plymilling and pulpwood are relevant. In indigenous tropical forests it is customary to talk about commercial species (principal and lesser-used species. The concept "commercial" is dynamic as new species are constantly introduced into the market. It is difficult to suggest an operational definition here as the criteria to include species tend to vary in individual forest inventories. The principal use of wood also depends on the location of resource.

- Accessibility of the resource. As an economic concept it is a dynamic variable which does not only depend on terrain conditions, location or the legal status, but also on production costs. They are influenced by productivity and the advancement of road construction both of which change over time.

The earlier classification criteria of accessibility might be reconsidered e.g. as follows:

- permanently inaccessible (for legal and physical reasons)
- accessible with reasonable investment (the interpretation could be left for national level)
- readily accessible or minor investment needed

The latter two groups may also be merged.

- Use of forest land for shifting cultivation and grazing. The earlier forest fallow concept is relevant here. It would also be useful to know to what extent forest areas are used for grazing.

- Management status which, however, might require a less rigorous definition than in the 1980 assessment, e.g. along the lines applied in ETTS IV (ECE/FAO 1986).

- Current potential/production of non-wood products and services of forests. With regard to these outputs, two main aspects are their economic importance (volume of production) and their impact on other possible uses of forests. Relatively broad categories could be applied by type of output.

- Supply potential of wood and other outputs from trees growing outside forest areas (shelterbelts, home gardens, canal side planting, etc.).

The needs for conservation have traditionally been considered based on biological and ecological assessments. Conservation of e.g. genetic resources is also justified based on economic grounds. Needs for conservation should be treated in resource assessements.

With regard to plantations, the information should be available on their purpose, type and production potential. It would be useful to break down the "other" plantations of the 1980 assessment e.g. into

- principally single-purpose fuelwood planting

- essentially multi-purpose planting (e.g. agroforestry, fodder production)

- planting principally for soil and water conservation

4.3 Social Aspects

International resource assessments should, in general, provide information on the man-land relationships to better understand processes resulting in deforestation or forest degradation, and to enable the design of appropriate policies. This requires that forest data should be accompanied by and cross-referenced with key demographic and social indicators. Such data can normally be obtained from the latest available census in each country.

The indicators to be considered are

- rural population density to be calculated by vegetative zone
- age structure
- family size
- sex distribution
- main occupation
- housing conditions

The key issue is what the sustainable human and livestock populations are in particular forest areas. It is not easy to measure them and "standards" are difficult to establish. On the other hand, options are few in areas where the ecological situation is rapidly deteriorating, and more active population policies are usually badly needed. If population growth cannot be controlled, the governments will have to

- try to reorient production to raise productivity in the current inhabited areas or

- resettle population with often adverse effects on income and living conditions, at least in the short run.

Neither of these non-exclusive options is easy but they become inevitable if the preconditions of growing agricultural crops, grazing and forestry production get destroyed or permanently reduced.

Much of deforestation in developing countries originates from the problem of "commons". Land tenure is therefore important explaining the interaction between man and forest. The following groups may be applicable

- private
- community, cooperative, etc.
- industry (incl. long-term concessions)
- public

It is not only the type of tenure but its security which influences utilization practices of forest areas in developing countries.

5. CONCLUDING REMARKS

The previous regional and world resource assessments have produced sizeable data bases but their analytic possibilities have remained far from utilized. If information is not integrated with social and economic data, analyses tend to remain technical and little advice can be obtained for national policy formulation or sectoral planning. The present information processing facilities offer good possibilities for the integration of physical and social data which should be tried. Furthermore, more efforts should be given to the analysis between countries.

Most of the necessary additional data on socio-economic aspects already exist. It is only a matter of procuring and processing them together with forest resource data. On national level, such work should be continuous and necessary technical assistance should be made available to expand the scope of national forest assessments. The design of national forest inventories will also need adjustment to duly take into account the multiple outputs and uses of forest land. In particular, watershed areas by problem severity class should be separated and main agro-silvi-pastoral systems should be identified as distinct categories. The role of trees growing outside forests should also be included in resource assessment as in dry and arid zones they can be very important for the total supply of outputs derived from trees. Respective analyses should follow as otherwise further efforts in data collection remain unjustified.

If it is not possible to develop direct measures for sustainability of forest lands under their current or alternative uses, one could consider estimating the degree of biomass equilibrium and its rates of change. Respective categories could be established.

It is apparent that both national governments and the international community require more frequent monitoring on the advancement of deforestation in developing countries than decennial assessments. Exponentially accelerating negative change is taking place in a large number of countries and their governments should be the first ones to be interested in such information. Systematic action should, however, be organized by international support.

National forest inventories have traditionally concentrated on collecting and analyzing data on the growing stock. As ecological considerations are getting increasingly important, a broader inventory concept than in the past is needed. In developing countries, this means that data have to be collected on soil and terrain conditions, forest fauna and other environmental indicators. Such indicators will have to be also included in regional and management planning.

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Holistic Forest Sector Models as Means to Combine Forest Resource Information to the Use of Resources

by
Risto Seppälä

ABSTRACT

Recent experience from many countries indicates that holistic forest sector models can be of major inportance in combining forest resource information to the use of resources. The Finnish forest sector model, MESSU, built in the 1970s was among the first holistic models to be used in policy analyses. Based on the experience gained from MESSU, a dynamic linear programming model, DLP, was constructed for the Finnish forest sector. Partly building on this tradition, IIASA commenced its work on the global trade model, GTM, in the early 1980s. IIASA's GTM, for its part, provided the impetus for a third generation Finnish model. The process of building this MESTA model is still going on.

MODELING OF THE FOREST SECTOR

Since the late 1950s, the modeling of separate parts of the forest sector has been increasingly popular. Timber growth models, harvesting simulation models, and land use models are examples of the numerous applications.

In place thereof, models covering the whole forest sector (forestry and the forest industry) either at national or regional level were not common before the 1980s. Recent experience from many countries indicates, however, that these holistic models can be of major importance in policy analyses and other planning activities (Seppälä et. al. 1983).

FINNISH FOREST SECTOR MODELS

Background

Because of the rapid expansion of the production capacity of the primary forest industries in Finland, the annual allowable cut was temporarily exceeded at the beginning of the 1960s. This led to increased investments in forestry to guarantee sustainable yields in the future. Concern over the optimal allocation of forestry inputs was the first step towards building a forest sector model.

It became soon evident that it was not reasonable to concentrate on wood production in isolation from the forest industry. A project to construct a policy analysis model for the whole forest sector was therefore initiated in 1973. The aim was to develop a tool to assist decision makers to study and evaluate the long-term consequences of different policy options concerning the forest sector. The model was completed in 1979.

MESSU - a simulation model

The construction of the first Finnish forest sector model, called MESSU, was partly based on a Scandinavian forest sector model SOS, developed by Randers et. al. (1976). There was also an effort to "finlandize" the SOS model by re-parametrizing it, but this was not very succesful because of structural differences between Finnish and the common-Nordic forest sectors (Kuuluvainen 1979).

In principle, MESSU was a System Dynamics model. The SD approach was, however, applied in a rather liberal way. The model covered the whole forest sector from the growth of the forests to the global end-product market. It was built up of seven submodels (modules) shown in Fig. 1 (Seppälä et. al. 1980).

At product level, the model was very aggregated, consisting of only one forest industry product. On the other hand, it possessed a wide range of socio-economic features, such as population, urbanization and labor supply dynamics. (Kuuluvainen and Seppälä 1983.)

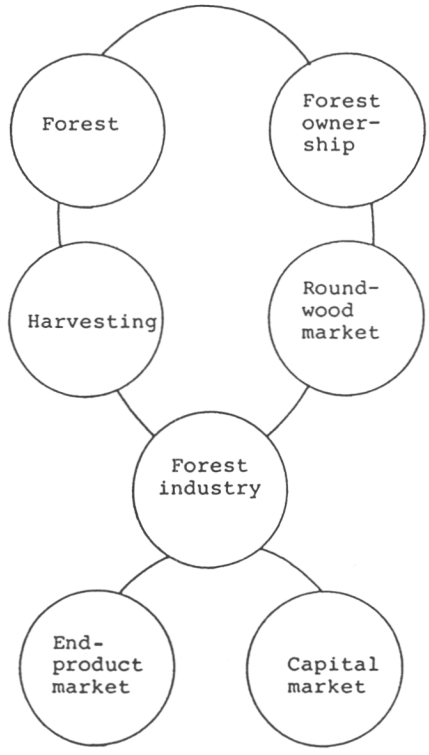

Figure 1. The general structure of the MESSU model.

Scenarios based on model runs showed that the problems of the primary production of the forest industries in Finland have two main sources: domestic raw material constraint, and low profitability of the industry connected to a weak financial situation. The availability of wood raw material is not, however, constrained by physical availability (suistainable yield), but by the decreasing supply from non-industrial private forests.

D L P - a d y n a m i c l i n e a r p r o g r a m m i n g m o d e l

Using a simulation technique one can evaluate the consequences of specific policies. Using only simulation, however, it is difficult to find a "proper" (or optimal) policy. For this an optimization technique is needed.

Based on the experience gained from the simulation model MESSU, a dynamic linear programming model, DLP, was constructed for the Finnish forest sector in 1978-80 (Kallio et. al. 1985). Objective functions related to GNP, balance of payments, employment, wage income, stumpage earnings, and industrial profit were formulated. Product assortments consisted of 17 industrial products.

Although the DLP and MESSU models were built using a different modeling paradigm, their outcomes were surprisingly similar. The explanation is that both models had a similar basic structure tending to reflect the "real" structure of the Finnish forest sector. This experience demonstrates the importance of the correct structure in a model. Structure can be more vital to a good model than the modeling technique or precise parameter values.

M E S T A - a t h i r d g e n e r a t i o n m o d e l

Partly building on the Finnish experience of forest sector models, IIASA (The International Institute for Applied Systems Analysis) commenced its work on the global trade model, GTM. After its completion in 1985, GTM has been extensively used in Finland to analyse questions such as changes in stumpage prices and exchange rates, and effects of trade barriers and acid rain. In spite of this, it was decided to again build a new model for the Finnish forest sector. The process of building this MESTA model is still going on.

In MESTA we so far have only two geographical units: the country of interest - Finland - and the rest of the world. We have lumped all Finland's trading partners into the rest of the world component and consequently precluded the identification of bilateral trade flows. As a starting point, this seemed reasonable. Otherwise, the structure of the model is more or less the same as that of IIASA's GTM (see Kallio et. al. 1987).

The next task is to make the two region model more spatial. This means the inclusion of more regions, and bilateral trade flows. At the same time, we try to link the existing forest management planning model, MELA, into MESTA. The MELA model is a long term model describing the timber production possibilities of large forest areas (Siitonen 1983). In fact, MELA has already been "softly" linked to MESTA by using its results as exogenous parameter values. This has been done primarily to evaluate the so called Forest 2000 Programme (The Forest 2000 Programme 1986).

On the end product side, we have emphasized the strategic role of printing and writing papers in the future development. They are therefore segregated into four grades. In MESTA there are altogether 24 products (21 of which are traded).

The demand side of this type of model is, in principal, simple to formulate. One only has to define the rest of world's import demand relations, one for each product. In MESTA, the dynamics of the import demand are based on FAO (1986) projections of consumption of forest products. Thus, we do not have to worry about democraphic or income developments since they are already taken into account in the these projections.

Because the model building process is still going on, MESTA has not yet been intensively applied to policy analysis or any other purpose. Nevertheless, an example of typical application can be given concerning the evaluation of the Forest 2000 Programme.

The Forest 2000 Programme

In the Finnish Forest 2000 Programme, cutting and timber production targets are made up to the year 2010. However, no economic analysis has been made to evaluate the forest industries' ability to expand its capacity to meet these targets. We have tried to do this with the aid of MESTA.

The evaluation process raised many questions; such as what should the stumpage price be in A.D. 2000 to meet the cutting targets? Similarly, do different decisions concerning the national energy policy have any influence to the international competitiveness of the Finnish forest industries? The answers to such questions have so far been the main results of the MESTA model.

CONCLUSION

We feel in Finland that our relatively long and still continuing tradition of forest sector models has produced both scientific and practical results. This tradition has, for its part, provided the impetus for IIASA's Forest Sector Project, which in turn further stimulated expanded research in forest sector and trade modeling throughout the world. There is also good reason to believe that scenarios produced by forest sector models have influenced decision making in many countries.

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Classification and Assessment of Forest and Forestland Degradation

by
Victor Sosa

I. INTRODUCTION

I.1 GENERALITIES

This paper is based on the revision of the project assessment for the tropical forest resources in Latin America (1981) and on the format and guidelines developed for the Asia-Pacific region (1986), realized by FAO, as well on the experiences derived from the national forest inventory of Mexico, and on the forest inventory projects in development at different levels as a part of the Agreement for forest cooperation between Mexico an Finland starting from 1982. The paper includes some ideas for the 1990 world forest resources assessment.

I.2 ASSESSMENT OF THE FOREST RESOURCES ACCORDING TO THE MEXICAN LAW.

According to the provisions of article 6° of the new mexican forest law (1986) "The Ministry of Agriculture and Water Resources, has the responsability for compailing and organization the national forest statistics, as well as for integration and updating the national forest inventory and wildlife inventory". This law consider as basic principles, the ordination of watersheds, the adequate land use and the integrated management of the forest resources and its interaction with other activities (agriculture, grazing, et cetera).

1.3 MEXICO-FINLAND AGREEMENT.

Bearing in mind this principles of the law, it will be neccesary to make a second national forest resources assessment. A new methodology will be testes in the state of Tlaxcala, within the framework of the Mexico-Finland Agreement as a previous work of the general project. In this project will be necessary to incorporate, the recommendations of this meeting, in order to have an updating and compatible system.

II. CLASSIFICATIONS FOR THE FOREST RESOURCES ASSESSMENT

May be is convenient to adapt the name of the second tropical forest resources assessment for 1990, in order to avoid any confusions, in the special case of Mexico for instance, there are in addition of the tropical regions, big temperate forest areas as well as others with dry vegetation. So, the actual name is not as wide as neccesary to reflect the different vegetation types existing.

II.1 OBJECTIVES

The objectives for the 1990 forest resources assessment should be clearly established at both, national and international levels. At a national level the objectives could be: to outline policies, to support sectorial planning and the execution of the Programs. Meanwhile at international level: the monitoring of the quantitative and qualitative changes of the forest resources in order to determine, the impact of their use and conditions in the environment quality, and to identify support actions from the international organizations (financing, technical assistance, et cetera), as was established in the papers sent by FAO for this meeting.

II.2 CONCEPTS

The concept of "land with natural woody vegetation" could be clearer, if it is defined as" a land where the woody elements cover more than 10 porcent of the ground, and has not other permanent uses".

II.3 LAND USES

The classification utilized in the 1980 assessment, is for present woody vegetation. In the classification for the Asia-Pacific region, it has been incorporated the present land use categories, present information and change projections for this use. Some observations concerning these classifications are:

- To analyze the possibility of separating the present land use and its changes, and to include information concerning to potential land uses and necessities for specific periods, in order to avoid overlaps like non permanent agriculture related to forest fallow, or land to be affo rested in the future.

- Changes suggested in the Format and Guidelines for Asia-Pacific region, about the denomination of some concepts are considered adequate (opera ble instead of productive, or managed instead of intensively managed, et cetera).

- In order to fill adequatly the Chart B of the document for the Asia - Pacific region, it should be necessary to explain clearer, the way to get the information for the concepts "Total land" and "Other", as well as how the potential afforestation land could be taken into - account (There is an overlap between present and potential land use).

- The concept "Managed Forest" should be clearly precised as "a forest ten ding at a maximum sustained yield in the long term, where the regenera - tion is assured". In the form like is described could produce some con- fusions or mistakes in the case of Mexico.

- In the case of undisturbed forest, the "operable forests" could be di- vided into different operable classes according to their use possibili- ties, infraestructure, isolation, et cetera.

- The first national forest assessment of Mexico, does not include in its presentation at a national level, information about land uses, planta - tions, and data concertning to operable, inoperable, undisturbed, clo - sed and open forests. In this sense, the information for the 1980 assess ment was very difficult to get, and may be it isn't enough suitable.

II.4 CONCEPTS OF VOLUME

The 1990 forest resources assessment will include not only tropical vegetation, in the specific case of Mexico, the more important forest are coniferous in temperate zones, for these coniferous forests is convenient to in clude the concept of "Commercial volume"

II.5 BIOMASS

As it is recommended in the document for the Asia-Pacific region, the biomass production, for instance for fuelwood, should be considered on both, outside and inside forests.

II.6 OTHER INFORMATION

It is necessary to analyze the possibility of including another information like: allowable cut, projected demand of wood from natural forest and plantations, and the effects of the depletion and degradation on the forests.

III. INFORMATION OBTAINING

III. 1 PROCEDURE

As is mentioned in the document for the Asia-Pacific region, is better that the information of each country must be compiled by local personnel, with the technical advice of FAO.

It would be recommendable to complement the format and guidelines now existing by annexing specific methodologies, in order to support the countries about the best way of getting some information like deforestation, use of remote sensing, variable projections, biomass calculations, et cetera.

III.2 FEASIBILITY

The forest inventory of Mexico at the subnational and national levels is almost stoped now . And if this situation continue, it is possible that the information for the 1990 assessment won't be obtain over realistic ba-

sis. That is why it is necesary to accelerate our second national forest resources assessment with international support as we have from Finland and from international organizations like FAO. It is also necessary to make additional studies in order to define operable forests, land use changes, growing stock, allowable cut, biomass, production, depletion and degrada - tion effects, etc.

IV. USE OF THE INFORMATION FOR PLANNING

It would be convenient that the information from the 1990 world forest resources assessment, might be connected to a complete and comprehensive pla nning system. In this way it could be possible to put clearly into practi ce the use of the information at different levels: subnational, national, and international ones, in order to make appropiate decisions and execute concrete actions.

This would help to identify excess or lack of information and to know its con crete use for each specific case. We could say for instance, that planning and executing of the activities, could requiere not only the knowledge of the present land use, but the desirable one, and also the quantity of natu - ral forests and plantations in order to reach the necessary national wood pro duction, and the forest types posibilities of production. We should also estimate the impact of the forest resources development in the water produc - tion, agriculture, grazing and to get aditional data concerning social and economic aspects. A system like a forest balance could help to clarify many of this things.

V. CONCLUSIONS AND RECOMMENDATIONS

- The 1990 world forest resources assessment has to carry out within the framework of a well defined planning and action system, in which the par ticipation of the international organizations and all the countries in - volved in the proccess must be assured.

- Technichal advice from international organizations like FAO for underdeveloped countries would be a good support, specially through handbooks and methodologies for forest resources assessment at subnational and national levels, sectorial forest planning and procedures to get social, economic, forest resources and environmental variables, for an integrated analyze.

- It is convenient more involving of the political and technical levels closed related to the forest activities in each country, in the assessment tasks, the achievement of this action needs additional efforts and support from the international organizations.

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Assessment of the Forest Resources of the Asean Region and their Management

by
H.C. Thang

1. INTRODUCTION

The ASEAN member countries, (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore and Thailand) with the exception of Singapore, are fortunate to be endowed with extensive areas of tropical rainforests which are amongst the oldest and most complex ecosystems in the world. These forests have provided the basic essentials of food, energy and materials as well as water and arable land to meet the needs of the people in the ASEAN region since the dawn of mankind.

In recent years, the forest resources in the ASEAN region have also become an important source of foreign exchange earnings necessary for the implementation of socio-economic development programmes in the ASEAN member countries. The increasing pressure on the tropical rainforests in response to the growing demand for tropical hardwoods and other commodities has resulted in many consequences including:-

(i) depletion of the forest resources;

(ii) wasteful exploitation and utilization of trees;

(iii) deforestation through current harvesting practices;

(iv) inadequate conservation or renewal;

(v) impacts on the environmental quality; and

(vi) degradation of soil and water resources.

Although the ASEAN member countries have emerged as the most important suppliers of tropical hardwoods for the world in recent years, and in spite of the fact that the tropical forest resources in the ASEAN member countries have been exploited at a rapid rate, the region is still fairly well endowed with natural forest resources as shown in Table 1 below:-

Table 1 : Status of Forest Land in ASEAN Member Countries (million hectares)

Country	Land Area	Forest Area	Percentage Total of Forest Area
Brunei Darussalam	0.58	0.47	81.0
Indonesia	181.16	143.90	79.4
Malaysia	32.86	19.31	58.8
Philippines	29.82	15.50	52.0
Singapore	0.06	*	*
Thailand	51.31	14.91	29.1
Total	295.79	194.09	65.6

* Negligible

It is evident from Table 1 that the total area of forest land in the ASEAN region amounts to approximately 194.1 million hectares, which represents about 65.6% of the total land area of the region with Brunei Darussalam, Indonesia, Malaysia and the Philippines still have more than half of their total land area under forest.

2. FOREST RESOURCES ASSESSMENT AND MANAGEMENT

2.1 Brunei Darussalam

The national forest inventory of Brunei Darussalam was completed in 1984 by Anderson & Marsden - Forestry Consultant Ltd., a private company based in Singapore.

Traditionally the forests in Brunei Darussalam have been managed under the modified Malayan Uniform System but in recent years there have been concerted efforts to manage these forests under a selective logging (management) system modelled after the Selective Management System of Peninsular Malaysia.

2.2 Indonesia

Since the late sixties, Indonesia has been carrying out low intensity reconnaissance survey with the aim of providing basic forestry information for the purpose of assigning utilization right to concession holder, and uptill 1985 a total of about 90 million hectares had been surveyed. This survey uses

systematic strip sampling at average intensity of 0.2% to 0.3%. The distance between strips is 5 km apart with the width of each strip being 20 m wide. All trees having a diameter of 20 cm and above at breast height or 20 cm above buttress are recorded while stem heights are measured through the use of Christenmeter at free branch and buttress. Other information collected include accessibility, forest conditions and topography.

For more detail information, Indonesia employs systematic strip sampling at 1% sampling intensity with the distance between strips being 2 km apart.

Assessment of stand volume is also being carried out with the aid of aerial volume tables which were constructed from aerial photographs of scales 1 : 10,000 and 1 : 20,000 through the measurements of crown closure (%), crown diameter and average stand height (Anon., 1987).

Currently, Indonesia is planning to embark on a national forest inventory in 1988 for a duration of seven years through the assistance of the International Bank for Reconstruction and Development. The objectives of this inventory are to provide reliable and adequate information on forests and forest lands so as to enable the formulation of strategic forest policy and forest management plans at the national, regional and provincial levels; and to develop methodology and strengthen institutional capability to continue future national forest inventories.

Under this inventory it is envisaged that forest stratification will be carried out using LANDSAT MSS and SPOT at scales 1 : 250,000 and 1 : 100,000 respectively. In high priority areas, new aerial photographs of scale 1 : 20,000 will be flown at systematically spaced intervals of 10 km to 20 km on UTM grid. Field sampling will be carried out using a 9 plots cluster. Each plot will consist of two sub-plots having common centre. The largest sub-plot will have a radius of 26.6 m on which all trees having a diameter of 50 cm and above will be measured. The smaller sub-plot will have a radius of 13.3 m and on it all trees having diameters between 20 cm and 49.9 cm will be measured (Indrabudi, 1987). The total cost of this national forest inventory is estimated to be US$ 14 million.

The natural forests in Indonesia are generally managed under a selective logging (management) system with the objective of retaining a minimum of twenty five well-distributed trees (residuals) of good quality for the next cut.

2.3 Malaysia

In 1981 and 1982 the second global forest inventory was carried out in Peninsular Malaysia to collect and update the forest resources information obtained during the first global forest inventory which was carried out in 1970 - 1972 by the FAO under the Forestry and Forest Industries Development Project.

The objective of the inventory was to enable the Forestry Department to review and/or update the various policies and strategies that had been formulated for the development of the forestry sector in terms of the capacity of the forest resource base to support the wood-based industries and the formulation of more effective forest management systems in accordance with the principle of sustained yield management.

Under this inventory, the forested lands were stratified into eleven broad forest types (excluding mangrove forests) using panchromatic black and white vertical aerial photographs of scale 1 : 25,000 while the sampling was carried out using random cluster sampling, in which each cluster sample comprises twelve separate sample plots of 50 m x 20 m each and three sub-plots of 50 m x 5 m. The sample plots were arranged in a 4 x 3 matrix with the sampling lines being spaced at 200 m apart from one another while the distance between plot centres was 150 m apart.

All trees having a minimum diameter of 15 cm at breast height were enumerated. The occurrence of rattans and bamboos were also recorded in each sample plot.

The field data collected were then analysed by computer from which stand and stock tables were produced by species/species groups, diameter classes and diameter limits; and quality classes for each cluster sample and for each forest type found in each state and that of Peninsular Malaysia. Forest resource maps of scales 1 : 250,000 and 1 : 750,000 were also produced.

In Sabah, the first statewide forest inventory was conducted in 1969 to 1972 under the Canadian Bilateral Aid Programme (Colombo Plan). The objective of this inventory was to collect forest resources information so as to enable the state government to formulate proper forest development and management plans for the Permanent Forest Estate as well as for the wood-based industries.

Fixed area rectangular plots were used during the inventory which were randomly allocated to each forest type taking into account the frequency, extent of occurrence and accessibility of the forest types. From the inventory data, height-diameter equations, tree

volume equations, stand and stock tables were prepared. The tree volume equations and volume tables were constructed to three utilization standards for the inland forest while for the mangrove forest the tree volume equations and volume tables were constructed to two utilization standards only.

Currently, the State Forest Department of Sabah is carrying out a statewide inventory of the disturbed forest with the assistance of the FAO/UNDP as vast areas of the Permanent Forest Estate were released for logging since the first forest inventory. The objective of this inventory is to collect information on the location, stocking, composition, distribution, condition and competitive status of the disturbed forests so as to enable the formulation of appropriate silvicultural and management prescriptions. This project which started at the beginning of 1986 is expected to be completed towards the end of this year.

Forest sampling is carried out sequentially using systematic line plots, comprising principal plots of size 60 m x 20 m and four sub-plots of 20 m x 20 m, 10 m x 10 m, 5 m x 5 m and 2 m x 2 m.

Apart from the enumeration of trees and seedlings, the incidence of rattans in the 60 m x 20 m plot and climbers in the 10 m x 10 m plot will also be recorded. The field data will be analysed by computer and colour-coded stock maps of scale 1:5,000 will be prepared. The occurrence of rattans and climbers will also be indicated by using codes to be written above each of the 60 m x 20 m plot.

In 1969 to 1972 a forest resource inventory was carried out in Sarawak by the FAO under the Forestry and Forest Industries Development Project covering a total area of 1.2 million hectares through the use of Basal Area Factor (BAF) 10 (ft^2/acre) wedge prism with each ground sample consisting of a cluster of nine plots. The main objective was to collect basic data necessary to facilitate the formulation of industrially oriented forest sector development plans.

Following this forest resource inventory the State Forest Department of Sarawak has been carrying out forest inventory on different forested areas annually. The sampling design and methodology used in this inventory are essentially the same as that used by the FAO except that the sampling intensity is much higher [wedge prism of BAF 5(m^2/ha)]. It is anticipated that through this ongoing inventory programme, the total timber resources of the state will be quantified. In the Mixed Dipterocarp Forest, the growing stock of all trees having a diameter of 45 cm and above are estimated while for the species Gonystylus bancanus (Ramin) which is found in the Peat Swamp Forest, the growing stock is estimated for all trees having a

diameter of 30 cm and above. Stand tables are prepared for trees having a diameter of 20 cm and above for the more important species only.

At the end of 1985, a total of 3.56 million hectares had been inventorized which represents 41.2% of the total forested land of Sarawak. Of this, 1.98 million hectares or 22.9% were in the Permanent Forest Estate while the remaining 1.58 million hectares or 18.3% were in the stateland forest.

Since the beginning of this century when the first Forest Officer was appointed in 1901, the forests in Malaysia have been systematically managed. Over the years, ecologically sound forest conservation and management practices have been developed to ensure forest renewal and sustained yield. Currently, the natural forests of Malaysia are being managed under the modified Malayan Uniform System (MUS) and the Selective Management System (SMS) with cutting cycles of 55 years and 30 years respectively. The MUS consists of removing the mature crop in one single felling of all trees down to 45 cm dbh for all species and releasing the selected natural regeneration of varying ages which are mainly the light demanding medium and light hardwood species. This felling operation is followed by climber cutting and poison-girdling of defective relics down to a minimum diameter of 15 cm. Approximately 5 to 7 years after felling a linear strip sampling is carried out to verify the presence of sufficient regeneration on the ground and subsequently to determine suitable silvicultural treatments especially in Peninsular Malaysia and Sabah. In Sarawak, liberation thinning is carried out whereby only trees that overtop or are too close to those selected for the next crop are removed through poison-girdling as current harvesting practices seldom remove more than 25 trees per hectare. It is estimated that the number of potential final crop trees liberated is sufficient to provide, in approximately 30 years, a selectively-cut harvest equal to that currently cut which is 15 to 20 trees of listed species above 60 cm diameter including defective trees.

The SMS is designed to optimize the management objectives of economic and efficient harvesting, sustainability of the forest and minimum forest development cost, under prevailing conditions. It requires the selection of a management (felling) regime based on inventory data, instead of an arbitrary prescription, which will be equitable to both logger and forest owner as well as to ensure ecological balance and environmental quality. Under this system of forest management which is in practice in Peninsular Malaysia, when the next cut is expected in 25 - 30 years after the first logging with an expected net economic outturn of 30 m3 - 40 m3 per hectare enriched with dipterocarp species, the following prescriptions are generally followed (Thang, 1986):-

(i) the cutting limit prescribed for the group of dipterocarp species should not be less than 50 cm diameter at breast height;

(ii) the cutting limit prescribed for the group of non-dipterocarp species should not be less than 45 cm diameter at breast height;

(iii) the residual stocking should have at least 32 sound commercial trees per hectare for diameter class 30 cm - 45 cm or its equivalence;

(iv) the difference in the cutting limits prescribed between the dipterocarp species and that of the non-dipterocarp species should be at least 5 cm; and

(v) the percentage of dipterocarp species in the residual stand for trees having diameter at breast height greater than 30 cm should not be less than that in the original stand.

The sequence of operations under the Selective Management System is as follows:-

(i) pre-felling forest inventory using systematic line plots and determination of appropriate cutting limits;

(ii) climber cutting to reduce damage during logging with tree marking incorporating directional felling and no marking of residual trees for retention;

(iii) felling of all trees as prescribed; and

(iv) post-felling inventory using systematic line plots to determine residual stocking and appropriate silvicultural treatments.

2.4 Philippines

In the Philippines the first national forest inventory was conducted in 1965-1969 and currently the second national forest inventory is in progress. This forest inventory was initiated in 1978 with the assistance of the FAO when a pilot project was then established in the island of Mindanao. This was followed in 1983 when a bilateral agreement was reached between the Government of the Philippines and the Federal Republic of Germany to continue this forest inventory which is scheduled to be completed in March 1988. The total cost of this inventory is estimated to be US$ 2.5 million.

A two stage sampling design using LANDSAT false colour composites of scale 1 : 250,000 and small scale aerial photographs of scales 1 : 30,000, and 1 : 60,000 as the area frame, and clusters of relascope sample plots for information on the growing stock, was developed for this inventory (Schade & Uebelhor, 1986).

For the dipterocarp forest, a six-point cluster in a triangular arrangement is used with relascope factor 9 (m^2/ha). The distance between the point samples is 50 m apart. For the pine forest, a triangular arrangement of three Bitterlich point samples or recording units with a basal area factor 4 (m^2/ha) is used and the distance between the Bitterlich point samples is 75 m. In the relascope sampling, only trees with a diameter of 15 cm and above are included where the species name, diameter and commercial height are recorded and for trees having a diameter above 35 cm the number of logs and log grade are also being recorded. A regeneration survey including rattans, bamboos and erect palms is carried out at the three corner point samples on circular plots of different radii.

In the mangrove forest the sampling unit consists of 50 m sampling line where all trees having a diameter of 15 cm and above are measured 30 cm above stilt roots and 5 m on both sides of the sampling line. Smaller trees and the regeneration are counted on three circular sample plots per strip in the same way as that for the point clusters. The distance between the sample plots is 15 meters (Gulmatico, 1987).

The dipterocarp forests of the Philippines are managed under a Selective Logging System. This System consists of three phases which are as follows:-

(i) marking of trees to be left as residuals for the next cyclic cut, the determination of which is prescribed by a marking goal formula developed for the purpose;

(ii) residual inventory to determine the actual structure and quality of residual stands left after logging; and

(iii) timber stand improvement which involves primarily the removal through girdling or cutting of the undesirable trees and other competitors in order to enhance the growth of the crop trees and to increase the total yield of harvestable volume at the end of the cutting cycle.

This Selective Logging System is intended to eventually convert the natural dipterocarp stands into managed multi-storey and multi-aged stands. Cylic cuts of 30 to 45 years are prescribed, the length of which is based on the climatic type within which the stand falls.

2.5 Thailand

The Royal Forest Department of Thailand had planned to conduct a complete national forest inventory every five years. However, due to some internal problems the first national forest inventory which started in 1961 was completed in 1968.

Camp-Unit System is used in carrying out the forest inventory in Thailand where locations and number of camps are permanently fixed on the map. One fifth of the camps which are systematically located 15 km apart throughout the country will be sampled each year. A complete cycle of forest inventory is therefore expected to be finished within five years.

Each camp represents an area of 225 sq km and comprises four units. The distance between centres of units and camp is 1,700 m. Each unit comprises four tracts which are located 700 m from the unit centre. Each tract, which forms a side (300 m) of a square, comprises 20 circular sample plots of radius 17.84 m or of area 0.1 ha. The sample plots are 60 m apart. The actual area of all sample plots of each camp-unit will cover 0.04% of the represented area of 225 sq km (Anon, 1986).

The Royal Forest Department of Thailand is now emphasizing more on working plan inventory. The sampling design and methodology used in this type of inventory are essentially similar to that used under the national forest inventory except that the intensity of sampling is much higher (2%). For the fiscal years 1982 to 1986 as much as 3,000 km^2 of concession forests were inventorized yearly and for the fiscal years 1987 to 1991, the Royal Forest Department plans to continue with the working plan inventory for some selected areas throughout the country (Kakhong, 1987).

Besides the above, since 1973 the Royal Forest Department of Thailand has been utilizing LANDSAT imageries of scales 1 : 500,000 and 1 : 250,000 with the aid of 1 : 1,000,000 diazochrome colour composite in classifying and mapping the forest resources of Thailand. Uptill 1986 base maps for forest inventory planning and forest management at scales 1 : 250,0000, 1 : 500,000 and 1 : 1,000,000 for the years 1973, 1976, 1979, 1982 and 1985 had been completed (Klankamsorn, 1987).

All forests in Thailand are state properties and these forests are managed under a Selection Cutting System. Under this system of management a forest will be divided into 30 annual coupes of almost equal area. Theoretically, all trees at their allowable cutting limits will be selected and marked one year prior to logging and during harvesting, approximately 30% of these selected trees will be retained for the next cutting cycle and the rest will be removed. The allowable cutting limit of each species is designated

by Forest Acts, and varies from diameter limits of 6.5 cm to 47.5 cm. After the forest has been harvested, it is generally left to natural regeneration to produce the final crop for the next cutting cycle which is usually after 30 years (Anon, 1986).

3. PROSPECTS

Past attempts to appraise the forest resources of the ASEAN region have been unsatisfacatory due to serious inadequacies in information. Furthermore, there are significant differences in the definition of land categories and in usage or interpretation of terminology. Consequently, the information obtained has been of very limited value, primarily because it does not meet the tests of relevance, reliability and timeliness, and secondly because it may be inconsistent, anomalous or even erroneous. Moreover, the forest land base is shrinking, utilization rates are changing, and the marketability (and, hence value) of the products is uncertain.

In recognition of the critical importance of the forest resources in the ASEAN region and the serious counter-productive effects resulting from misuse of these valuable resources, the ASEAN member countries agreed to establish the ASEAN Institute of Forest Management which became operational in January 1986 with the appointment of its Director. The total operating cost of the Institute (5 years) is estimated to be US$ 7,685,000 which is jointly funded by the ASEAN member countries and the Government of Canada.

The objective of the Institute is to develop and provide the ASEAN member countries with the management and operational expertise in forest inventory, and forest planning of the natural forest in order to maximize socio-economic benefits from their tropical forest resources.

Hence, it is hoped that through the ASEAN Institute of Forest Management, the remaining tropical rainforest of the ASEAN region can be better appraised with the objective of formulating sound and effective policies, plans and programmes for rational management, utilization and development of these resources on a regional basis.

Currently, the Insitute is developing a common ASEAN forest classification, a common ASEAN forest inventory terminology, a forest inventory manual, an inventory projection model, a resource allocation model and a land use model.

4. CONCLUSION

Despite the importance of forestry in the region and the widely recognized need to measure, monitor and manage the resource, there is generally still a lack of adequate forest management inventories in all ASEAN member countries.

The critical element in all cases is insufficient computer facilities to process, store and update inventory data. Moreover, it is apparent that the world and regional requirements for tropical woods will increase rapidly during the coming decades. Thus there is an urgent need for improved planning, management and development of the ASEAN forest resources.

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