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Scope and Approach to World Forest Resource Appraisals.

Mål och inriktning för studier av världens skogstillgångar.

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FOREWORD

The first version of this report was hastily written in early 1977 as an end of project report. This first version is a summary of the experience gained from my work with FAOs World Forest Inventories and the forest resource reports mentioned in the bibliography (Persson, 1974, 1975 and 1977).

My intention was to publish the report in a final version after I had received comments and could make the necessary adjustments and a final editing. Actually rather few comments have been received. During the two years that have now elapsed I have had a number of new ideas. Some of these ideas have already been discussed in another report (Persson, 1978 b) and others will be discussed in detail in a forthcoming article.

For these reasons I have judged it best to keep the changes in this present report to a minimum. A complete rewriting has not been possible, but I have edited and included "summaries" of new aspects and ideas. The "concluding discussions" (chapter 7) have been rewritten completely. In that chapter I discuss in some detail why knowledge is so limited. The emphasis here have been changed quite drastically. Appendix I also contains new information.

Many people have helped me with this work over the years. I am indebted to all those at the Royal College of Forestry in Stockholm and FAOs Forestry Department who have helped me at different stages. I should also like to thank Dr Bo Hektor (SIAR) for his valuable comments.

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ABSTRACT

This report argues the need for reliable statistical information about the world's forests. It discusses the type of information needed, the work done so far in the field of International Forest Resources Appraisals, the difficulties in undertaking such appraisals, the limitations of present knowledge, methods hitherto used and methods that may be used in future appraisals. The most urgent task in this connection is to establish a World Forest Resources Data Bank.

The main message of the report is that little is known about the world's forest resources. Improvements are needed at the national level since international statistics must basically rely on national statistics.

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1 INTRODUCTION

1.1 Background

Man is becoming familiar with every crater on the far side of the moon, but still does not know how much of the world's surface is covered by forest. This report discusses the present state of knowledge of the world's forests, and methods which can be used to improve it.

In the effort to collect information about the world's forests, FAO has undertaken at five-year-intervals from 1948 four "World Forest Inventories" (WFI). These WFIs are by no means true forest inventories, being rather a collection of figures giving some information about the forest resources in different countries. The name "World Forest Inventory" formerly used by FAO has now been changed to World (or Regional) Forest Resource Appraisal, which is more appropriate.

From 1968 to 1972 I worked at FAO Headquarters in Rome on the fifth version of the WFI. The work was not completed during my stay at FAO; in connexion with my return to Sweden, it was agreed between FAO and the Royal College of Forestry in Stockholm, that I should be given time to summarize the information I had gathered during my stay at FAO. This work has therefore been completed at the College in Stockholm.

This has led to the publication of two reports: World Forest Resources (1974), which in short country notes summarizes knowledge about the forests in all countries of the world, and Forest Resources of Africa (Part I in 1975 and Part II in 1977), which tries to describe in detail the forest resources in African countries and their potential for wood production. The present report is intended to summarize the experience I have obtained over the years concerning the collection of information on international forest resources.

1.2 Statement of the problem

The basic problems discussed in this report are as follows:

- Why is information on international forest resources needed?
- What kind of information is needed?
- What has been done to collect information and what is available?
- What is the knowledge gap?
- How should a World (Regional) Forest Resource Appraisal be carried out?

1.3 Some basic facts

To facilitate the reading and understanding of the report some basic facts and conclusions are given here.

Each year international organizations inside and outside the UN family produce an enormous amount of statistics covering most aspects of human life and the conditions on earth. The international statistics must always be based on the statistics collected by national authorities. These have sources of error. The method for collecting the information is rarely known.

The quality of the international statistics is generally speaking bad. In spite of this the international statistics are quoted with reverence and are often considered as the absolute truth.

The low quality of the international statistics depend on three basic reasons:

1. The statistics are often not available at the national level. The information given, if any, is then pure guesswork.
2. The statistics collected at the national level are often of bad quality.
3. Even when countries produce information of acceptable quality international organizations must collect and interpret this information as best they can.

The comparability of the statistics is often poor. One reason is that different countries use different definitions. The definitions used in e g UN-questionnaires are often interpreted differently.

The international statistics give few details. Better information is often available at the national level. The national totals published in international statistics can often hide important differences within a country.

A lot of available information cannot be traced or prompted by a questionnaire. Neither is it possible to collect data about any problem areas. In such cases often only "approved" information is given. Misleading information can also be given when there is competition between countries. The international organizations cannot give any qualitative statements about the statistics they collect.

When it comes to forest resource statistics it is a fact that knowledge about the world's forests is very limited. The forests can perhaps be seen as the remaining blank areas on the world map.

Increased knowledge about forest resources is needed firstly at the national level. International statistics must in the cheapest way try to utilize this national knowledge. Questionnaires are not suitable for this work. As a first step the knowledge must be collected through travels, correspondance, litterature surveys etc. Much can be gained by collecting and organizing the knowledge actually available in the countries. Then knowledge must be improved at the national level.

In this report the term Regional Forest Resource Appraisal will be used whenever feasible. I prefer to see a World Forest Resource Appraisal as a summary of Regional Appraisals.

2 WHY IS INFORMATION ON INTERNATIONAL FOREST RESOURCES NEEDED?

2.1 General

At the national level forest resources are often utilized in accordance with objectives formulated by government. The translation of qualitative objectives into quantitative aims and targets, and into the policies and strategies to be employed to attain these aims, requires long-term (strategic) planning. (FAO 1974 a.) Long-term planning of the utilization of natural resources can be said to be the weighing between the needs of today and the needs of tomorrow.

Planning requires information about conditions that influence utilization of resources. Strategic planning of the utilization of the forest resources requires e.g. knowledge about the national forest resources. In Sweden this knowledge is collected by the National Forest Survey. Its objectives have been formulated as follows (SHS 1973).

"The National Forest Survey shall continuously give information for planning and control of the forests' utilization as a natural resource at both district and national level.... The information shall show the actual forest conditions, activities carried out and other changes that have occurred."

The need for information varies of course from country to country. The more intensive is utilization, the more detailed the statistics must be. In Sweden, forest resources are now utilized so intensively that increasingly detailed knowledge is needed. To meet the objectives the following information is required (SHS 1973):

- A description of soils, vegetation, terrain, site-classes, forest stand, accessibility class.
- Estimates of standing timber per ha within classes of forest stand, specified by species, dimensions and qualities.
- Description of the area where exploitation has taken place, estimate of exploited volume by species.

- Estimate of the size of the increment and its variation with climate.
- Description of clear-felled areas and young forests.

Even all the information mentioned here is now, sometimes considered barely adequate. According to many researchers, for example, better recording of changes is needed.

What has been discussed so far in this chapter concerns mainly the so-called industrial forestry (see below). This is no doubt the usual way of discussing forestry. In a country like Sweden this sector is also very important. Forestry is, however, composed of at least three important sectors:

Economic Market
Industrial forestry

The utilization of existing forests and creation of new forests in order to meet the existing and future demand of wood for industrial use.

Farm forestry (Village forestry or Forestry for Community Development.)

The utilization of existing forests and tree lands and creation of new forests in order to meet the existing and future demand for domestic wood (fuelwood and farming timber), fodder and minor forest products.

Environmental forestry

The production of environmental services such as erosion and water-control including wildlife management and conservation.

This means that the concept of forest production whenever used must cover the whole range of goods and services provided by the forests. Forestry should adopt a multi-purpose approach when feasible.

In this context it is suitable to quote the following paragraphs from Nilsson (1971):

"As guidance for the following discussion, the objectives of forestry could be defined as follows.

Forestry aims at satisfying the present and future demand for major and minor forest produce and for the protective and recreative functions of the forests (wildlife, tourism), taking into account competing claims from other sectors (agriculture) and the urgent need of creating employment opportunities in rural areas.

This definition has the advantage that it points out the need for a realistic appraisal and evaluation of the present and future demand for forest production. (Forest production defined in a wider sense in accordance with the concepts of primary and secondary area production.) The conventional name for such studies adopted by FAO is "Timber Trend Studies and Prospects". In order to indicate that forest production, in a wider sense, must be taken into account and that the prospects as given by the trends or otherwise should not automatically be accepted as a target for the planning, I would propose the following concept to be adopted.

Forest Production and Consumption Studies (trends, prospects and targets). The National Forest Inventory, thus, should provide adequate data for Forest Production and Consumption Studies."

National Forest Inventories (and other types of inventories) shall give information that can be used for planning and practical implementations. Often they have given only an interesting description of the forests. This may be interesting from the geographical point of view. The questions raised have been badly formulated. The planning has then often been more dependent about existing statistics than on important questions.

In the case of private forest owners the value of statistics can be calculated in economic terms (Sprängare, 1975). It is more complicated to decide the value of statistics at the national level. One could, however, ask what would be the result if we did not know our forest resources in Sweden. One possibility could be that the forest industries were over-

established. Another possibility could be that industry was badly developed (due e g to fear of over-establishing). It would hardly be possible to undertake any meaningful planning of the forestry sector.

Although the detailed objectives of forestry are different in different countries I am convinced it is mad to lack knowledge of forest resources in all countries. Without a proper knowledge of forest resources a sensible planned utilization is practically impossible.

At present forest resources are evidently heavily utilized in many tropical countries. In some years time log-export will have to cease and the existing industry will have difficulties in finding wood. It is also said that existing resources of vegetation used for fuelwood are dwindling in many countries. Without proper evidence it is difficult to prove that certain actions are needed.

It must be admitted that forestry has many interested parties. I have talked from the point of view of government. As examples of interested parties can be mentioned government, political parties, the Forest Service, the Agricultural Department, the Industry Department, other government authorities, private industry, private forest owners, the public, journalists, workers, worker's unions and protectionist groups.

These interested parties have different interests. The time-horizon is e g different for different user-groups. Some of the interested parties may also consider it to their advantage if the resources are not well known to all interested parties.

2.2 The need for knowledge about international forest conditions

That knowledge is needed at the national level is more or less self-evident. It can easily be proved by discussing examples of what would happen if certain information did not exist or what could happen if information existed.

It is much more difficult to prove the need for international forest resource statistics. The need is often taken for granted. Sometimes a

parallel is drawn between the need for knowledge about the world's oil resources and the world's forest resources. Most researchers seem to find it self-evident that we need information about the world's forests and the world's living biomass. The basic problem would be to find methods to collect this information. To some extent I can agree. As I see it, it is necessary to try to evaluate the value of all kinds of research and the increased knowledge it gives. One reason why many inventories are bad may be that the need for a "description" of the forest resources is taken for granted. It is important not to get carried away, fascinated by a scientific or technical problem without evaluating the value of these efforts.

A good "world forest inventory" requires more resources than most research. It is therefore important to clearly explain the value of increased knowledge. If good arguments for its value are not found it will be difficult to get hold of the necessary funds.

To be able to evaluate the need and value of international forest resource statistics it is necessary to know the main users and the main uses they make of the statistics. According to my knowledge International Organizations, International Banks, National Forest Services, other national authorities, the forest industry, producers of forestry equipment, consulting firms, researchers, development authorities and journalists are up to date the main users of international statistics. The statistics are also commonly used in the introduction of speeches and in general articles about a great many subjects.

2.2.1 The requirements of governments authorities

At national level there is mainly a need for knowledge about the country's own forest resources. If such information is lacking, plans cannot usefully be made. For national planning, knowledge about the surrounding world is, however, also needed. A country must know what opportunities exist for exporting goods produced in surplus and what possibilities they have of importing the products they do not produce (assuming that the foreign exchange situation permit import of forest products). For

this reason they must know the probable future market for various forest products. This knowledge provides a framework for national planning. How should existing forest resources be utilized? What new forest resources must be established?

The countries need information about the surrounding world mainly as it concerns the planning of industrial forestry. In the case of planning of farm forestry and environmental forestry there is not in the same undisputable way a need for knowledge about the surrounding world. Fuelwood and poles can e g hardly be imported at a large scale in the case of a shortage. The needs for environmental forestry in a country are not so often influenced by conditions in other countries. In some cases, however, environmental forestry in a country can be beneficial in other countries.

In addition to the international information needed for planning utilization of national resources, there is a need in developed countries for information for the planning of foreign aid. An acute shortage of fuelwood in parts of Sahel scarcely influences forestry in Sweden; but in planning foreign aid policy, it is necessary to be aware of existing or potential crisis areas. For instance - what problems exist or may develop due to shortage of fuelwood or paper or destruction of the natural forests?

In this case, therefore, there is a need to know the situation concerning all forestry sectors in the developing countries. It must be concluded that it is difficult to define exactly the type of information that may be needed in the case of farm forestry and environmental forestry. This is because the questions raised can be of such very different types.

In order to be able to utilize knowledge about the forest resources for a proper planning of the forest resources there is a need for a strong national agency responsible for planning. A strong national agency which utilizes the national and international information for planning does not always exist. In some cases the "national planning" is mainly done by a number of private companies. These companies may then have most of the existing knowledge.

2.2.2 The requirements of forest industry

For proper planning of investments, forest industries need information about future trends in the production and consumption of forest products in different countries and regions. It is also necessary to know the potential production capacity of the forests in these countries (or regions). Is it possible to forecast a future lack of wood or a surplus? Can wood in the future be supplied cheaper from other parts of the world?

It is also increasingly of interest to the wood-based industries, mainly those in industrialized countries, to identify areas in the world with under-utilized forest resources or with climate and edaphic conditions suitable for plantations of fast-growing species. The forest resources in many traditional forest industrial countries are limited compared to the prospective demands of the forest industries. The forest industries in these countries are now often looking for areas (countries) in which to establish forest industries, to buy wood, establish plantations or perhaps more commonly to sell their know-how.

Long-term trends can be of greater value to the government than to the forest industry. The future trend for the coming thirty years may indicate a brilliant future for the forest industry. But this knowledge may be less important to the forest industry than the fact that the coming five years may be disastrous. For its policy-making government must consider long-term trends. The knowledge about the world's forest resources are of importance firstly for discussions of long-term perspectives. Knowledge about the present capacity of the industry etc are of greater importance for short-term perspectives.

2.2.3 The requirements of international organizations

It is neither possible nor necessary for every country to collect for themselves all international statistics needed for planning. The existing international organizations should provide member countries with statistics. In the case of forestry statistics FAO has hitherto provided most of the international statistics. The international organizations shall not only collect statistics but also analyse them.

According to 2.2.1 some knowledge and understanding about the factors influencing the future balance in the world (or regions) between the production and the consumption of forest products is needed for national planning. FAOs "Timber Trend Studies" have for many years attempted to provide such information. These are probably the most important forest studies hitherto carried out by an international organization. Emphasis will firstly be put at a discussion of the Timber Trend Studies.

Many related studies are undertaken by international organizations and also by national authorities. The international organizations ought also to be responsible for identifying most of the problem areas mentioned in 2.2.1.

2.2.3.1 Regional Timber Trend Studies and their need of statistics

Background

In 1950 the member countries of the FAO/ECE Timber Committee asked FAO and ECE to investigate the nature and development of wood requirements and of the productive capacity of the forest resource for Europe as a whole. This investigation was intended to provide the regional framework within which national plans and policies affecting the forestry in the reconstruction of post-war Europe.

The study was completed in 1953. Similar studies were later undertaken by FAO and the various UN Regional Economic Commissions for Asia-Pacific (1961), Latin America (1963) and Africa (1967). In 1967 these reports were the basic information used in preparing the FAO report "Wood: World Trends and Prospects".

The study for Europe has been revised several times, most recently in 1976. New studies have also been undertaken for Asia-Pacific and Latin America.

Objectives

In the Latin American Timber Study of 1963 the aims of the study were given as follows:

"The general aim of this study can be stated simply: It was undertaken to provide a basis of information for decisions by planning agencies, forest producers, and forest industries. The hoped-for result will be achieved if the information presented here helps the forest and forest industries of Latin America to contribute better to a rapid and orderly economic development.

Viewed more narrowly the study has the following aims:

1. To present qualitative estimates of present forest-product consumption and corresponding estimates of the wood supplied by the forests for the manufacture of these products.
2. To present estimates of future requirements for forest products, based on probable demographic and economic changes.
3. To analyse the problems and opportunities revealed by a comparison of these estimated future requirements with the productive capability of the forest resource.
4. To offer recommendations regarding forest industry and resource development as an aid to planning agencies in their efforts to promote economic advance."

The first studies were mainly descriptive. As more information has become available the analyses have increased in importance.

Method used

Data has been gathered for a description of the existing situation of the forest resource and the consumption and production of forest products. Information was initially available in the World Forest Inventory and the annual FAO Yearbook of Forest Products. Additional data was ob-

tained directly from government agencies. It has become evident that this basic information often had serious limitations. FAO has therefore often tried to use other sources of information.

The economic and demographic data needed in the study were sometimes prepared by the study team and sometimes taken from the various UN Economic Comissions. The estimates e g of economic growth and population growth were normally made by subregions.

The future requirements for wood products, as estimated in these studies, are forecasts of the consumption of forest products for assumed levels of economic activity and population; they also assume that supplies of forest products will be available on the scale needed, without any change in relative price. Assumptions are made concerning the way in which the relationship between per capita consumption of different wood products and income will develop.

There are som slight differences between the methods used in the different studies. The principles are however roughly the same.

Information given in the Timber Trend Studies

The studies give a detailed appraisal of the present production and consumption of wood products in different countries. The studies also evaluate present forestry conditions.

As regards forest resources, the studies have mainly tried to evaluate forest areas. In Europe, figures for standing timber and increment have also been utilized. For other regions figures for removals have mainly been cited. In the latest studies, however, attempts have been made to use some crude estimates of standing timber.

The studies also provide estimates of the future consumption (or rather requirements) of wood and wood products and the forest's potential for producing wood. Estimates of the future balance between supply and demand are discussed. In the case of the calculated future requirements (and balances) for wood products, the calculations are made by subre-

gions. For present consumption and production of wood and wood products, information provided by each country is normally given.

Discussion

Although valuable, the Timber Trend Studies (and studies of related type) have, according to my opinion, certain limitations:

- Most balance studies give in reality forecasts of the requirements and not of actual consumption. We do not know how great the requirements will be or what will be the actual cost of producing wood at the end of the period discussed. We have hardly any indication of what will be the actual consumption of wood in a future period.
- Little consideration is taken of the availability of wood in different countries. The forest resource statistics utilized are also of low accuracy.
- Consideration is normally only given to the requirements that show up as market demands. The real requirement may be quite different.
- The studies assume the same relative income distribution as during the base period. If the increase in income is concentrated to e g the wealthiest or poorest quarter of the population there could be a great difference in requirements.
- Prognoses of these types show often spontaneous development. Extrapolations of present trends are often considered as the truth (at least by the reader). The prognoses often show the development based on wishful thinking rather than reasonable expectations.
- One may ask if economic development will follow logic rules. Development is often influenced by political decisions. Many of the pulp mills recently established in tropical countries can be cited.

Trend studies may sometimes give the impression of academic exercises. In spite of all complicated regression analysis the studies give rather little information about what in reality may happen in the future. They

show what may happen under certain specific circumstances. One may ask if they should not consider more which possible misjudgements exist in our picture of the world. Scenarios could often be more useful than the traditional trend projections.

2.2.3.2 Comments about other international studies

In addition to Timber Trend Studies (and related "balance studies") the international organizations make many studies which call for information about international conditions. Some of these studies are complements to the Regional Timber Trend Studies. Other studies are concerned with farm forestry or environmental forestry. Important examples are mentioned here.

a) Policy making by international organizations

International organizations must often make studies to clarify their own policy and try to identify the need for action. These may take the form of a detailed study of questions discussed only superficially in the Timber Trend Studies, and may sometimes serve to clarify a problem that has earlier been underestimated. The increasing understanding of the importance of fuelwood in the developing countries may be mentioned as an example. Agro-silviculture is another field, the importance of which is becoming increasingly evident. Some problems of this type may be of interest to investigate but may also be politically difficult. As an example can be mentioned the importance of agrarian reform to rural development. International studies of this type can provide Forest Services with arguments for use in discussions with their governments. The potential of forestry is fully utilized in very few countries. If FAO demonstrates the importance e g of agro-silviculture or environmental forestry, this should be of great help in national planning. The Forest Services (or FAO) cannot initiate development without the necessary information and knowledge.

b) The relationship between developing and developed countries

The industrialized countries have developed without much international planning and statistics. They have all benefited more or less from free

trade. The developing countries seem to have been caught in a situation in which they depend greatly on the industrialized countries. The present trade pattern is not to the advantage of developing countries. The dependence of the developing countries therefore must be changed. This will probably not happen through any *laissez-faire* system. Individual national planning will not be enough. International studies are needed to find out what has gone wrong, and what can be done to change present patterns.

One may for example ask in this context what would really be the beneficial development of forest industry in different types of developing countries? Is the establishment of large pulpmills in developing countries really to their advantage? Should they all try to become self-sufficient in paper? To what extent are the present development trends within the forest industry in developing countries governed by the interest of developed countries?

That studies of the above type are needed must be evident. These studies should result in realistic recommendations. What can the developing countries do to develop and utilize their own resources? It is not likely that the industrialized countries will undertake the necessary changes in trade patterns and so on of their own free will. The more the developing countries know about these conditions the better chance they must have to get things changed. The developing countries must also be made aware of the information they can benefit from.

c) As other examples can be mentioned the need in certain fields for international planning and cooperation

FAO has hitherto undertaken most of the studies of this type (a-c) that are of forestry interest.

2.2.4 Other requirements

In addition to the studies mentioned many other studies are being made at present. A lot of work is going on to try to decide how the climate, carbon cycle etc is influenced by changes in the vegetation cover. Without adequate knowledge such studies are impossible. The result can be

pure nonsense. The decrease of forest resources and the fuelwood crisis are at present the most popular international forestry subjects among laymen.

Most articles about international forestry (by researchers, journalists etc) suffer from the lack of reliable statistical data. Many user groups do not know how to analyse international forest resource statistics. The first available figure is taken as absolute truth. Sometimes protectionists want to give alarming figures. Recently a high Swedish official said that "forest" resources in the world had decreased by 2.5 billion ha between 1950 and 1973. If he instead had said that the decrease was from the days of Adam it would not have been complete nonsense.

2.3 Conclusions about the need for information about the world's forest resources

So far the discussion has to a great extent concerned the balance between consumption and production of different forest products. The need for information is most evident in this field. There are however also other fields where there are a need for information about forest conditions.

As examples can be mentioned the need to know the world's total biomass or to know the changes in the biomass. Many environmental problems should also be known better. The need for information about the world's forests is however not met by information of adequate quality.

In the case of Timber Trend Studies (or "balance studies"), the need for information could in theory be satisfied if the countries themselves provided information about planned production and expected consumption of wood and wood products.

But not all countries have comparable plans and investigations. Production can within wide limits be influenced by man. Forests can be over-exploited and industries can expand more than has been planned. Plans may for many reasons rapidly become obsolete. Existing national plans in any case must be compared. Can the countries concerned import as much as they consider necessary and can they export as much as they wish to?

The different national calculations must be made comparable. Future consumption, for example, should be estimated by using comparable assumptions about the development of prices.

So even if national plans (and estimates) for production and consumption exist, this is not enough. It is also necessary to know the potential for forest production in different countries. In which countries do the largest unutilized forest resources exist? In which countries do the greatest potential for new forests exist? Which countries are now overexploiting their forest resources? What plans are there for increased wood production (e g from new plantations)?

To be able to make useful Regional Timber Trend Studies, detailed information about the forests in the region is required. Information about forest conditions and trends in different countries is also needed for many other international studies (see 2.2.3). Sometimes complete statistics are required - sometimes examples are enough. It is impossible to tell exactly which forest resource information is needed for these different studies. If we accept that Timber Trend Studies require detailed information about forest conditions and about the potential for forest production in different countries, it is likely that this will in most cases be adequate for other purposes, too. If more detailed statistics are required, the possibility of collecting additional details must be assessed from case to case.

Considering this discussion the primary objective of a World (or Regional) Forest Resource Appraisal can be formulated as follows:

"A World (Regional) Resource Appraisal should principally collect, analyse and provide the information about forest resources in different countries, that is needed at the national and international level in order to quantify existing and future forest potential."

Another objective should be to identify the major gaps in knowledge that are to be reduced or removed.

The objectives chosen here depends very much on the question considered to be most important. If the objectives had been formulated by someone from UNEP, IUCN, UNESCO, a geographer or a journalist they would have been formulated differently as the basic questions would most likely have been different. A principal objective is often formulated in national surveys. Information to meet this objective is searched for. The cost of collecting other additional information would often be low. Such information is also nearly always collected. In theory this could be the case in World (Regional) Forest Resource Appraisals.

In summary one could say that the most important thing is to give information so that the forest resources (or let it be national resources in general) can be utilized in "the best way". Forestry ought especially to play its potential role in the developing countries.

For most studies forest resource information is not enough. There is a need for other kinds of information. The forest resource information gives the physical conditions for forestry but says nothing about the cost for forest production etc.

It must finally be concluded that the statistics collected must be of adequate detail and quality for the purpose for which they are to be used. If statistics of inadequate detail and quality are used in sophisticated studies the end-result may be nonsense.

3 WHICH FOREST RESOURCE INFORMATION IS NEEDED?

3.1 General

From the discussion in chapter 2 it is concluded that the information collected should primarily make it possible to forecast (or at least indicate) how much wood can be produced now and in coming years. Here information about forest resources needed to give a picture of the potential of forests in both the short and the long-term perspective will briefly be discussed. There are six main types of information:

- Description of existing resources (area information, volume, increment, etc)
- Fellings and removals
- Past trends in utilization and development of the forest resources
- Expected changes in the forests' capacity to produce wood (e g new plantations)
- Felling forecasts
- Potential cut

Of the six types of information mentioned above the four first are necessary in order to be able to calculate the two last. The three first register facts. The three last give prognoses.

What is discussed may look like a catalogue of information. The description starts with the most basic information (land use) and proceeds stepwise towards ever more detailed information. When a detailed kind of information is available (e g of standing timber) the need for certain more elementary information (e g crown-density) may decrease. The same method must be used at the national level.

The information discussed here should in principle be available in each country. (At least in a simple form.) It is the minimum set of data needed at the national level. This information is needed for national production and consumption studies. A world (regional) forest resource appraisal must try to utilize the national data base as far as possible.

At the national level there is of course a need to have an inventory system where the problem dictates which detailed kind of information is collected. It must quite obviously be more difficult to collect problem-oriented information at the international level. It will at least take a long time before the specific data needed is known for all countries.

The different items discussed here are defined in a broad way (when necessary), the reason why they are needed are given, and the type of information that can be of value is discussed. Many of the arguments given refer to conditions in tropical regions (or countries where available information is scarce).

3.2 Area information

3.2.1 Land use

Information about the present land use should be collected in all inventories. This information would show the importance of wooded areas in relation to the overall land use pattern. As an example, a modified version of a land use scheme recommended by FAO (FAO 1973) is given here.

I. Total land area

A. Forest and other wooded areas

1. Forest

- a) Natural forest
- b) Man-made forest

2. Other wooded areas

- a) Savanna, open woodlands
- b) Heath, stunted and scrub forest
- c) Trees in lines, windbreaks and shelterbelts
- d) Other areas

B. Non-forest area

- 1. Agricultural land
- 2. Other lands

There is also a need to classify non-utilized areas according to their potential for forestry. What size of plantations of fast-growing species could theoretically be established? There is certainly also a need to classify forest areas according to their potential for agriculture. In many countries, forest areas with a potential for agriculture will be converted to agricultural use. Often there is also a great need to classify different areas according to the environmental services they provide or ought to provide. Certain forest areas are best utilized for water control. Certain agricultural areas ought to be taken out of production and planted by trees. These last points relate mainly to a land-capability classification. Such classifications are needed but very rarely undertaken.

What is discussed in the paragraph above concerns basically national surveys. It is at present hardly possible to consider these kinds of statistics in an international forest resource appraisal.

3.2.2 Forest and other wooded areas

The description should classify the wooded areas according to different conditions. The National Survey in Sweden classifies e g the forest area by vegetation, terrain, site, forest stand, accessibility, age-classes, cutting-classes, owner, density, trees per ha, etc. These classes can be combined, e g cutting-classes with ownership classes or age-classes with ownership and altitude classes.

It is here of basic importance to have a clear definition of forest or different types of wooded area. What is forest? There is no undisputable, logical definition to use when one discusses forest resources at world level. The meaning of the word varies from country to country. In some countries, large areas of scrub have been classified as forest.

Fig 1 shows diagrams for a few ecoclines. (Ecocline = A gradient of eco-systems.)

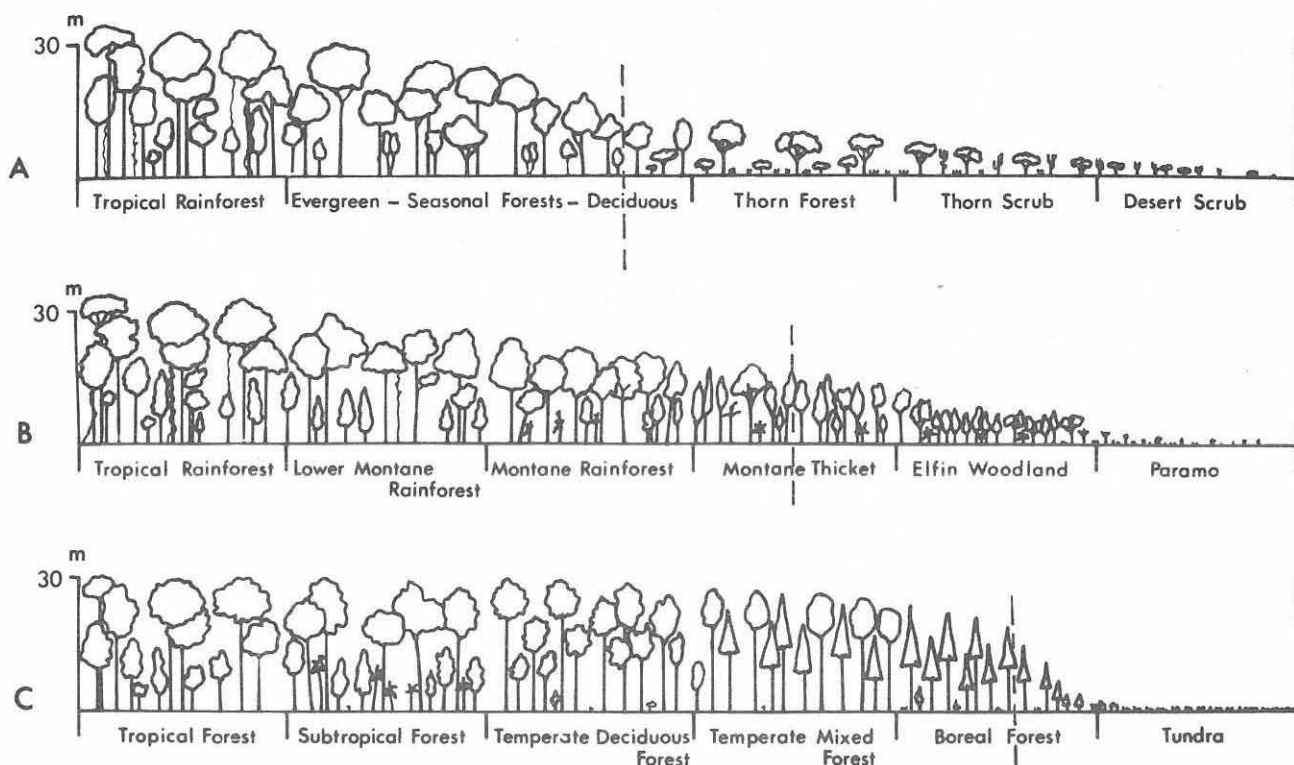


Fig 1. Diagrams for three ecoclines. A. Along a gradient of increasing aridity from rainforest to desert in South America. B. Along an elevation gradient up tropical mountains in South America. C. Along a latitudinal gradient. (After Whittaker, 1971)

The boundaries between forest and non-forest can be drawn in several places in these diagrams. The specific question to be answered (e.g. timber forest, fuelwood forest, protection forest) decides where the boundary is drawn. The dotted vertical lines indicate crudely where the boundary has been placed in my own reports.

FAO in its latest definition (1967) makes a distinction between "closed forest" (or rather forest) and "open woodland". Closed forest is defined as having a crown-cover (the projection of the crowns on the ground) of more than 20 per cent and open woodland as having a crown-cover of 5-20 per cent. Simplifying somewhat, one may say that the definition of

closed forest is meant to identify the wooded areas (forest types) that can be of interest to industrial forestry. The open woodlands include e g the different types of "savanna forests", which are found in the tropics. These types are now of limited importance as suppliers of industrial wood, but are in many areas of great local value for the supply of fuelwood and other household wood. The open woodlands can sometimes have a great potential for wood production if they are planted with fast-growing species.

The boundary between forest and open woodland in the tropics is often clearer than that shown e g under A. in fig 1. This is due to the influence of fires in dry areas. The closed forest (rain forest) is more resistant. There are, however, a number of borderline cases.

The dry vegetation types are changing very rapidly, as a result of the influence of man. They may vary from relatively dense forest to open forest within a short distance. The tropical rain forest can vary from closed forest to bush in a mosaic pattern, depending on shifting cultivation.

These examples are intended to show that there are no clear boundaries between different types of forest. Neither are there always clear boundaries between forest and non-forest. Bush fallow after shifting cultivation: Is this young forest or non-utilized agricultural land?

It is necessary to classify wooded areas according to their importance for wood production (as well as for other uses). The value of one type may vary from country to country. Non-utilized land may often be of interest too.

Since the questions asked are changing continually, there is reason to describe all wooded areas relatively completely or rather, to describe the present tree cover on all kinds of land. The work must, however, normally be carried out most intensively for the forest types that provide industrial wood.

We shall discuss here the basic classifications of forest and other wooded areas that are necessary. These classifications concern mainly their potential for wood production. As has been mentioned there is also a need to classify wooded areas according to the environmental services they provide. This classification must normally be done in connection with the land use study (or rather the land-capability classification) already mentioned.

3.2.2.1 Vegetation types (forest types)

It is nearly always necessary to classify forest and other wooded areas into vegetation types. This classification may e g be used to stratify by volume. It may also show the potential of the forests.

As examples of the major types, may be mentioned broadleaved, coniferous, mixed coniferous-broadleaved, bamboo, mangrove, palms, woodland, savanna woodland, tree savanna. An additional breakdown of each type by species, species groups, climate type and so on, is normally also needed.

3.2.2.2 Maturity classes

It is nearly always necessary to have some classification of the forest area into maturity classes. It is necessary to know how large a part of the forest area consists of mature forest, regeneration etc.

In the temperate zone, the forests can be classified by age-classes. Related to this is the classification of forests into cutting-classes or management-classes. It is difficult to make a meaningful age-class classification for a whole region (especially in the tropics). What is old forest in one country may be middle-aged or even young forest in another country.

A crude classification into "maturity classes" can possibly be made comparable within a region. As examples of categories in such a classification may be mentioned blanks, degraded forest, young forest, middle-aged forest, old forest, over-mature forest. This information would at least give some indication of how much mature forest can be found, how much forest is under regeneration and so on.

3.2.2.3 Density

We should now know the distribution of maturity classes in different vegetation types. The next step must be to describe the density of the forest. Is e g the mature forest open or closed? This information can give a crude idea of the value of forest resources.

The density of a stand is often expressed as a decimal coefficient of full density. Density may e g be described in terms of crown-cover (the projection of the crowns on the ground in relation to the total area).

3.2.2.4 Human influence

Most vegetation types are influenced by man in one way or another. In most cases a description of the present status of the forests is needed. If possible, every forest type (vegetation type) should be classified in respect of the degree of human influence to which it has been exposed. The following scheme is shown as an example:

Managed

- Intensively
- Extensively

Unmanaged

- Undisturbed (climax vegetation)
- Disturbed (e g shifting cultivation, selective cutting)
- Heavily disturbed (bushes, secondary vegetation)

Information about exploited and unexploited areas is often of great value. Sometimes it can be the only "quality classification" available.

3.2.2.5 Accessibility

Let us now assume that we have a first crude idea about the value of the forests. The next step must be to get hold of information which shows the physical possibilities of utilizing the existing resources. Are the forests situated in remote areas or are they situated close to

the market? Is the terrain difficult for utilizing? To obtain an idea about the opportunities for utilizing different forest areas, forest land must be classified by types of terrain (e g swamps, mountainous areas). The important first step is to identify the areas where utilization is very difficult. This information should also be possible to trace in most countries. Of still greater importance is information about how forest areas are situated in relation to roads, industries and export harbours.

Accessibility as discussed above gives no indication as to whether an area will be utilized or not. This depends very much on the value of the existing forest. At a more advanced stage an accessibility classification (or ranking of areas for utilization) should be made, depending on the actual value of the forests.

3.2.2.6 Information concerning forest policy and administration

In addition to the physical factors which describe the value of the forest and the possibilities of utilizing it, there are also administrative factors about which it is often necessary to know when the feasibility of utilizing the forest resources is to be judged. Some of the most important concepts will be mentioned here.

Forest reserves (Permanent forest) are those parts of the forest which are effectively protected against destruction and in which provisions are established to ensure maintenance of the forest vegetation. In many countries, the forest reserves alone are of interest for continuous forestry. Forest areas outside the reserves are often considered to be without value. It is necessary to know these conditions for each separate country.

Protection reserves are those parts of the forest in which all industrial cutting and all destruction, such as burning, is prohibited. Protection reserves cannot be utilized for wood production, and it is therefore necessary to know the extent of such areas, so that the area which can be used for commercial forestry can be identified.

Ownership shows the legal owner of the land. When the forests are privately owned, the government has often greater difficulty in changing e g the exploitation policy, than is the case when all forests are owned by the state. For such reasons it is often necessary to know the ownership conditions in forest land. It is also necessary to know whether the possibilities to utilize the forests are different between owners. Due to ownership conditions utilization can be impossible in certain forest areas.

Tenure. In WFI 1970 questionnaire (Africa) tenure was defined as follows: "For the purpose of this enquiry tenure is concerned with the civil or juridical person operating the land and not the owner of the land. Tenureship can be derived from ownership, lease contracts, cutting licences or traditional right of usage. It can also be illegal."

The information can be of interest to know e g in countries where large forest areas are under concessions. In such cases the interest for long-term management of the forests can be very limited.

3.2.2.7 Man-made forests

The man-made forests must often be described separately and in more detail than other forest areas. The description should e g give a breakdown of the planted area by species, age-classes and site-classes. Such a description is most important in the case of man-made forests that have considerably different qualities than the natural forests (e g plantations of fast-growing species).

3.3 Volume information

Chapter 3.2 shows the basic area information we need to collect in a Forest Resource Appraisal. This means a step-wise more detailed description of the forest area. In a Forest Resource Appraisal a detailed description of the area is not adequate. Information concerning the standing volume is also needed. What types and what quantities can be found in different types of forest?

In principle, we wish to know how much sawtimber, pulpwood and so on can be continuously produced in different forest areas. This is of course partly an economic question, and varies from country to country.

Since information concerning the potential production often cannot be obtained it is necessary to give a rather complete description of the standing volume. This will always give some indication of how much wood can be produced.

Discussion about the definition of standing volume

It is evident that a figure giving the total of standing timber does not give enough information. There is a need for a breakdown of the total standing volume into species, dimensions and qualities.

One must also define which kind of volume(s) is to be given. The problem of defining volume is most pronounced in the case of mixed tropical hardwood forests. In FAO "Manual of forest inventory" (FAO 1973) the following terms are defined: Total volume, gross volume, net volume, industrial volume, log volume, other usable volume and branch volume. The term "commercial" can be added to the terms industrial, log volume and other usable volume or to specified portions of the volumes and then distinguishes the volume which can economically be removed under given conditions. This classification is changing continuously. The total net volume of commercial species is rarely removed in the tropics. Sometimes only half this volume reaches the market (Lanly-Lepitre 1970).

Example of volume descriptions

To simplify matters, only an example of a breakdown of total stem gross volume is given here. The same kinds of breakdown can be given for other volume concepts when this is necessary. The following breakdowns should at least be given in inventories:

- The total stem gross volume of standing timber classified by species (or species groups), dimensions and qualities. This information should not only be given for the total forest area but also for different land use classes, vegetation types, maturity classes, density classes, accessibility classes and so on.

- The above information could also be given as mean-values per ha. Such figures give information which is more easily interpreted than figures for total volume.

This information would then make it possible to see e g how much wood is to be found in mature forests in easily accessible areas or how much wood of sawtimber size is to be found in a specific forest type. The rate at which these resources can be utilized depends on a number of factors e g increment, status of the forests, forest policy.

3.4 Increment

For discussion of the potential productivity of the forests, information about the total volume of standing timber is not enough. It is also necessary to have information about the increment of different species and species groups, and in different types of forest.

The knowledge of increment in the world's forests is at present very limited (especially in the tropics). In climax forests net increment is by definition zero. The gross increment is balanced by natural damage. Where selective cutting occurs in tropical forests, the net increment may be in non-commercial species. In large parts of the world's forests information about net increment is not only missing, but is also of very limited interest. Information about gross increment may in theory be of greater value, since it gives an indication of how much wood the forests can produce if fully utilized. If information about gross increment and total drain is available, it is possible to decide whether the wood resources are increasing or decreasing. How much wood can be exploited annually without reduction of the total volume of standing timber?

It is a fact that many studies of tropical forests consider these resources to be static. This means that no increment is taken into account. Instead, estimates are made of how long existing resources will last if certain assumptions about exploitation are made. This is of course a very pessimistic view.

3.5 Past trends in the development and utilization of forest resources

An inventory must if possible show the changes that have taken place over a period of years. Is forest area increasing or decreasing? Is the composition of standing volume changing?

To be able to show such changes in detail, detailed inventories at intervals are required. The most important changes to record are the following:

- Changes in land use
- Changes in the volume of standing timber in different forest types
- Changes in density (m^3/ha) in different land use classes
- Changes in increment

It is also necessary to know the present (and past) exploitation of the wooded areas.

3.6 Expected changes

Information about expected changes in the forest resources is required when it is desired to know the future production of wood. An important question is whether the trends in changes seen so far will continue. As examples of questions can be mentioned:

- In what way will the existing forest resources change?
- In what way will the areas of man-made forests change?

3.7 Felling forecasts

Felling forecasts are here intended to show the estimated (or planned) exploitation during a coming period. This may e g mean that the forests will be overexploited. In the first place, it is necessary to know what volumes will be removed. What species and dimensions are expected to be exploited? How will this exploitation influence the forest resources? Information about the areas affected by different kinds of exploitation would also be of interest. How large areas will e g be clear-felled each year?

3.8 Potential cut

Felling forecast should show the estimated future exploitation. It is also of great interest to know the possible exploitation if all exploitable forests are put into production. The production quite naturally depends on the investments made in management. It can also vary with time.

It is also of interest to know how exploitation actually can increase. If it e g takes 30 years to bring a country's forest area into utilization the maximum production possible is of somewhat limited interest. How much can a country's forests produce in 10 or 20 years time? The answers can of course vary considerably with the assumptions made about investments in forest production.

3.9 Conclusions

It must be stated already here that for the moment it is impossible to collect all the different kinds of information discussed in 3.2 to 3.8. Is all this information really needed?

In 3.1 has already been mentioned that what is discussed in chapter 3 is an attempt to get a stepwise improvement of the knowledge. Some kinds of forest resource information is no doubt of greater interest than others.

At the national level there is a need for different inventories. The type of inventory undertaken depends on the questions to answer. Different kinds of inventories must put the emphasis on different kinds of information. This means that a National inventory must not put the same emphasis on all kinds of information. Neither must all National inventories put the emphasis on the same kind of information.

A detailed attempt to show the relative emphasis on different kinds of information in a World (Regional) Resource Appraisal is shown in table 1. This classification is made to meet the requirements of the objective discussed in the previous chapter.

At the national level the type of inventory (and amount and accuracy of the information collected) depends on the formulated objectives. In theory

the same holds true for a Regional (or World) Forest Resource Appraisal. It is, however, hardly to the same extent possible to define precisely the objectives of a Regional Forest Resource Appraisal (or to undertake different kinds of regional appraisals). I have identified the Regional Timber Trend Studies (or let it be Production and Consumption Studies) as the basic field where international forest resource information is needed. This is the principle behind the discussions in chapter 3.2-3.8. The information mentioned in 3.2-3.8 will hopefully be adequate for most other purposes too. It is, however, hardly possible to answer all possible questions about a region's forest resources. It is also very difficult to tell how accurate different types of information must be.

Table 1. The relative emphasis on different kinds of information in a World (Regional) Forest Resource Appraisal

Type of information	Forest and other wooded areas				Non-forest land	Total land
	Closed forests ³⁾		Open woodland	Scrub and brush land		
	Natural	Man-made				
Land use	-	-	-	-	-	I
Land capability	II	II	II	II	II	II
Vegetation types	II	I	III	IV	IV	IV
Maturity classes	II	I	III	IV	-	-
Crown - density	II	II	III	III	-	-
Accessibility	II	II	III	IV	-	-
Managed - Unmanaged	II	II	III	-	-	-
Exploited - Unexploited	II	II	III	-	-	-
Legal classifications ¹⁾	I	I	II	III	-	-
Ownership	II	II	III	IV	-	-
Tenureship	II	II	III	IV	-	-
Gross volume	I	I	II	II	III	III
Dimensions	I	I	II	-	-	-
Species	I	I	II	-	-	-
Quality	I	I	II	-	-	-
Increment	II	I	III	-	-	-
Past trends ²⁾	II	II	III	III	III	III
Future trends ²⁾	II	I-II	III	III	III	III
Felling forecasts	I	I	II	IV	III	III
Potential cut	I	I	II	III	III	III
Present removals	I	I	I	II	II	II

Priority classes: I - very important
 II - general estimate
 III - little emphasis
 IV - can be eliminated
 - not valid

1) E g protection reserves
 2) E g in areas of closed forest
 3) Crown - coverage more than 20%

It is not likely that a number of different World Forest Resource Appraisals will be undertaken. Different international organizations can, however, collect complementary information (depending on their special interests). They must normally concentrate on the information that is likely to be available. The classification in table 1 would be valid if a real world (or regional) inventory could be undertaken. In reality it is now impossible to collect all this information. The information is not of the same importance in all regions.

In the case of a World (Regional) Forest Resource Appraisal it is a question of getting a step by step improvement in the quality of the information. One could say that there is a natural sequence of data collection at international level.

The information mentioned in table 1 could for example be collected according to the following sequence:

- Step 1 Land use (to distinguish wooded from non-wooded areas)
 - Closed forest
 - Other wooded areas
- Step 2 Vegetation types in forest and other wooded areas
- Step 3 Maturity classes
- Step 4 Crown density
 - Human influence (e g exploited, undisturbed, managed)
- Step 5 Area and location of protection reserves
- Step 6 Accessibility
- Step 7 Volume information
- Step 8 Past trends
- Step 9 Expected changes
- Step 10 Felling forecasts
- Step 11 Increment
- Step 12 Potential cut

For each type of information the quality of the information can be improved step by step. In the case of e g accessibility the information can be stepwise improved as follows:

- Step 1 Identification of areas with very difficult logging conditions
(e g swamps, mountains)
- Step 2 Distance to road (area)
- Step 3 Terrain difficulty (area)
- Step 4 Distance to industry or port (area)
- Step 5 Combination of step 1 to 3
- Step 6 Cost to transport 1 m^3 of wood from the forest to industry or port

So far I have mainly discussed natural closed forest. In the case of man-made forests it may be easier to get hold of the information considered necessary. In the case of open woodland, on the other hand, it will certainly be very difficult to gather the information mentioned. But if one does not have information about e g crown-density it is very difficult to give any meaningful information about the area of open-woodlands. In reality one will certainly have to accept less detailed information in the case of open woodlands than in the case of natural closed forest and man-made forest.

Due to availability of information the scheme may also have to be adjusted somewhat. In reality one may for instance have to collect (and utilize) information about human influence (e g unexploited areas) before one collects information about maturity classes and crown-density. This is simply due to the fact that information about human influence is more readily available.

As a conclusion to this discussion one may possibly dare to state that it is after all of little interest to try to decide what information about the world's forests is really needed, and what information is less important. The risk of collecting too much valuable information is small.

Where complete information exists (e g National inventories), it is fairly easy to express the most important information in a few figures. The accuracy of this information is also fairly well known. Where information is incomplete (the normal situation), it is mainly a question of trying to obtain as much and as accurate information as possible. By adjusting this information in different ways one may manage to calculate figures that can be used in world or regional studies.

4 WHAT HAS BEEN DONE AND WHAT IS AVAILABLE?

4.1 General

The forest resource statistics collected by international organizations must in the main be based on the statistics collected by the national authorities. In theory certain information can be collected by satellites. The international organizations cannot, however, undertake their own surveys in the various countries. The national forest resource statistics quite naturally have sources of error. The international statistics can never be better than the sources available.

To be able to give the detailed information indicated in chapter 3, forest inventories are needed. Table 2 shows roughly the percentage of closed forest in regions where some form of inventory has been undertaken.

Table 2. Percentage of closed forest covered by inventories.

Region	Approximate percentage of closed forest area inventoried
North America	78
Central America	54
South America	10
Africa	13
Europe	71
USSR	40+
Asia	40
Pacific Area	40
World	42

Source: Persson, 1974

According to table 2, about 40 per cent of the world's forest was covered by inventories in the early seventies. This proportion would increase somewhat if all kinds of reconnaissance surveys, recent inventories etc, were included. It is evident that forest in the developing countries have been inventoried to a minor extent only. It should also be added that many in-

inventories give an incomplete picture of forest resources.

The figure of 40 per cent inventoried is useful when discussing how little we know but not when discussing how much we know. Countries with closed forests occupying not more than 10-15 per cent of the world's forests seem to have adequate knowledge about their forest resources (my own judgement).

Information about the forest varies from country to country - from very detailed information, to a complete lack of reliable data. In the countries that lack inventories there is often a number of sources which could be used to give at least a preliminary, rough but complete, picture of the forest resources. As an example can be mentioned vegetation maps, topographical maps, land use maps, forest maps, information from logging operations, botanical descriptions. Sources of this type are not always utilized in forest resource appraisals.

In this chapter will be given a detailed discussion of the work done hitherto. Especially I concentrate on the limitations (e g of the questionnaire approach). As requirements on a new World Forest Inventory may be raised one day I think it can be of value to document the experience gained so far. This chapter is therefore not only of historic interest.

4.2 The first attempts to estimate the world's forest resources

The first comprehensive attempt to estimate the forest resources of the world was made by Zon and Sparhawk from USA immediately after the First World War. The results of this inquiry were published in 1922 and served as a standard source of reference throughout the period between the wars. Ilvessalo and Jalava from Finland made further investigations in 1930.

In 1931 in Sweden Streyffert published an important study of the coniferous resources of the world. The next step was taken by the International Institute of Agriculture in Rome, which published estimates supplied by national governments in a series of yearbooks which appeared from 1933 to 1938. In 1946, available information concerning the world's forests was summarized in a report submitted to the Second Session of the FAO Conference under the title "Forestry and Forest Products -

- World Situation 1937-1946". In the same year Watson from Great Britain made an independent study which appeared in the Empire Forestry Handbook. The sources used in these studies were national reports, published material, correspondence, travels and questionnaires.

4.3 FAO's World Forest Inventories

4.3.1 Background

At the First Session of the FAO Conference in 1945, a recommendation was made that a world forest inventory should be undertaken as soon as possible. The first World Forest Inventory of FAO was carried out in 1947/48 and its results were published in *Unasylva* (Vol II. No 4, 1948 and Vol IV. No 2, 1950). At the sixth Session of the FAO Conference in 1951, it was recommended that available information on the forest resources of all countries of the world should be collected and published at five-year intervals. The results of the second inquiry were published in 1955 under the title "World Forest Resources". The third in the quinquennial series of World Forest Inventories was carried out in 1958, the results being shown in the document "World Forest Inventory 1958". The results of the fourth and most recent of the periodic inventories are given in "World Forest Inventory 1963" (published in 1966).

In the 1950s FAO started a project sometimes called World Atlas of Forestry. The project was evidently never finished. A report published in 1957 under the title "Le monde forestier. - Vol I - L'Europe et L'URSS" may have been the only visible result of this project.

In the past, several world or regional studies have been made outside FAO. The studies are mainly botanical and give very little information on the extent and value of the forests. Where statistical information is given, this is normally based on figures presented in the WFI.

During the past 30 years, nearly all work in the field of international forest resource statistics has therefore been done by FAO in its WFIs (and to some extent in the Timber Trend Studies).

4.3.2 Objectives of previous WFIs

The primary objective of the WFI was given in the recommendation of the Sixth Session of the FAO Conference in 1951: "... available information on the forest resources of all countries of the world should, at five-year intervals, be collected and published."

One of the basic principles behind the first reports was the fear of a shortage of wood. Zon and Sparhawk said: "As the timber shortages of the different countries develop, it is becoming more urgent for the world to know where its timber supplies will come from."

"The whole world is suffering from shortages of forest products. Are the forests of the world inherently capable of yielding more bountiful supplies of their products in the years to come, or must man forever resign himself to the present forestry situation?" (WFI, 1948)

There is too the question of whether forests are being destroyed. "The forest is a renewable resource, but it is also destructible" (WFI, 1948). The WFIs were undertaken at five year intervals and intended to provide a check on changes in forest resources from one inventory to the next.

Since ancient time man has explored the world in which he lives. That he seeks to know the extent of the world's forest resources and what is happening to it is natural for just this reason.

4.3.3 Method used for the previous WFIs

The information shown in these FAO appraisals was obtained by sending questionnaires to individual countries and then compiling the data contributed. Where insufficient information or none was provided, estimates were sometimes made by FAO personnel (at least to reach complete regional figures).

4.3.4 Shortcomings of the questionnaire approach

It has long been recognized that the questionnaire approach used for the WFI has many disadvantages. In spite of this FAO has continued

to use it. The main reasons are that it is considered to be a cheap method, and that no better (and at the same time cheap) method has been found.

The fact that the WFIs were based on data supplied by individual countries means that their accuracy and reliability varied according to the quality of the information available in the country to the respondent. A WFI cannot be better than its sources.

The limitations of the questionnaire approach depends, however, not only on bad base statistics at the national level; many other problems also exist. Some of the most important difficulties in using a questionnaire in a forest resource appraisal are summarized below:

- 1) It is difficult to formulate the most important questions in a questionnaire. One may usefully only ask questions which one can hope to have answered. The important questions differ from country to country. Some questions in the questionnaires have had a meaning only in one part of the world (e g coppice). The first WFI questionnaires perhaps concentrated too much on the forest conditions occurring in Europe (because the conditions there were best known).
- 2) It is hardly possible to make water-tight definitions. Furthermore, the definitions are not always read by the respondent.
- 3) With a questionnaire one can only collect part of the information that actually is available in the countries. Information available on maps cannot be collected in this way.
- 4) It is often impossible to recalculate the national statistics according to the standard definitions used by FAO.
- 5) The measurement units often differ in the reporting countries. This causes confusion.
- 6) The government agencies are increasingly burdened with questionnaires from different international agencies, and are becoming ever more reluctant to make the effort needed to answer them properly.

There has been a tendency for the number of answers received in some inquiries to decrease. The questionnaires are not always filled in by the most qualified persons, because these are occupied by more important tasks. Those who fill in the questionnaire have often little interest in the exercise.

- 7) An answer submitted in a questionnaire must always be considered as the truth even if it is known to be wrong. FAO cannot, without permission, change data submitted to them by a member government.
- 8) The FAO Conference recommendation in 1951 that a WFI should be undertaken every fifth year was based on the belief (or hope) that it would be possible to check on changes in forest resources by repeating the inventory. It has, however, proved impossible to compare figures from succeeding inventories. This is because changed figures are mainly caused by new definitions, new inventories, new estimates, etc and not necessarily by an identifiable change in the forest resource. Neither is it possible to say anything about improved knowledge.
- 9) Many countries do not want to give information about problem areas. Only approved information is then given. Sometimes countries are afraid that knowledge about their national conditions (e g forests) may be misused.

One of the strong arguments in favour of a questionnaire approach is (or was) that WFI questionnaires should have taught forest officers in different countries the main information they need to know about their forest resources, reminded them about this every fifth year and given them good definitions of important subjects.

This is probably true concerning questionnaires which are sent out annually. There is, however, reason to doubt that this is of great importance where the WFI questionnaire, which is sent out at five-year intervals, is concerned. The forest officer filling in the questionnaire on one occasion of the WFI is probably not in the same position on the next (and may not be in a position where this knowledge is of value). In my experience, most forest officers know nothing of the existence of a WFI questionnaire. It can therefore naturally not guide development in the

field of forest inventories. Furthermore, the definitions often change between inventories. The questionnaire method is commonly used in inquiries at the national level too. Even here it has serious limitations. The results are often biased.

It must be concluded, however, that the basic reason behind the lack of success with the questionnaire approach (the WFIs) is not the questionnaire approach as such, but the lack of suitable information in most countries. A questionnaire method would probably work relatively well if all forests in the world were covered by inventories, and if the questionnaires were properly and consistently answered.

In theory the utilization of questionnaires is the natural way of doing a WFI. During the first attempts it was difficult to utilize any other method. At that time the published sources were few. Whichever reasons exist a questionnaire approach does not function well in reality.

4.3.5 Information presented in the WFI

Recognising the limitations of the questionnaire approach, the WFIs have tried to present information on forest areas, ownership, composition, management status, allowable cut, crown-density, standing timber, growth, fellings and removals. The detailed kind of information required under those categories has undergone an evolution in the course of the four studies, owing to changes in definitions and specifications for the data requested.

4.3.6 The 1968 WFI

The four WFIs published were carried out on a global basis on each occasion. This had the disadvantage that it was very difficult to prepare a questionnaire applicable to such different forest conditions, and to consolidate the widely disparate answers. In addition, a world inventory every fifth year concentrates work to the time of the inventory, with periods between when no information is collected. The suggestion was made in 1966 that these disadvantages could be alleviated by a regional approach. This means that inventory efforts would be carried out for a series of regions and on a continual basis.

For this reason, the WFI which started in 1968 was planned to cover one region at a time. Over a five-year period the whole world should be covered. Each region could have a specially tailored questionnaire, taking into account the different forestry conditions occurring there.

The questionnaire for Europe was dispatched in 1968 and the results were more or less ready for publication at the end of 1969. For technical reasons it was never officially published. The questionnaire sent to the European countries (and in slightly modified form, to other temperate countries) was largely a copy of the 1963 questionnaire. The basic difference was that the definition of forest had been made clearer. So called "open woodland areas" were no longer to be shown as forest. The results from 1968 are quite similar to those given in WFI 1963, because Europe has no large open woodland areas.

The questionnaire for Africa was prepared with great care during 1968 and differed greatly from the previous questionnaires. It made an effort to answer the questions of importance in Africa, and tried to take into account the form in which the information was available. The definitions were carefully prepared and attempts were made to explain why the different information was needed. This proved perhaps to be the main difficulty with the questionnaire. It became too complicated.

At this stage the disadvantages of a questionnaire approach had since long been recognized. It was therefore proposed to investigate the possibility to discard questionnaires as the main tool for collecting information, and instead to show as much of the information as possible on maps, ("The New Approach"). The information for these maps should be collected mainly by travel and work in each country. The undertaking of a pilot study for the Asian region was discussed. To complete the necessary work in Asia, it was considered necessary to have five forest officers and additional office personnel. The whole idea was abandoned, since no resources could be found. The work with the regional questionnaires therefore continued.

The questionnaire for Africa was dispatched in 1970 (called WFI 1970 Africa). One year later, in spite of repeated reminders, only 20 answers had been received. Some of the answers were of poor quality. At

a later stage letters were sent to the Forest Services in the countries, asking for information to complement and correct the questionnaires and for maps, inventory results and so on. The response to this effort was rather disappointing. Few countries replied.

The main conclusion which could be drawn from this work was that even the use of regional questionnaires was a difficult way of collecting information on forest resources. The approach using regional questionnaires was never carried out for the whole world.

4.4 The "New Approach" for Forest Resource Appraisals

4.4.1 Background

The difficulties connected with the questionnaire approach for a WFI have been discussed in some depth in 4.3. There had long since been discussions within FAO, e g at the end of 1968, about carrying out the WFI in some other way. The proposal to have a number of officers travelling around and collecting information was never put into practice.

During the spring of 1970, I started to develop proposals discussed earlier. Pilot work done for Latin America proved that it was possible to collect much better information by checking reports, by interviews with FAO field experts, travel and so on than by any questionnaire, however well-designed. Maps also proved to be a very suitable tool in presenting incomplete information about forest resources.

When I was about to leave FAO it was agreed between FAO and the Royal College of Forestry in Stockholm that I should try to make a pilot study of a Forest Resource Appraisal for Africa.

It must be pointed out here that the "New Approach", of which certain aspects will be discussed in this chapter, does not mainly aim at publishing a report about the world's (or Africa's) forest resources. It aims at being a method which manages to collect the best available information about the world's forests, by which our knowledge of the world's forests can be continuously improved. The mapping approach discussed at an early stage in this work was thought to have many ad-

vantages from the point of view of collecting the information and keeping it up to date.

The term "New Approach" is used here for all the efforts made to replace the questionnaire approach by something better. From the beginning it meant a method which to a large extent tried to show the information on maps. My related work has here taken over the term "New Approach". What is discussed here is basically the work with the report "Forest Resources of Africa". The report "World Forest Resources" utilized a related but simpler method. The work behind the last mentioned report is discussed in Persson (1974).

4.4.2 Objectives of the work

In practice, the main emphasis has been placed on what it is possible to do at present. In the case of World Forest Resources (Persson, 1974) and Forest Resources of Africa (Persson, 1975 och 1977) the primary objective was to give a description, country by country, of the forest resource.

The second objective was to review existing information, so that the gaps to be filled could be identified. The accuracy of the information was also scrutinised.

It is important to bear in mind these rather limited ambitions. It was considered more natural to publish the basic information, than to carry out an analysis of it in depth or to continue to search to fill all remaining gaps.

4.4.3 Method used

The investigation of the forest resources of Africa started in 1968 with the preparation of a questionnaire specially tailored to conditions in Africa. As was mentioned in 4.3, much work was undertaken to make a really good questionnaire. This thorough, detailed and scientific approach failed.

During the work with the questionnaire a preliminary study was made of material available in the files at FAO Headquarters, interviews were undertaken with visiting experts, etc. When it was finally accepted that the

questionnaire approach in the case of Africa (and in reality for the whole WFI) was a complete failure, I had already managed to collect a good deal of information about the forest resources in Africa.

The next step was a visit to eight countries in Africa. During this travel all available information about the forest resources was collected. This was mainly done through personal contacts.

The journey not only gave information about the forest resources in the countries visited, but also gave a better understanding of general forest conditions in Africa.

The next, and perhaps most important, step in the work was a detailed final study of all material in country files available at the Forestry Department of FAO. This means FAO reports, mission reports, travel reports, letters, country notes, correspondence with projects and so on.

Short visits were also undertaken to Paris (Centre Technique Forestière Tropicale), Oxford (Commonwealth Forestry Institute) and Reinbek (Federal Research Organization for Forestry and Forest Products).

From all of these sources the first draft of "Country reports" was prepared and sent for checking to the Forest Service in each country, to FAO Projects and to other persons and institutes which were thought to have additional information, which it was thought probable that the country in question had available or explanations to points which were still unclear, was specifically asked for.

This time-consuming stage was quite successful - about 25 countries gave complementary information or approved the prepared country notes. A number of countries also supplied forest maps. "No answer" was interpreted to mean that the country accepted the country note given and had no complementary information to give.

It must finally be mentioned that in the first phases of this work it was not thought that the result would be a report of the type "Forest Resources of Africa". In preparing "Forest Resources of Africa", I have utilized information collected at all of these stages (even from the questionnaire stage).

4.4.4 Information presented

It is more difficult to publish information of the type collected by this approach than to publish the results from questionnaires. From the beginning it was felt that maps are necessary in the presentation of such information. The first intentions were to show all information on large maps for each country or also to make a set of transparent maps with different information. In the latter case information can be combined in various ways.

In the report I have tried to give as much as possible of the forest resource information available in as easily accessible a way as possible and at as low a cost as possible.

The main type of information included in Forest Resources of Africa is the following:

A. Statistical tables

These tables show some of the main features such as forest areas, ownership, management plans, etc. This material comes to a very limited extent only from the African questionnaire, but was instead extracted from a large number of sources. In reality this part tries to give more or less the same type of summarized information as previous WFIs.

B. Maps

A map was prepared for each of the important forestry countries. These maps were intended in the first place to give the following information:

- a) Location of the forests
- b) Different types of forest (e g vegetation types)
- c) Site of inventories undertaken
- d) Location of forest reserves (when applicable)
- e) Exploited areas and/or areas under concessions (when applicable)
- f) Transport system (when this really shows something). This is the only practicable way of indicating accessibility
- g) Location of plantations

It was rarely possible to trace all this information for any single country. Due to the lack of resources too, much of the mapping information had to be based on already published maps. Such information is often outdated.

C. Country notes

A note was prepared for every country. This note may be regarded as a long explanatory note to the map mentioned under B. Index numbers on different inventories and forest regions or both on the map relate to the same numbers in the text. These country notes were intended to contain at least the following points:

- a) A general description of the forest. (To some extent a description of the vegetation)
- b) Summary of inventory results
- c) Description of accessibility. (On this item it has rarely been possible to give information of value)
- d) Information about plantations - areas, species etc
- e) List with most important species and their possible use. This is normally given in connection with inventories
- f) Some notes about exploitation and concessions
- g) Other information of interest

It was thought that this arrangement of the collected information would be the best way to make it accessible.

4.5 Final discussion of the two approaches

From what has been said so far, it is evident that the results given in the traditional WFIs, owing to problems with definitions, the questionnaire approach, etc have many limitations.

In designing a WFI questionnaire every word must be carefully chosen. It is a matter of compromising between what is really wanted and what it is possible to obtain. To make the respondent aware of all difficulties with the definition, long explanations are necessary. Long explanations often

cause irritation and are rarely read. The designing of a WFI questionnaire is an enormously difficult and time-consuming task, and it is almost impossible to carry it out successfully.

In spite of all these limitations, the WFIs have been valuable, since they have for 30 years been almost the sole source of information about the world's forests. Something is certainly better than nothing. Only specialists can, however, fully use the information in the WFIs correctly.

One of the basic difficulties with the questionnaire approach is that nonsense figures are mixed with more accurate figures. The result is therefore always uncertain. To evaluate the information presented in a questionnaire it is always necessary to check against all other sources. Often the same or even more detailed information is traced during this checking. This implies that the whole approach with standardized questionnaires is rather meaningless, since more detailed information is normally traced while checking the information presented in a questionnaire. The accuracy of the figures found during this checking is also better known.

The New Approach has, in my opinion, several advantages compared with the WFIs:

- a) It describes more completely the present state of the forests
- b) It explains better what is known about the forests and what is not know. It gives information about the quality of the statistics
- c) It gives more information about changes (e g in the forest area) that have taken place in recent years
- d) It gives more information about plans for the future
- e) The maps make it possible to locate the different forest regions, the vegetation types, man-made forests, inventories, etc

In spite of considerable improvements as compared with the WFI, the reports utilizing the New Approach do not fulfil its basic objective, viz to give all information about the forests that is needed in Timber Trends and Prospect Studies.

This information is not available in most countries at present. A Regional Resource Appraisal must naturally find a level of requirements for

information, at which it is possible to do anything at all. As long as an Appraisal does not give adequate information, the work to improve it step by step must continue.

The most recent forest resource reports have certain limitations which can be changed in coming reports.

The information given in the country notes could for example have been analysed further. Ideally an analysis of the present and future production potential for each country should have been given. As in the case of the questionnaire approach, the information given in the country notes cannot be better than its sources. Where sources with conflicting information were traced, it was not always possible to judge which information was best. Often it was not exactly known what terms (e g commercial forest, accessible forest) used in different sources meant. Part of the information in the country notes, maps and summary tables is outdated. The information varies in quality. There are difficulties in comparing information in different country notes. These facts may be evident to readers with experience in this field. The reports should all the same try to judge what at most can be said about the present day situation.

When first working with the New Approach it was thought that the preparation of forestry maps was of paramount importance. Initially the maps had two objectives:

- a) The maps should facilitate the reading of the country notes.
- b) The maps should be a working tool. (It is easier to find mistakes in cartographic information than in tables. This fact would make it possible to improve the cartographic information continuously.)

Owing to the small scale used, and the lack of time and resources, the second point is somewhat reduced in importance and the maps must be seen mainly as informative. They have the disadvantage that they often contain outdated information. National maps are not often updated.

Maps of different types can of course facilitate the understanding of forest conditions in a country. It is a fact, however, that what we basically need is figures. Information on maps can be transformed into

figures, but in this case maps must be very detailed to be of any use.

Few readers have time to study in detail the country notes for a large number of countries. Summary-tables are therefore necessary. These tables have many of the limitations discussed for the WFI and give of course less information than can be given in the country notes.

In summary I think we can conclude that the New Approach gives a more complete reference book than the previous WFIs. The information can also better be kept up to date. The New Approach (and the resulting reports) can no doubt be improved.

4.6 Other recent studies

FAO has recently undertaken a pilot project on tropical forest cover monitoring (Baltaxe & Lanly, 1976). The pilot project has just been completed in Benin, Togo and Cameroon. The maps and reports being printed (1979). Most of the work done was on small-scale vegetation mapping and on analysis of changes of the vegetation cover in selected critical areas. UNEP will decide if there will be a follow up.

FAO has also started a world-wide assessment of tropical forest resources. The work will be finalized by May 1980. It will consist basically of a desk study with the compilation of existing information on forest resources at national and sub-national levels in all tropical countries. Special emphasis will be put on studying the present trends in deforestation and afforestation.

4.7 What information is available at present?

The bibliography gives the most recent publications with forest resource information. Europe (FAO/ECE, 1976), Africa (Persson, 1975 och 1977), Asia and Far East Region (FAO, 1976 a), and Latin America (Persson, 1974 and FAO/RLAT, 1976) are covered by relatively detailed regional reports. For North America and USSR national studies can be found.

A complete world picture is given in Persson, 1974. FAO, 1978 b, gives information about the closed forest resources in different regions. It is evidently a summary of the regional reports mentioned above.

The forest areas in the tropics are discussed in a recent FAO report (Lanly & Clement, 1979). The information to this study has been collected from different country reports to FAO meetings, country reports in proceedings of technical meetings, annual reports, project reports, published articles and from questionnaires. The material was collected in a very short period of time. Results are given for regions.

In a recent paper (FAO/ECE, 1979) FAO has completed the Lanly & Clement paper with information for other regions. This complementary information is based on the regional reports mentioned earlier.

It is evident that FAO sometimes hesitate to give country figures. This is due to the fact that FAO as an international organization cannot make adjustments to the figures reported by the countries.

In Appendix I I have given my latest review of knowledge of the world's forest resources. Tables A and B give a summary of present knowledge. This review is a summary of a forthcoming paper, which discusses the limitations of present knowledge.

5 WHAT IS THE KNOWLEDGE GAP?

5.1 General

In chapter 4 a description has been given of work done to improve the knowledge of the world's forests. The limitations of these approaches have been discussed.

In this chapter the major shortcomings of the present information will be discussed in greater detail. What do we know? What do we not know? The point at issue here concerns totals for the world or for regions. There are, of course, always some countries which have more detailed knowledge of their forests.

In Appendix I the accuracy and shortcomings are analysed from another point of view. It has been felt natural not to include the result from this new study in the original manuscript. The results are also preliminary and will probably be adjusted before the final publishing of the complete report.

5.2 The present knowledge and its limitations

5.2.1 Land use

The most complete statistics about present land use in the world may be found in FAO Production Yearbook. For each country information is given about: Total area, land area, arable land, land under permanent crops, permanent meadows and pastures, forest and woodlands, and other land.

These statistics are of rather poor quality and give an incomplete picture of land use.

The classes used in the Production Yearbook are too few compared with what is needed. "Other land" is e g composed of many different types of land (e g urban land, desert, swamps). Parts of "Other land" can have a potential for use as agricultural land or forest land.

There is also a need for a quality classification within each category. Natural pastures of semi-desert type and intensively managed and productive pastures are included in the same category in the statistics. There is also a need to know how intensively different categories are utilized. Intensively managed agricultural land and land under shifting cultivation are included in the same category. Savanna areas which are occasionally pastured by grazing animals can be classified as pastures.

The boundary between different categories is unclear, too. There are many intermediate categories. Open woodlands can sometimes be classified as pastures and sometimes as forest and other wooded areas. Bush fallow in shifting cultivation can be classified as forest or agricultural land, depending on what the future utilization is expected to be.

Our knowledge of how land is utilized by man is evidently very limited. Knowledge about potential land use is still more limited. How much of the world's land area can e g be utilized for agriculture? Is the world's agricultural potential decreasing owing to soil destruction? How large are the areas that are misused today?

In many countries, however, the state of knowledge is better than might be thought from the Production Yearbook. Information at the national level cannot be utilized fully when it is collected by means of a questionnaire (see chapter 4.3.4). Improvement of the present knowledge of the world's land utilization can probably best be achieved in the same way as described for Forest Resources of Africa (4.4.3). There seems to be little point in the international organizations trying to collect more detailed statistics by means of questionnaires. This may cause more confusion than it gives information. Most of the improvements must be made at the national level.

5.2.2 Forest and other wooded areas

Forest and other wooded areas in principle include the areas that are of interest for forestry and which are not primarily used for something else. In chapter 5.2.1, it has already been explained that our knowledge is limited about the areas which in one way or another are or could be, of forestry interest. The figures shown for forest land in the FAO Pro-

duction Yearbook are often misleading, as the main interest normally lies in agricultural land. Forest land is sometimes something of a residual category. Appendix I (table A and B) is an attempt to give our existing knowledge about different types of forest and wooded areas.

The areas of forest and other wooded areas must normally be described with additional details. The description should be more accurate and detailed, the more valuable the forest types are. It may sometimes be necessary to include certain non-wooded areas (which have not been classified as forest and other wooded areas). As an example may be mentioned open but potentially interesting areas (e g for plantations).

As has been explained (chapter 3.2.2), it is very difficult to define clearly different types of wooded area (at least for large regions). In temperate regions, land use is often stable and it is possible to define the boundary between forest and non-forest. Forest is simply forest. Even in temperate regions it may sometimes be difficult to decide the boundary between e g forest and tree-covered peatbogs, and between forest and alpine regions. In USSR and Canada it is probably uncertain what areas should be classified as forest and what areas as tundra. Large areas of poorly productive "forest" are evidently included in forest areas (Sutton, 1975, Manning & Grinell, 1971). In the dry areas of USA, poorly productive wooded areas are also included in forest. (Anon, 1974.)

Our knowledge about the forest areas of the tropics is normally much more limited than our knowledge about the forests in the temperate zone. We cannot give anything other than crude figures for the area of closed forest, and still cruder figures for the area of open woodland. Some of the country-figures often quoted are about 50 years old. For some countries many different estimates have been prepared. They may differ from each other by millions of hectares.

Even were there are exact figures for the wooded areas that correspond to FAOs definition of closed forest, this would still give a very incomplete picture of the forest conditions. A far more detailed description is needed. This first classification shows only the land areas that should be described in more detail. Information concerning other important classifications will be discussed below.

5.2.2.1 Vegetation types

In Persson (1974) table 14 gives a rough picture of the area of different vegetation types in the world. This table is in the main based on Weck & Wiebecke (1961). New figures have later been published for Africa (Persson, 1977), Asia (FAO, 1976 a) and Latin America (FAO/RLAT, 1976). Sommer (1976) has given related figures for the whole tropical rain forest zone.

An undisputable classification of the wooded areas of the world into vegetation types is lacking. (The recent UNESCO system may be dominating in the future.) The figures shown for the area of conifers, tropical rain forest, mangrove, etc are very uncertain. There are many intermediate categories which are difficult to describe (e g mixed coniferous - broadleaved). Knowledge which above all is missing, is the distribution by different secondary stages.

It should be said here that maps (e g World Forestry Atlas) give a summary of most existing knowledge about the distribution of vegetation types in different regions. The classification system utilized vary, however, from map to map. Most of them show the potential vegetation too.

5.2.2.2 Age classes (maturity classes, stand classes, cutting classes)

In temperate countries there is often a classification of this type - at least when inventories have been made. No regional figures exist, however. FAO/ECE, 1976 gives e g only figures for a few sub-regions.

In the tropics such information is missing in most countries. It is no doubt also very difficult to find a meaningful (and possible) classification for use at the regional level in the tropics.

5.2.2.3 Density

Regardless of whether area-density, crown-cover or some form of volume density is considered, it is possible to produce knowledge for the regional level.

5.2.2.4 Human influence

In various reports, attempts have been made to describe forest in use, exploited and unexploited forests, managed and unmanaged forests, etc. The information given has many defects and can only give a rough indication of the size of different categories.

In reality we do not know how much forest is in use, exploited or unexploited. We do not know how much forest is managed in one way or another. We do not even know how certain vegetation types (e g tropical rain forest) should be managed. Nor do we know how large the forest areas are that for one reason or another must be classified as degraded, nor how large the areas are affected by shifting cultivation.

5.2.2.5 Accessibility

In a very few countries has an accessibility classification been made. The information must therefore be rather limited for considerable areas.

An attempt to make a crude accessibility classification is reported in Persson (1977). The areas that can be incorporated into timber production without the need for major infrastructural work were defined as "accessible".

FAO 1976 a and FAO/RLAT 1976 give some figures showing the operable forest area. "Operable forest" in the sense of these two reports has a somewhat different meaning, but should include areas that can be made accessible and included in timber production.

It is apparent that these guesses give a very incomplete picture of accessibility. We do not know how large are the areas that are economically accessible at present, or how large are the areas that can easily be brought into production. This statement is valid not only for the tropics but also for many countries in the temperate zone. In reality it is not clear what would be a useful classification system for use at the regional level.

5.2.2.6 Forest reserves

Information concerning the wooded areas declared as forest reserves in Africa is given in many regional reports.

It may be difficult to discuss what type of forest and other wooded areas are included in forest reserves. Sometimes all of the original forest has disappeared; large non-wooded areas are therefore included in forest reserves. Forest areas designated as forest reserves are often not protected to any extent against forest destruction.

Owing to the difficulties mentioned above, the information must have limitations. It can, however, be much improved.

5.2.2.7 Protection reserves

An attempt to give information about the forest areas covered by such reserves was made in Persson (1977). It is often difficult to discover in which type of wooded areas the protection reserves are situated. The information about the areas covered by protection reserves is very incomplete. What is still worse is that we do not know whether the areas classified as protection reserves are really protected.

5.2.2.8 Ownership

Information about ownership conditions on forest land is given in WFI 1963. These figures are very incomplete and give furthermore (at least in theory) information for all kinds of forest and other wooded areas combined. Very often information is given only for certain parts of the wooded areas, e g for the forest reserves.

In Persson (1977) an attempt was made to give information for natural closed forest, open woodland and man-made forests separately. Such information is missing for other regions.

In Europe and other temperate regions the ownership conditions have not changed much since the WFI 1963. We therefore have a rather complete picture for these regions. In the tropics much of the closed forests is offi-

cially public. In reality it is not always state forest in the European sense, but some kind of community forest. Private ownership of land may not exist at all. The ownership conditions must occasionally be considered to be undecided. Thinly populated forest areas have sometimes been declared to be state forests in relatively recent times. A local community may claim ownership.

The present information about ownership conditions in the world's forests is crude and rather incomplete. Ownership conditions in open woodlands and man-made forest especially are not clear. It would, however, be possible to obtain most of the information needed.

5.2.2.9 Tenure

In Persson (1977) information is given about the areas in Africa covered by concessions. Similar information is given in other regional reports too. This information is, however, not complete and it rapidly becomes out of date. Information concerning the extent to which the state, the communities, the forest industries, etc utilize their forests is incomplete.

5.2.2.10 Man-made forests

Information about the area of man-made forest in different regions of the world was given in Persson (1974). In Appendix I (table A) these figures have been adjusted with the help of new information. Lanly & Clement (1979) give recent figures for tropical regions.

There is some information of how large the areas are that have been planted in different countries, and some information about the species planted. However, figures giving the area of man-made forests are often overestimates. The planted area may have been calculated from the number of plants that should have been planted. The figures given are in most cases some years old, and can have been adjusted upwards. Plans for establishing plantations are often very optimistic.

Knowledge of the age-distribution of man-made forest is very limited. It is not known how the plantations have succeeded, what the possible

production is, nor what is the most suitable use of the plantations (e.g. to produce fuelwood, or for protection). It is not known how much of the wood can be utilized as rawmaterial for the forest industries. This depends e.g. partly on the size and location of the plantation blocks established.

It must also be pointed out that there can be difficulty in defining what is a man-made forest and what is not. How bad may a man-made forest be, before it must be called non-forest? Enrichment planting of commercial species in the tropics: Is this to be regarded as man-made forest? As is so often the case, one single figure can give only part of the truth. The only way to give the true picture is to give all necessary details (e.g. crown-density, type of plantation).

It is fairly certain that knowledge about existing plantations in the world could be considerably improved if the information that actually exists at the national level could be obtained. It is necessary also that a continuous effort be made to collect new information. Information about plantations quickly becomes out of date.

5.2.3 Volume information

Rough guesses about the standing volume in different regions were given in WFI 1963. Persson (1974) also contains some rough calculations of the standing volume. In WFI 1963, and to some extent in Persson (1974), information about standing volume is given for some countries only. The figures given are rarely comparable. For each region, mean values for standing volume have been calculated, based on the national country data available. These mean values have thereafter been used to give an impression of the total standing volume in each region.

In Persson (1977) the area of different vegetation types (forest types) was estimated as accurately as possible for each country. The mean value for standing volume in every vegetation type was thereafter assessed from inventory results and other information. The total volume of wood was thus calculated. The intention was to show the volume of wood that could at least be used as fuelwood.

The information given on standing volume in FAO 1976 a and FAO/RLAT 1976 was calculated in roughly the same way. The figures per ha for standing timber used in these studies seem to be lower than those used for Africa in Persson (1977). To some extent this may be because these studies were mainly intended to give information about the timber volume.

The information about standing volume given in these sources is of course very unreliable. The knowledge of standing volume in the forest must logically be less accurate than the information on area. The volume concepts which it is best to use vary from country to country. To be able to give detailed, meaningful and comparable information in a Regional Forest Resource Appraisal, it is necessary to collect very detailed statistics for each country. Such information rarely exists.

It is not known how much timber or pulpwood there is in the forests. This is, of course, partly a question of definition. Neither is there information about any other quality grading. There is not even crude information about the species distribution in different regions (although there may possibly be crude information about the volume of coniferous and broadleaved species). The diameter distribution is unknown. We lack information for different types of forest or for forest areas with different accessibility. The figures given for commercial volume in some reports are very crude guesses, and, what is more, the term can hardly be defined precisely.

Information is most inadequate for the broadleaved tropical forests. We also need to know the volume in open woodlands and in agricultural land. This information is completely non-existent (or at least very unreliable).

5.2.4 Increment

Reliable knowledge about increment in the forests can be found in very few countries. WFI 1963, Persson 1974 and FAO/ECE 1976 give information for Europe, and some information is given for other countries in the temperate zone. In FAO 1976 a crude increment figures for the countries in the Asia-Pacific region are given. Even WFI 1963 gave some increment figures for the countries in the tropical zone.

In reality, we hardly know how we shall measure and describe the increment in tropical forests. We do not know how we shall be able to utilize the increment that occurs. The gross increment can probably give some indication about the potential wood production. In some reports guesses as to its size can be found.

Some authors (e g Paterson 1956) have utilized climatic data in different attempts to calculate how much wood the forests of the world can produce. Other authors (e g Bazilevich et al, 1971) have tried to estimate the production of biomass of the world. They have often based their studies on the production in different vegetation types (often the potential area has been used). Such theoretic calculations give very different results. It is safe to conclude that we have at best a very vague idea about the increment condition in the world's forests.

5.2.5 Past trends

We have some information of how the consumption and production of different wood products have changed with time. Such figures can be calculated from different volumes of the Yearbook of Forest Products. For the developing countries knowledge is very limited - especially in the case of fuelwood consumption.

We have little idea of how land use has changed, how the standing volume in different forest types has changed, how the increment has changed and so on.

The only information of this type available is that showing how the closed forest area has changed during recent years. A relatively detailed discussion for Africa is given in Persson (1977). Short discussions of how the forest areas have changed in different parts of the world are found in Persson (1978 a).

The regional figures summarized in the last-mentioned report are unreliable. One may ask what has changed (closed forest?). Sometimes crude guesses made at intervals have been compared. In such a case the difference can be caused by poor guesses.

We know, however, that the forest resources have decreased in most developing countries and increased in certain developed countries. But we cannot say how fast this change is taking place. Nor do we know how the standing volume or the crown-density is changing in different forest types.

We have some idea of how the area of man-made forests has increased during recent years. Some figures are given in Persson (1974 & 1978 a) for example. Some more recent information is found in the regional reports.

5.2.6 Future trends

How the forest area, standing volume and so on will change in different countries during for example the coming 25 years depends on a number of factors. In developed countries there is often a strong Forest Service that can plan and carry through important changes. Political changes can, however, make today's assessments and plans wrong.

In many countries one can often assume that the negative trends of today, e g a decrease in forest area, will continue in the years to come. Past trends can, however, not by far always be projected forward. Nor do we know exactly how development has been in past years.

Persson (1977), FAO/ECE (1976) and FAO (1976 a) contain guesses as to how the natural forests will change in some regions up to the year 2000. Lanly & Clement (1979) have recently published estimates of how large forest areas will be in the year 2000. This is a very ambitious study. To arrive at the total estimates (or guesstimates) have been prepared for each single country. As we do not know what is happening at present it is of course difficult to make forecasts up to the year 2000.

Lanly & Clement (1979) also discuss how the area of man-made forests can change. In many countries plans exist for the immediate future. These plans are often over-optimistic and may quickly be changed.

5.2.7 Felling forecasts

Felling forecasts of one type or another exist in most developed countries. FAO/ECE (1976) has e g utilized figures for the European countries.

Some scattered national figures are also given in the other regional reports. The plans depend on man and can change quickly for a number of reasons.

In many countries in the tropics no felling forecasts whatsoever exist. In regional studies it is therefore often assumed that production will increase by a certain percentage every year. This is a very crude method, and it normally assumes a very liberal economy.

We may assume that the accessible forests of the world will be utilized intensively in coming decades. The wood will be needed. What this will mean in the developing countries we cannot, however, say. Under no circumstances can we tell how much exploitation is planned (or likely) for different species, qualities, etc.

5.2.8 Potential cut

Over the years, a number of rough calculations of how much the world's forests can produce have been made (see e g 5.2.4). A prerequisite for such calculations is that the type of management is known or at least assumed. Many studies assume that existing forests are in good shape and that the potential can be easily reached. According to my opinion such theoretic studies are of rather limited value. There are no reliable estimates of how much the world's forests can produce in the year 2000 (nor how much they can produce today). A requirement for this is for example that changes in forest area are taken into consideration. The estimates sometimes made for the year 2000 show what one believes will be produced but not what could be produced. As mentioned many studies give theoretic maximum production.

Calculations of how much wood could be produced are missing for many developed countries, too. The possible production in for example Europe, according to some sources, is considerably larger than is often maintained (see e g Nilsson, 1975). Calculations showing how much could be produced under different assumptions of intensified management are also usually absent.

In the case of tropical countries we really do not know how the existing potential should be utilized. We do not know how much wood of different sorts can be produced in the long term, and, even were this is known, it would be impossible to say what this potential (if extracted) could be used for.

5.2.9 Possible or suitable utilization of wooded areas

The discussions undertaken so far indicate that we do not know how large the forest areas are that are needed for protection; how large the forest areas are that can give timber; or how large the wooded areas are that can give fuelwood. In any case, we do not know how much the various types can produce. We do not know how large the forest areas are that can give pulpwood. We do not even know to what extent tropical rain forest can give pulpwood.

5.3 Conclusions

It must be evident from this summary that our present knowledge about the world's forest resources is miserably poor. Readers still not convinced are recommended to study Appendix I, which tries to explain the same thing in another way.

According to Appendix I the "present knowledge" about the world's forests may be described as in table 3.

Table 3. Examples of "present knowledge" about the world's forest (1977)

Type of information	Unit of measurement	Possible minimum value	Possible maximum value
World population ¹⁾	Millions	3 850	4 350
Closed forest/land area	%	16	21
Closed forest area/caput	Ha/caput	0.5	0.7
Standing gross volume ²⁾ /caput	m ³ /caput	53	117
Felling/gross increment	%	30	246
Felling/standing gross volume	%	0.6	3
Closed forest/caput the year 2000 ³⁾	Ha/caput	0.3	0.5

1) According to Grove (1970) the accuracy of the population figures in Africa is in the order of ± 15 per cent. I doubt the estimates are much better in Asia and Latin America (makes ± 450 million). Bertelman et al (1977) writes: "In reality we do not even know to nearest 100 million, perhaps 500 million how many people live today". As an average value I have here chosen ± 250 million.

2) In "all land".

3) According to UN 1977 medium variant ± 300 million (5950-6550 million).

Forest resource information is often utilized in studies which raise questions of the following type:

- Can the world's forest meet the need for long-fibred pulp in the year 2000?
- Can the world's forest meet the need for coniferous timber in the year 2000?

- Can the world's forest meet the need for broadleaved timber in the year 2000?
- Will mahogany and other well-known tropical timber species disappear completely?
- How large fuelwood plantations are needed?
- How large protection plantations are needed?
- How much of the natural forest is needed for protection?
- What is the present land use?
- What is the potential land use (land-capability)?
- How should the tropical forests be utilized?
- How are the forest areas changing?
- How is land use changing?

We can never expect to be able to give an exact answer to all these questions, since they sometimes require knowledge about the future. If we had better knowledge of the measureable factors, our judgement of the future would not be pure guesswork. Present studies are often academic exercises which can give the answers we want them to give or, rather, which give the answers we expect them to give.

If one takes the limitations of the present knowledge seriously the utilization of existing data becomes close to impossible. Both optimists and pessimists will find the world much more difficult to live in. In all studies one may have to work with a number of alternatives. One alternative could be based on the data one believes is most likely (this may sometimes be impossible). Another alternative could be to analyse the result if one utilizes certain combinations of max and min figures (e g in the case of felling and standing gross volume). As we know so little different combinations of data must be tested. Timber Trend Studies, environmental studies with a world coverage, etc must accept the present state of affairs. Much work must be directed towards improvement of the statistics.

6 SUGGESTIONS FOR CONTINUED WORK IN THE FIELD OF INTERNATIONAL FOREST RESOURCE APPRAISALS

6.1 General

Relatively detailed and recent forest resource appraisals are now available for all regions of the world. It is necessary to discuss how this work should continue. If no action is taken for a continuous revision and improvement of the information in the reports, our "knowledge" will quickly become obsolete.

The discussion so far indicates that improved information about forest resources is needed mainly at the national level. Few, if any, investigations at the national level can be made to meet any demand at the international level. International organizations should guide and support the work of improving the forest resource statistics at the national level. They should also try to standardize definitions, etc so that the information can be compared from country to country. Improvement of international statistics depends on improvement of the national statistics.

At the national level much could be gained by organizing existing knowledge (e g in National Forest Resource Data Banks). These "Banks" should try continuously to collect the best possible information about the forest resources in their own countries. They should also try to initiate action to improve the existing data base.

Certain steps can also be taken independently to improve international statistics. A World Forest Resource Data Bank should be established. This "Bank" should try continuously to collect the best possible information about the world's forests that is available. How can such a Data Bank be organized to make best use of the information available at the national level? This chapter will consider some aspects of a World Forest Resource Data Bank.

6.2 World Forest Resource Data Bank

6.2.1 General

The World Forest Resource Data Bank will be dealt with from these aspects:

- a) Collecting and updating of the information.
- b) Storing of collected information e g as pre-prepared tables and maps
- c) Publishing of results

It is natural that any "World Forest Resource Data Bank" will be situated within FAO. FAO is the only international organization which has direct contact with the Forest Service in all countries. FAO is also the main user of the statistics. It is normally best that the main user of the statistics collects them. All the knowledge and experience that is gained while collecting the data can then be utilized in many of the analyses. Since FAO has collected world forest resource statistics for so long it would be unrealistic to propose that a new organization, e g the World Bank or UNEP, should take the main responsibility. To propose any new independent organization is also most unlikely to get support. Academic research can only to a limited extent improve knowledge of the world's forest. It is realistic to assume that FAO will continue to have responsibility for world forest inventories. (The discussion here is raised because some "experts" argue that FAO has failed to improve the world forest resource statistics and will most probably fail to improve it in the future.) Certain related statistics can be collected by organizations like UNEP (which may then be the main user).

International organizations (like FAO and UNEP) have limitations. They can for example not always make critical analysis of forest resource statistics in different countries. For this reason there is a need for researchers or institutes that can work independently. Their most important task would be to analyse limitations in the international statistics.

The information needed has been described in chapter 3. It is basically the need for figures that is described. As questionnaires will rarely be used the figures will not be collected directly. Instead inventory reports,

annual reports, project reports, country reports, published articles, maps etc will be used. Information will also be collected from interviews and correspondence. The information sought for must be extracted from such sources. As will be described later the information will be stored and published in the form of country notes, maps and tables.

6.2.2 Collection and updating of the information

It is my definite opinion that we must try to have continuity in the work of collecting information about the world's forest resources. In the first phase, this means that we shall have to try to fill the major gaps and deficiencies which will remain in the latest published versions of Regional Forest Resource Appraisals. The information in these appraisals are in the form of summary-tables, country notes and, to some extent, maps.

The basic task of the Bank is to build up a system where the best possible information about the world's forests can always be found.

The continuous updating of the Bank will mean reviewing all incoming material which can be of interest e.g project reports, travel reports, mission reports, magazines. Information of interest found in some of these sources is fed into the Data Bank. When all other FAO officers at the Headquarter or in the field know about this work they will, it is hoped, transmit all information of interest to the Data Bank. The Data Bank must also contact practically all FAO project officers passing through FAO Headquarters and ask them for comments about the country notes, working maps, etc for the country they know. The success of a Data Bank of the type described here depends very much on an efficient feedback of information from all forest officers concerned and the input of this information to the bank. The more travels that can be undertaken by the staff of the bank the better it will be.

Some of the basic types of changes and new additions needed are listed below:

- a) Basic information lacking in a country note may often be available in the country in question. The Data Bank must then obtain this information.

- b) Figures and information given in the country notes are probably often out of date. The Data Bank must obtain the latest available information or prepare guesstimates for completely outdated information.
- c) Wrong information given in the country notes must be identified and removed.
- d) The results from new inventories must be included continuously.
- e) Information about man-made forests must be updated continuously.
- f) For each figure of basic importance (e g closed forest area, growing stock) intervals showing the accuracy must be prepared (see Appendix I). This means that the accuracy of the figures must be revised continuously. For each item it may prove necessary to prepare the best "qualified guesstimate".
- g) When information is completely lacking the best possible guesstimate must be produced and included in the Bank. In such a case the interval will be very wide. The objective must be to get hold of country figures for practically all the items discussed in chapter 3.

After a two to three-year-period, the information in the Data Bank (probably in the form of summary-tables, country notes and maps) might be updated rather completely and sent to the Forest Services, FAO Projects, Bilateral projects, etc for comments and additions. Specific questions concerning gaps and obscure information can also be raised. After this, the Data Bank would contain a relatively accurate picture of knowledge about the world's forest resources. The necessary parts of this material could then be published.

The work would thereafter continue in the same way, it is hoped with an increasing feed back of information from the national Forest Services. From this Data Bank it will then always be possible to pick out the latest available picture about the forest resources in a country, region or the whole world.

The basic difficulty at present is to arrange the initial capital in the Bank in such a way that it can easily be improved, updated and made accessible. This will most probably mean computerization of at least part of the information in the Data Bank.

One may ask here if FAO as an international organization should critically analyse the accuracy of the statistics. One may also ask if the countries themselves will accept reports that their forest resource information has serious limitations. This approach may cause difficulties in the case of feed back from the Forest Service. A critical analysis of the accuracy is, however, necessary. It would also be of great value if the countries accepted this way of working. This would mean that they accepted their deficiencies and, with that knowledge as a base, could start to improve their resource statistics.

The discussion so far in this chapter has very much concentrated on the possibilities of building up a World Forest Resource Data Bank. As described it is very much a desk-study. If resources were available the work could be intensified considerably.

In Europe the FAO/ECE Timber division has had a number of working parties meeting for many years. One of these working parties have been devoted to forest statistics (including the World Forest Inventory).

Such working parties concerning forest resource statistics should perhaps be started in all regions. These working parties could e g be undertaken in connection with the Regional Forestry Commissions which meet every second year. The cost of this work would then be limited. The main objectives of these working parties would be to discuss means of acquiring the resource information at a regional and national level. The delegates to the meeting could report achievements (national reports) and discuss the problems they encounter in their work. The delegates should also help FAO to develop methods for use in its work with resource appraisals.

These regional working parties should be the contact point between the member countries and the World Forest Resource Data Bank. This could give countries concerned the opportunity of influencing the work of

the Data Bank. The basic task of the working party would, however, be to improve knowledge at national level.

Still more important would be to start an international program for the establishment of National Forest Resource Data Banks. In many countries the first step would mean organization of existing knowledge. Better forest resource statistics are needed in most countries. That would mean an important improvement of international statistics, but more important is the fact that better knowledge of a nation's forest resource is a prerequisite for a properly planned development of the forestry sector. If some countries would not wish to know their own forest resources it would be to their own disadvantage.

This report mainly discusses conditions in the tropical regions. One basic reason for this is that the forests in temperate regions are normally better known than their counterparts in tropical regions. A questionnaire approach could therefore theoretically give relatively good results. To reach something more than "not far from acceptable" results, other methods than a questionnaire must, however, be considered.

The information available about the forest resources in Europe is actually rather unreliable and incomplete. To improve the knowledge it is necessary to undertake a new Forest Resource Appraisal for Europe. In this work, a detailed study should be made of all available inventory reports for each separate country. After detailed study of the inventory reports, complementary questions concerning obscurities and incompleteness in the information should be sent to the countries.

As a final step, visits should be undertaken to all countries. These visits should not only be made to gather as much information as possible, but also to check the validity of the data in each country. In the temperate regions new crude estimates and maps cannot add much to our knowledge. Many studies of this type have already been made. It is more important to identify errors in the information presented in these countries. Finally, efforts must be made to make the collected information comparable between countries.

6.2.3 Storing of collected information

In theory the collection of data for the Data Bank may not be very difficult. It should in the first place imply the collection of national reports, maps, etc about forest resources. These sources are, however, often difficult to identify. It is still more difficult to acquire all the unpublished knowledge.

The incoming material can be kept in national files. After a while these files will become very difficult to use. In the long run it does not help to have separate national files e g for man-made forests, natural forests, inventories, management, forest policy. Nor will it be possible to have continuous revision of the country notes.

The basic problem is to extract continuously the information of first-hand interest from the incoming material, and to keep it easily accessible. How this can be done practically will briefly be discussed here.

Complete set of the summary-tables needed (pre-prepared tables)

In World Forest Resources (Persson, 1974) and Forest Resources of Africa (Persson, 1975 & 1977) the figures in the summary-tables have been extracted from different kinds of sources. In these tables information about a subject was given when information was available. Where no information is available about an important subject (e g increment), no information can be given. Sometimes crude guesstimates can be of some value. The Forest Resource Data Bank must try to prepare basic tables for all important subjects.

As a start, outlines of tables aiming at giving the information discussed in chapter 3 must be prepared. The personnel of the Data Bank must continuously try to add information to these tables.

It is evident that this work, especially at the beginning, will mean the continuous rearrangement, complementing, etc of the draft pre-prepared tables.

It is not only that new findings and ideas will cause continuous improvements; it must also be accepted in the starting phase that no information is available at present concerning several important items. In the case of accessibility, where no information will be available for a long time, it might be decided to collect information on related subjects, such as length of roads, too.

At the start it will often be difficult to find information which exactly follows the definition for a certain term. Very often an index number will have to be given instead of a figure in the tables. These index numbers will then have to relate to a file in which related information is described.

The objective of this work must be to try to give as complete a set of tables as possible, as quickly as possible. Many of the first figures will be very unreliable.

It is necessary to give intervals (accuracy classification) for each figure in each single country. The basic task of the work must be to narrow step by step the present intervals.

When the tables begin to be complete, it will be rather easy to pick out one part of the information on request, for a specific study or to be published e g in FAO Yearbook of Forest Products. It is evident that at least in the future, when these tables contain relatively complete and accurate information, the information must be computerized. This will make access much easier. It is, however, likely that computerization is needed from the very beginning and should be planned for.

I consider the preparation and updating of the pre-prepared tables as the most important part of the World Forest Resource Data Bank.

Maps

Forest resource information in the form of figures is needed for most forestry studies (see e g chapter 2). At present figures can often give nothing but a very rough idea of the existing forest resources. For a number of countries, maps give much better (truer) information

than figures. This last point was one of the main reasons behind the concentration on maps in the first discussions about the New Approach. It would perhaps be naive to believe that a Forest Resource Data Bank will ever be given resources to prepare detailed forest maps. This work can also be done at the national level. At the present state of knowledge the map has, however, many advantages as a source of information and as a working tool.

It is most probable that a combination of summary-tables and maps will prove to be the best way of presenting the material about forest resources in a Regional Forest Resource Appraisal, once the knowledge at the country level is more complete than at present. Country notes become very costly. Maps are also very suitable to show incomplete information. From this point of view, rather crude maps are adequate in reports from the Data Bank

Furthermore, it is most likely that many figures to be included in the pre-prepared tables from the very beginning will have to be calculated from different kinds of maps.

In addition to the reasons mentioned above, the map is a very suitable tool for keeping control of unorganized material (e g scattered inventories). At present this is a very strong point in favour of using maps in a Data Bank.

It is clear that the countries concerned cannot supply the Data Bank with all the figures considered to be needed. Forest maps will neither always be available nor be prepared at the national level. For these reasons the Data Bank may initially have to try to do some active work in mapping.

In the ideal case, basic working maps could be prepared for at least all important forest countries outside the temperate zone. Even for many countries in the temperate zone it might be valuable to use maps in the work. These working maps should contain information about roads, towns, and so on. Information about the present extent of the forests and/or vegetation must be included as fast as possible (at first the accuracy level may be low).

Working maps of the type discussed can be stored in the form of sheets for each country (e g 1 x 1 m).

Into the working maps prepared, information that becomes available in reports, etc is incorporated. As examples can be mentioned:

- a) New inventories
- b) New plantations
- c) Areas under concessions
- d) Areas exploited
- e) Changes in area of forests
- f) Changes in transport system

Index number on the maps can e g refer to published information found in special files.

The information that is included in these maps must not come from published reports. The maps should instead include, as far as possible, unpublished information. Information can be taken from aerial photographs but can also come from forest officers with local experience, travellers, etc. The drafted maps can be sent at different stages to the Forest Services and other institutions of interest for comments, additions and corrections.

It is doubtful whether resources will be adequate to prepare forest maps of the type discussed. The Data Bank should however try to acquire all national maps of interest, and to include new information (e g situation of inventories, plantations) directly on these. When there is a specific need, a special forest map can be drafted.

The Federal Forest Research Institute in Reinbek, Hamburg has been preparing the World Forestry Atlas during the past 25 years, with the basic aim of showing the actual extent of the forests. An enormous amount of work has been put into this. For some countries in Africa, such as Ivory Coast and Cameroon, the maps in the World Forestry Atlas have been prepared from large scale topographic maps (showing also the closed forest area), which have been reduced in scale step by step. The World Forestry Atlas has the disadvantage that it is based entirely

on published maps. The maps are consequently no better than the sources, and these may often be outdated.

It should also be mentioned here that during recent years, a World Atlas of Agriculture has been prepared. Large resources seem to have been put into this work. This map shows the position of "forest". The information of forestry interest comes partly from the World Forestry Atlas. It should perhaps be mentioned that forestry was of minor importance for the preparation of this map. There is for example not always a clear boundary between closed forest and open woodland.

In this context it must also be mentioned that plans exist for utilizing satellite imageries for mapping vegetation in the tropics, for example the FAO/UNEP project on tropical forest cover monitoring (Baltaxe & Lanly, 1976). Researchers in the field of the global carbon cycle are also investigating the possibility of utilizing satellite imageries for studying the vegetation types (and the standing biomass) in the tropics. Funds may be found. So there is a possibility that some basic mapping will be done.

Satellite imageries will not give all the information needed. Forest and non-forest can, however, normally be distinguished. Different vegetation types can also often be identified. Maturity classes cannot be seen. When forest and non-forest is very mixed there is some difficulty in distinguishing "forest area".

Country notes

At present, most of the summarized information available to the Bank is in the form of country notes. For some time to come, country notes will in one way or another be very basic when publishing results from Regional Forest Resource Appraisals. If results from the pre-prepared tables are published the country notes must be seen as explanatory and complementary comments to these tables. When no reliable figures exist the country notes can give some indication of the actual situation.

In the long term, the form of the country notes should change towards being more an analysis of the production potential than a description

of the existing resources. The better the figures in summary-tables become, the more the country notes become a complement to the figures in the summary-tables.

Information must come in to the Data Bank continuously. This information must be checked against the information in the country notes. New information, better information, corrections, etc must be kept together with the original country note for later rewriting. When a considerable amount of new information has become available, the relevant parts of the country note could be redrafted.

Country notes are a complicated form for information storage. Their basic advantage is that they can be easily checked. Wrong information in the country notes is much more easily discovered than for example information in the summary-tables. At intervals, the information in the country notes should be checked with the Forest Services, Research Institutes, etc.

Computers

The information in the pre-prepared tables can and ought to be computerized. In theory maps can be computerized, too. Whether this is worth the work is difficult to say. Systems can be worked out which allow fast changes, corrections and additions of information in the computer. If the information were computerized, it would be much easier to utilize it in a number of different ways.

The initial activities here would be very costly. The advantages that can be won by computerization of e g maps may not be worth the price at present. The best way of starting a Data Bank is no doubt to design a very cheap and simple system.

6.2.4 Publishing of results from the Data Bank

The basic aim of the Data Bank should be to collect and store information about forest resources in different countries in such a way that the information is easily accessible. There is certainly a need to publish at intervals the basic information collected by the Data Bank. Reports of this type have here been called Regional Forest Resource Appraisals.

The need for continuous updating of the resource information given has been explained earlier. It is most likely that after a two to three-year-period, the information originally given in the country notes (and maps) has been so much improved that it should be published. The information of interest to publish could be arranged for each country in the form of country notes, maps and summary-tables. Each country can be printed as a separate report. This would make it easier continuously to introduce new material, corrections, maps, etc.

When a considerable amount of new information has been collected for a country, the country note should be redrafted and reprinted.

The capacity might be to publish a simple list with corrections and new information each year, and to renew the whole material every five years. In the case of some countries, this will mean the complete re-writing of the country notes perhaps twice and in the case of some other countries, no rewriting.

About every fifth year, the Data Bank could publish a report containing summary-tables, maps and an analysis of the situation based on the country notes. This quinquennial report could resemble WFI 1963. The summary-tables would be based on the pre-prepared tables. Many comments may be needed. Some of the basic figures in the pre-prepared tables could continuously be included in Yearbook of Forest Products.

6.3 Conclusions

In this chapter, measures that can be undertaken to improve knowledge about the world's forests have been discussed. It is evident that an improvement of this knowledge is not an end in itself. The increased knowledge must be used for better planning of the utilization of forest resources.

The methods discussed are of a rather unsophisticated type. Conditions are changing so fast that what is valid today may not be valid tomorrow. If resources became available more sophisticated methods could no doubt be used.

As has been shown in this chapter, some measures can be taken by FAO alone: To collect, store and analyse the information about the forests in a better way. Most improvements must, however, be made at the national level. FAO's basic task when trying to improve the international statistics is therefore to try to initiate improvements at the national level. This action is not only intended to improve statistics, but also to improve the use of the data for planning.

The basic work to improve knowledge about the world's forests must be made at the national level. A Forest Resource Data Bank must get hold of existing information in the cheapest way, so that international need can be met.

In international discussions in this field there is often a superstition that remote sensing from satellites will in the near future solve all our problems. It can no doubt be of value but it has limitations. Many studies are also done by national authorities. But there is still a need for a Data Bank that collects all this new information.

Inventories undertaken at the national level have often been concentrated on scattered areas considered to be of commercial importance. Often very limited efforts have been made to reach an over-all national picture. Each country needs to know its national forest resources.

Here must be added that inventories may be a political question. In Sweden for example most interested parties want to know about forest resources. In many countries opinions about what is needed may be conflicting. There are also different opinions about the need for international knowledge. Interested parties want information but may be reluctant to share what they know.

With these reservations in mind I think one can conclude that a Forest Resource Appraisal must be made as follows:

- Collect as much information as possible from literature surveys, correspondence, travels and interviews.
- Make guesstimates for missing information and judge the accuracy of all information.

- Make confidence interval for all figures.
- Make the objectives and work of the Forest Resource Data Bank known to all interested parties.
- Publish selected parts of the collected information.

7 CONCLUDING DISCUSSIONS

7.1 Background

It has been the main message of this report that knowledge of the forest resources of the world is limited. The forests can be seen as the remaining blank area on the world map. Another message has been that knowledge about forests can be improved by rather simple means.

The most logic explanation of this state of affairs would be that knowledge about forest resources is completely unnecessary. As must be evident from my discussion so far I do not consider that this is a valid explanation. A number of different fields in which there is a need for international forest resource statistics have been discussed in this report.

The collection of international forest resource statistics can be discussed and explained in technical terms. It is difficult, on the other hand, to prove in a satisfying way the actual value of these statistics, the need for quality and so on. What resources should be made available to improve knowledge?

It is evident (for economic and political reasons) that international organizations cannot produce country statistics based on their own surveys. International statistics must be based on national statistics. It may be difficult to prove the value of international forest resource statistics. But when it comes to the need for national statistics this task is easy. One may e g show what would be the result if countries like Austria, Finland, Sweden and USA did not know their forest resources. One may also show what would be the result if countries like India, Indonesia and Zaire knew their forest resources better. I consider the value of forest resource statistics proved (both at a national and international level).

In spite of all this, interest in improving information about forest resources is surprisingly weak (this statement is valid both in the case of national and international statistics). Only about 40% of the world's forests are covered by inventories.

The discussion in this chapter is very much based on my own experience in this field during the 10 last years. The chapter can be seen as an attempt to raise some provocative questions. Many of my assumptions and speculations can hardly be proven. Many of the questions cannot be answered.

7.2 Some possible explanations to the bad quality of forest resource information

The lack of forest resource information in developing countries is often explained by the fact that they in certain aspects are "underdeveloped". This does not explain everything. First of all certain developed countries have poor knowledge too. Secondly knowledge about the developing countries is not bad in all respects (oil and mineral resources are pretty well known).

Certain possible explanations as to the lack of reliable statistics (and lack of interest) concerning forest resource information will be discussed here (for developed and developing countries, and for national and international statistics). The explanations to be discussed are:

- The resources with which to improve knowledge are inadequate.
- They who have the power do not understand the need for knowledge of forest resources.
- The methodology utilized is wrong.
- Low interest to collect forest resource information.

7.2.1 The resources with which to improve the knowledge are inadequate

At both national and international level this is often given as the main reason. If they who have the power understand and are convinced that knowledge is needed they can normally find the resources required. They must of course also have an active interest in getting hold of knowledge and making it known. During the last years interest in improving knowledge about the world's forests has been limited. Just recently, concern about the environment (e g decreasing forest areas) has prompted

some interest among protectionists.

7.2.2 They who have the power do not understand the need for knowledge of forest resources

This is no doubt a common reason why inventories (and statistical surveys) are not given adequate resources. It is the duty of those who have the understanding of the problem to inform they who have the power. Evidently it is often so that forest inventories and statistical surveys are given a low priority even within the Forest Service (who ought to know better). International organizations (who ought to understand the needs) evidently give statistical surveys a rather low priority too.

7.2.3 The methodology utilized is wrong

This cannot explain the lack of information but to some extent the low quality of certain information. Of the rather few forest inventories that have taken place in developing countries many have been of doubtful value. The inventories have often given (correct?) answers to the wrong questions. Often they have only been descriptive.

One basic reason for this is that the inventory experts have given the same type of information as they used to do in their home-countries. They have failed to analyse the specific questions needing to be answered in the country in which they work.

The developing countries have, however, often been hit by western snobbery too. Many so-called experts have utilized and taught unnecessary sophisticated methods. Experts often want to show themselves clever by developing sophisticated methods.

It is common that "qualification" in the western academic world is to a great extent made through the development and utilization of as sophisticated a methodology as possible. Methods of value in developed countries are "improved" more and more. Limited resources are put into efforts to develop methods which in a fast, cheap and simple way can give the basic knowledge needed in developing countries with a serious lack of data. The basic reason for this can be said to be the lack of problem analysis.

At least in earlier years many inventories were made to give information of interest for developed countries or international forest companies. Inventories covering only commercial species and sizes were often of this type. Many inventories have also covered only selected areas (e g so-called pre-investment surveys). The money utilized for these has often given limited results. The inventories have given neither valuable knowledge nor investments (but often some training). Inventories must be made to meet the national needs.

Forest resources in developing countries are changing fast. For this reason inventory data quickly become out-dated. In tropical countries especially knowledge about forest resources must be continuously up-dated.

If appropriate methods were used, knowledge at the national level could no doubt be improved considerably without much rise in cost. This is true too for many developed countries. In Europe many inventories are mainly made for management plans and not for national statistics. For assessment of volume and increment yield tables are commonly used. National statistics are compiled by adding district results. Experience shows that such methods often lead to considerable underestimates.

As has been explained in detail the methods hitherto used for world forest resource appraisals have had limitations too. It is possible to improve them.

7.2.4 Low interest to collect forest resource information

In the first part of this report we discussed the need for knowledge that is known and/or that can be proven by logical discussions. From the point of view of the Government (e g represented by the Forest Service) improved knowledge about forest resources, both national and international, must logically be of great value. There are, however, interested parties that can consider it to be in their interest that the knowledge remains limited. This is no doubt an important point to consider when one discusses the low interest in improving knowledge.

National level

At the national level statistics can be used for control and planning. This can limit the work of private companies. Private companies rarely want control or limitations.

If the statistics remain poor, unpleasant facts can be hidden. Private forest companies, high officials and so on can have interests of this type. Sometimes the Government do not want to be reminded about difficult problems. If facts are lacking necessary actions can be pushed into the future. The real need for fuelwood plantations is for example not sufficiently known and understood in many countries. Actions undertaken are most likely inadequate.

Sometimes decisions about investments in forest industries can be taken for political reasons. In this case interest in statistics must be limited. Improved knowledge might restrict freedom of action.

Forestry is a long-term business. Interest in statistics is often greater for short-term business. Mismanagement of forest resources does not show up immediately.

By these examples I want to show that it is not self-evident that all interested parties want to have good knowledge about forest resources. They often put emphasis on different aspects. Some of them may prefer to have as little knowledge as possible (or at least that all except themselves have little knowledge).

International level

The governing bodies of many international organizations often have only limited interest in improving knowledge about the world's forest resources (as well as other statistics).

As the developing countries often have limited knowledge about their own forest resources, it is logical that their interest for international statistics is limited. Under the present circumstances the developing countries think they cannot make much use of international knowledge. They naturally do not relish putting their poor statistics on show.

Different countries are dependent on the surrounding world to a varying degree. The developed countries dominate the international trade in world forest products. The developed countries (and strong forest companies) which know their need for knowledge benefit most from existing international forest resource statistics and studies based on these. They can utilize them in the best way. They have also the resources to collect information by themselves and fill in some of the major gaps in existing international statistics.

When the developed countries really want good statistics they get them. The Governments are, however, mainly interested in conditions in the developed countries. Both in the case of the forest and the industry (production, capacity etc), information is relatively well known for the developed countries (at least in the right order of magnitude). Certain statistics are collected by their own organizations (e g OECD).

? | The limitations of the international statistics are often well known at least to specialists. They know that it will take a very long time to improve the UN-statistics. If they really need better statistics they have better collect them themselves. This means that those in the developed countries who really need international statistics hardly ever try to get hold of better statistics through UN-organizations. Many forest companies, consulting firms and so on know the resources at least better than the UN-organizations.

In international organizations the developed countries show little more than a polite interest in learning more about the forestry conditions in developing countries. One important exception is the interest of protectionists in learning more about environmental conditions (including forest destruction) in developing countries.

We have here talked about the governing bodies of international organizations but said nothing about their staff.

The staff of the international organizations really could decide what work should be done. The governing bodies are given proposals worked out by the staff. Proposals are rarely refused. Often, however, the international organizations are rather opportunistic. Interest is often directed towards fields where it is easy to get hold of money,

at present for example the energy field. It is not likely that improved statistics will become a popular subject in the near future.

It is natural that international organizations have their own interests to guard too. The world changes but people are the same. International organizations and the people working for them find it difficult to change. A wrong approach once decided upon keep going for a long time.

In certain types of activities (e g mining, agriculture) large multinational enterprises have very efficient intelligence services. It is to their advantage if the UN-statistics are bad. They make money because they have better knowledge than Governments in small countries (Berg & Berg (1978), Hollander (1977), Lappe, Collins & Fowler (1977)).

If we talk about international statistics in general it is evident that many interested parties prefer that international statistics remain bad. The groups that would benefit from better international statistics are weak and the need is rarely fully understood by them.

When it comes to international forestry statistics the general impression is lack of interest from most interested parties. The developing countries will hardly take any action to improve international statistics. They have rarely analysed their own need for international statistics. Some may even consider the collection of international statistics as an unnecessary undertaking. But forestry companies and consulting firms can no doubt benefit from having better knowledge than others.

7.3 Some further comments about the result of bad knowledge

At present the situation is that knowledge is relatively acceptable (or at least in the right order of magnitude) for developed countries and extremely bad for developing countries. Does not this state of affairs matter at all?

There may be reason to consider Myrdal's (1970) statement: "There is a tendency for all knowledge, like all ignorance, to deviate from truth in an opportunistic direction."

As has been discussed even the interest for knowledge has a tendency to be opportunistic. Many interested parties fear a spread of knowledge and prefer that knowledge remains bad. In the case of forestry the majority do not seem to bother. Those who consider it to be in their interest to have a good knowledge base do not manage to influence the decision makers.

With the present knowledge as a base very different conclusions can be reached. By utilizing suitable examples nearly all theories can be proven. This is for example often the case concerning environmental problems. In this case no global statistics exist - only examples. For the same reason many doomsday predictions - e g in the case of food production - are of rather doubtful value. When the statistical base is weak the opinion of the most persuasive speaker or the best author is commonly accepted as the truth. What can happen as a result of complete misjudgement of the world situation concerning food production? Here hard facts are essential.

When common knowledge is missing those who have the best knowledge can manipulate the market. If knowledge was more widespread wrong decisions would become rarer. The powerful have the resources to make one or more misjudgements. The less powerful cannot afford a mistake.

In Asia for example a consortium of Japanese trading companies have had a strong influence on the prices of logs. Many countries have felt that the consortium has managed to keep the prices very low. After the so-called "paper-crisis" in 1973 a number of developing countries took decisions to establish pulp and paper mills. Whether these decisions will prove to be of value for the developing countries can be questioned. The decisions will certainly prove to be of value for consulting firms and equipment producers in developing countries.

7.4 Some further comments about present studies

In spite of my complaints about the low interest for international statistics "the world is hungry for figures". It seems, however, to be a fact that those who use the figures (mainly economists) are satisfied if they are just given figures. Any analysis of the accuracy and usefulness of the figures occurs in rather few reports. People inside

the international organizations find it difficult to criticize "their own statistics" (even if they happen to know that they are bad). Researchers outside the UN-organizations often treat the international statistics with great reverence. I doubt that there will be any desperate scream for better statistics from the main users.

It is my conclusion that the existing international statistics (not least the forestry statistics) do not allow any realistic and scientific analysis of the different problems (e g resources versus demand).

Many sophisticated studies ought to be classified as nonsense. International studies are often not much more than academic shows. It is important to name nonsense by the correct name. If this situation is going to continue (which I fear) it could be taken as an example of ignorance of the developing countries and an ignoring of their very real need for accurate reliable information.

Some scattered specialists in different fields understand how bad statistics sometimes are. Scientists and even small consulting firms start to collect statistics of their own. The Forest Services must be burdened by requests from all kinds of people. I fear they will become more and more reluctant to cooperate.

7.5 Some further comments about the need for better knowledge

The multinational companies are now commonly said to have tremendous power. More knowledge is needed of how they actually function.

In many countries (e g in UNCTAD) the developing countries try to establish a united front. To reach any result they must know their situation. The developed countries certainly know their own relatively well. Often they also know the situation in the developing countries better than these do themselves.

Changes of the present economic order to the advantage of the developing countries require knowledge. How is the world functioning? Lack of knowledge makes change more difficult. It is the developing countries which want and need change.

The gap between rich and poor countries is now widening. A laissez-faire system would certainly not mean much development for the countries that are worst off. Through studies of the relation between developed and developing countries it may be possible to find practical ways of turning development in a direction more beneficial to poor countries. The changes needed will not take place through national planning only. Knowledge about international conditions is absolutely necessary. If the developing countries really do manage to get control of their own resources they need knowledge about the surrounding world. If this knowledge is lacking they can be manipulated. In spite of all the reasons that have been given for an improved knowledge it is likely that it will remain bad if nothing drastic is done.

7.6 Final remarks

I consider it proven that the developing countries will benefit from better knowledge about international conditions. The present lack of knowledge is to the disadvantage of the developing countries. It is the duty of international organizations to give the developing countries reliable analysis of the world situation. The powerful can make the analysis by themselves. The present slackness concerning collection of reliable international statistics and analysis of the situation of the developing countries is an effect of opportunism. Often the interest for the developing countries is more dutiful than real. Much of the work done can be classified as most unscientific.

Improved statistics should be to the advantage of developing countries. It is, however, a fact that one of the basic difficulties when trying to improve international statistics is that the developing countries do not want to give away statistics. The developing countries often prefer to keep their statistics secret.

This is, frankly speaking, useless. They who really want to get hold of information usually manage to get hold of it anyway through bribes or whatever. They also manage to get hold of information about the accuracy of the information. This situation simply means that the important information is monopolized by strong countries, companies or consulting firms. The developing countries (and often the UN-organizations) on the other hand, have no idea of the actual situation.

Even if I am convinced that better knowledge about forest conditions in different countries is of great value, I am equally sure that other steps are perhaps still more important if successful development of the forestry is to take place.

Someone may argue that I talk too much about a "conspiracy" to keep the forest resource statistics bad. In many fields I understand this is common. In forestry ignorance and lack of interest may be basic reasons. The forestry agencies in Sweden seem to accept international studies rather uncritically. Sweden would benefit from better knowledge too but shows little interest in getting the knowledge improved. The often amateurish studies that are now made (due to bad statistics) can do no good. I quote Myrdal (1973):

"A scientist's faith is that realistic research leading to true knowledge is always and everywhere wholesome, while opportunistic illusions are damaging."

This means that the more we know about the world's forest resources, forest production etc the better the possibilities will be of finding the best ways of utilizing the forest resources to the advantage of the people in the developing countries. Lack of knowledge on the other hand will most likely be of advantage to the already advantaged.

It is the responsibility of all those who utilize international statistics to press for better statistics. Useless statistics must not be used. The world is not helped by invalid academic exercises.

UN-statistics may always prove to have some limitations. It is, however, unrealistic to imagine that international statistics can continuously be collected outside the UN-family. Outside researchers or institutes must be given the possibility of reviewing the accuracy of the statistics. A polite acceptance of international statistics is unprofessional and unscholarly. The statistics must instead be under a continuous review. Knowledge about the world's forests is now very bad. It must be improved. No other natural resource is as badly charted as forest. Yet wood is, next to sand, oil and coal the world's most important commodity in weight.

8 SUMMARY

8.1 Background

The objective of the report is to point out why knowledge of the world's forest resources is needed, which type of information is needed, what has been done up to date to collect information, what knowledge exists at present, what are the limitations of the present knowledge and finally what we can do to improve the present knowledge.

It is realistic to presume that international knowledge must be based upon national knowledge. Very few studies can be made with the specific object of giving international knowledge. Now national knowledge about forest resources is very bad. Only about 40 per cent of the closed forest is covered by some form of inventory. Many of these inventories are old and/or of poor quality. It is above all the forest resources in the developing countries that are badly known. It is logical then to maintain that knowledge of the world's forests is very bad

8.2 Why is knowledge about forest resources needed?

At the national level knowledge about the forest resources is needed for among other things the long-term planning of the utilization of the forest resources. Without knowledge about the forest resources wrong decisions are easily taken. The forest industry can e g be over-established. If the developing countries increased their knowledge of forest resources they would have much better possibilities of planning the long-term utilization of forest resources.

Tropical forestry has similarities with mining. The forests are not treated as a renewable resource. Plantations to supply the local population with fuelwood are now rarely undertaken. The national level knowledge is needed for the planning of industrial forestry, farm forestry and environmental forestry.

The planning of industrial forestry in a country requires knowledge about the forestry situation in the world. One basic reason for this is that the forest resources of the world are very unevenly distributed. For the time

being very few countries (if any) have isolated themselves completely from international contacts. The planning authorities must then make certain assumptions about the possibilities for export and import of forest products. Such an analysis requires among other things knowledge about the world's forest resources. It is also necessary to have some knowledge about the future market for different forest products. Countries which cannot afford import of forest products must of course try to satisfy the demand by domestic production. Their interest for forest conditions in the surrounding world should be limited just now. They need however knowledge about their own resources and their possibilities in a longer perspective. The last point requires certain knowledge about the surrounding world.

The classical question has always been whether the world's forests can meet the demand for forest products from a rapidly increasing world population. It must be considered self-evident that knowledge to answer this question is needed.

Knowledge about the forest resources in different countries is also necessary in order to identify global problems within the forestry sector (e.g. shortage of fuelwood, destruction of the forests, environmental problems).

Knowledge about the forest resources is also needed for the problem identification and policy formulation of the international organizations. The international organizations must try to understand how the world functions. Without statistics it is difficult to have a clear picture. If discussions and conclusions about world forestry are based on the statistics available at present one may easily reach a wrong picture.

The international statistics are used by many researchers too. Many studies dealing with the global climate require for example knowledge about the world's biomass and about changes in this. Such studies must normally be satisfied with the statistics published by the UN-organizations.

As will be discussed later the lack of easily accessible knowledge is often to the advantage of the powerful. They who cannot collect any knowledge by themselves can be manipulated. This too is a strong reason for the need for better knowledge about the forest conditions in the world.

8.3 Which information is needed?

International organizations ought to provide their member countries with most of the international statistics and the most important international investigations they need. Among the important studies that have hitherto been undertaken can be mentioned the Timber Trends and Prospects Studies undertaken by FAO. The international forest resource statistics have to a certain extent been collected to meet the needs of these studies. It is logic to suppose that this will remain the case in the future.

It is realistic to assume that different kinds of "balance-studies" (or Production and Consumption Studies) will decide which kind of forest resource information the International Organizations try to collect. The most important knowledge we need is how much the forests can produce now and in the future. It is in this context necessary to make different assumptions about how intensively the forests will be managed. For environmental reason it is for example likely that the forests in many developed countries cannot continue to be utilized for wood production as intensively as now.

Very few countries have reliable information of the above mentioned type. For this reason it is necessary to try to give a comprehensive description of the forest resources. After adjustments and guesstimates the information can be used to work out the best possible picture for a region. The objective of a World Forest Resource Appraisal must be to give the following information:

- Description of existing resources (description about area, volume, and so on).
- A description of past trends in the utilization and development of the forest resources.
- Assessment of future changes in the forest potential to produce wood (e g new plantations).
- Felling forecasts.
- Potential cut.

The two last points are the most important. For most countries only information about the first point is available.

Just now the balance-studies are not completely dominating when it concerns information about forest resource statistics. There is for example a great interest in learning about the rate of tropical forest destruction. Certain studies in this field are therefore undertaken.

8.4 Studies which have been undertaken up to now

The World Forest Inventories (WFI) that have been published by FAO do not give all the knowledge needed. This is true both as regards quantity and quality. The questionnaire method used hitherto cannot be improved to any great extent. The so-called "New Approach" (Country reports, maps etc) which has been utilized in some recently published reports can give more information than the WFI. The method is also suitable for a continuous improvement of the information.

Some reports dealing with the most important forest regions in the world have been published quite recently. This means no doubt that the knowledge has been improved quite considerably during the last years. In spite of this it is a fact that existing knowledge about the world's forests is very limited. The area of closed forest for example can only be given as somewhere in the interval 2 150-2 750 million ha (see Appendix I).

8.5 What can be done to improve the knowledge?

Much work remain to be done before the knowledge can be said to be "adequate". Most of the work to improve the knowledge must be done at the national level. Certain steps can however also be taken at the international level. The most important step is to establish a World Forest Resources Data Bank. FAO is the most natural place for such a Bank.

This Bank must continuously collect and update information about the world's forest resources. In the first stage the Bank must concentrate on the information that should be available at the national level. The information must be collected in the cheapest possible way. The resources available will certainly be limited.

A very important task in the work of the Bank is to store the information in such a way that it is easily accessible. The information collected must be published regularly in a suitable form.

The accuracy of the collected information must be judged. For each type of information it is necessary to show the interval where it is likely that the true value is found. It is necessary to clearly admit the limitations of the information. The Data Bank (if situated at FAO) will find difficulties to make these critical analyses. For this reason it is necessary that independent researchers or institutes continuously examine information given by the Data Bank and comment on its accuracy.

Perhaps the most important way to improve knowledge of the world's forest must be the improvement of knowledge at the national level. FAO ought to start a program to establish national forest resource data banks in all developing countries.

8.6 Discussions about possible explanations to the low interest for forest resource information

It is clear then that it is possible to give strong reasons for the need for forest resource information. It is also possible to improve this knowledge by simple means and without high costs. If a Data Bank really managed to get hold of the information available at the national level the global picture would be much better known than at present. In spite of this interest in improving knowledge is surprisingly low for both national and international levels.

The most logic explanation of the low interest shown would be that the information is completely unnecessary (especially in developing countries). This would mean that my main thesis is completely wrong. But there can however be other explanations.

- Knowledge is needed but the resources available for collecting the information are inadequate.
- Those in power do not understand the need for knowledge.
- The inventory methods commonly used are wrong.

- Interested parties have a very varying need for better knowledge and some may even find it to their advantage not to make known such knowledge as is available.

What has been discussed in the report is basically the needs that are well known and/or that can be explained by logic discussion. From the view of the government (the Forest Service) improved knowledge must logically be of great value. There are however also interested parties that consider it to be in their interest if the knowledge remains limited. This is valid for both the national and international level. This is probably an important but underestimated reason for the bad statistics.

At the national level the statistics would naturally be used in planning and controlling resources. This would limit the freedom of action of the forest industry. Private companies do not normally want control or limitations. If the statistics are bad unpleasant truths (e g for Government Authorities) can be hidden too.

Within many activities (e g mining, agriculture) large multinational companies do not want international information to be improved. The companies have the knowledge and make a profit by having better knowledge than others. The governments of developed countries and large multinational companies can usually manage to get hold of the information they think they need. Multinational companies and consulting firms sometimes know the resources much better than the UN-organizations.

In the governing bodies of international organizations the interest for improved knowledge about resources is often very limited. Of what has been said so far it is understandable if many delegates from developed countries do not give the need for better statistics a high priority. As most developing countries have only poor knowledge of own resources it is logical that their interest for international statistics is limited. Under these circumstances the developing countries think they cannot make much use of international knowledge. They may not either like to show serious limitations of their own statistics.

The interested parties (in for example international organizations) which want better knowledge are evidently rather weak. If nothing drastically new happens it is likely that knowledge will remain bad at both the national and international level.

Here there are reasons to quote Gunnar Myrdal (1970):

"There is a tendency for all knowledge, like all ignorance, to deviate from truth in a opportunistic direction".

The interest for knowledge is opportunistic too. Now some knowledge exists for the developed countries while knowledge of the developing countries is extremely poor. Interest in knowing shows the same tendency. Is this state of affairs of no importance?


If the developing countries really want to gain control over their own resources they need knowledge about the surrounding world (and of course their own country). If this knowledge is not available to them they can be manipulated by those powerful enough to have the knowledge.

The developing countries are certainly served by better knowledge about international conditions. In any case better knowledge will not hurt them. Many examples show on the other hand that they are hurt by a lack of knowledge. Because of the weakness of the developing countries it is the duty of the UN-organizations to provide them with reliable analyses of the world situation. Up to date they have often collected statistics which are mainly of interest to the developed countries. The basic question must always be what improved knowledge can most benefit the developing countries.

The existing statistics do not permit of any (or at least very few) realistic analyses. From examples all theories can be proven. That this state of affairs should continue must be taken as a sign of limited interest in the developing countries. Lack of knowledge is to the disadvantage of the weak.

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10 SAMMANFATTNING (SUMMARY IN SWEDISH)

10.1 Bakgrund

Rapportens målsättning är att klargöra varför det behövs kunskap om världens skogstillgångar, vilken typ av information som behövs, vad som hittills gjorts för att samla in information, vilken kunskap som finns för tillfället, vad som är begränsningarna av den nuvarande kunskapen och slutligen vad vi kan göra för att förbättra den nuvarande kunskapen.

Den internationella kunskapen måste realistiskt bygga på den nationella kunskapen. Ytterst få studier kan göras speciellt för att få fram internationell kunskap. Den nationella kunskapen är dock för tillfället ytterst usel. Endast ca 40 procent av den slutna skogen är täckt med någon form av inventering. Många av dessa inventeringar är gamla och/eller av dålig kvalitet. Det är framför allt u-ländernas skogstillgångar som är dåligt kända. Logiskt måste alltså kunskapen om världens skogstillgångar vara usel.

10.2 Varför behövs kunskap om skogsresurserna?

På nationell nivå behövs kunskap om skogsresurserna bl a för den långsiktiga planeringen av skogsresursernas utnyttjande. Utan kunskap om skogstillgångarna fattas lätt felaktiga beslut. Skogsindustrin kan t ex byggas ut för mycket. Ökade u-ländernas kunskaper om skogstillgångarna så skulle de ha betydligt bättre möjligheter att utnyttja skogstillgångarna på ett långsiktigt sätt. Tropiskt skogsbruk har nu formen av ren gruvidrift. Skogen behandlas ej som en förnyelsebar resurs. Planteringar för att förse lokalbefolkningen med brännved företas sällan. På nationell nivå behövs kunskap för att planera både industriskogsbruk, byskogsbruk och miljöskogsbruk.

Planering av industriskogsbrukets utveckling i ett land kräver kunskap om skogssituationen i världen. Skogsresurserna är nämligen mycket ojämnt fördelade mellan länder och regioner. För tillfället har också mycket

få länder (om något) helt isolerat sig från internationella kontakter. Planeringsmyndigheten måste då göra vissa antaganden om vilka möjligheter som finns för export och import av skogsprodukter. En sådan analys kräver bl a kunskap om världens skogsresurser. Den kräver också viss kunskap om den framtida marknaden för skogsprodukter. Länder som ej har råd att importera skogsprodukter måste naturligtvis försöka producera inom landet. Deras intresse för omvärldens skogsresurser bör då vara relativt obetydligt just nu. Dock behöver de kunskaper om sina egna resurser och möjligheterna i ett längre perspektiv. För det senare krävs viss kunskap om omvärlden.

Den klassiska frågan har alltid varit om världens skogar kan möta behovet av skogsprodukter till en snabbt ökande världsbefolkning. Det måste anses självklart att det behövs kunskap som kan svara på denna fråga.

Kunskap om skogsresurserna i olika länder är också nödvändig för att identifiera globala problem inom skogssektorn (t ex brännvedsbrist, förstörelse av skogarna, miljöproblem).

Kunskapen om skogsresurserna behövs också för de internationella organisationernas policy-formulering och problemidentifikation. De internationella organisationerna måste försöka förstå hur världen fungerar. Utan statistik är det svårt att få en klar bild. Byggs resonemang och slutsatser på den statistik som finns för tillfället kan man lätt få en felaktig bild.

Den internationella statistiken används också av många forskare. Många globala klimatstudier kräver t ex kunskap om världens biomassa och om ändringen i denna. Dessa studier får oftast nöja sig med den statistik som publiceras av FN-organen.

Som kommer att diskuteras i avslutningen så gynnar ofta brist på lättillgänglig kunskap de starka. De svaga kan bli manipulerade. Detta är också ett starkt skäl till behovet av bättre kunskap om skogsresurserna.

10.3 Vilken information behövs?

Internationella organisationer bör förse medlemsländerna med den mesta internationella statistiken och de viktigaste internationella utredningar de behöver. Bland väsentliga utredningar och studier som företagits kan nämnas de Timber Trends Studier (balansstudier) som utförts av FAO. Den internationella skogsresursstatistiken har i viss utsträckning insamlats med tanke på dessa studier. Det är logiskt att anta att det kommer att vara förhållandet även i fortsättningen.

Realistiskt sett kommer "balansstudierna" att även i fortsättningen i huvudsak bestämma den typ av skogsresursinformation man försöker samla in. Den väsentligaste kunskap som vi behöver ha om skogsresurserna för detta ändamål är hur mycket de kan producera nu och under en kommande period. Det är i detta sammanhang nödvändigt att göra olika antaganden om hur intensivt skogarna kommer att skötas. Av miljöskäl kan t ex skogarna i många utvecklade länder börja att utnyttjas mindre intensivt för virkesproduktion än nu.

Det är mycket få länder som verkligen har tillförlitlig information av denna typ. Det är därför nödvändigt att försöka ge en allsidig beskrivning av skogsresurserna. På så sätt kan man med hjälp av diverse justeringar och kvalificerade gissningar arbeta fram bästa möjliga bild för en region. Målsättningen med en internationell skogsresursbeskrivning måste dock vara att primärt ge följande information:

- Beskrivning av befintliga resurser (information om areal, volym osv).
- En beskrivning av tidigare trender i fråga om utnyttjande och utveckling av skogsresurserna.
- Bedömning av framtida ändringar skogarnas förmåga att producera ved (t ex nya planteringar).

- Den förväntade avverkningen.
- Den möjliga avverkningen om all skog utnyttjas.

De två sista punkterna är de viktigaste. För de flesta länder kan vi bara få information om den första punkten.

Just för tillfället är inte balansstudier helt dominerande när det gäller datainsamlingen. Så är t ex intresset för de tropiska skogarnas förstörelse mycket stort. Vissa specialstudier företas därför.

10.4 Studier som företagits hittills

De WFI (världsskogsinventeringar) som har publicerats av FAO ger varken i kvantitet eller kvalitet all den kunskap som behövs. Den metod med frågeformulär som har använts kan inte heller förbättras i någon högre utsträckning. Den s k "Nya metod" (länderrapporter, kartor osv) som har använts i några nyligen publicerade rapporter kan ge mer information än WFI och dessutom är metoden lämplig för en kontinuerlig förbättring av informationen.

Några rapporter som ger information för de viktigaste skogsregionerna i världen har alltså nyligen publicerats. Detta betyder utan tvekan att kunskapen har förbättrats avsevärt under senare år. Det är trots detta ett faktum att den befintliga kunskapen om världens skogar är ytterst begränsad. Arealen sluten skog kan t ex knappast anges med större säkerhet än någonstans i intervallet 2 150 - 2 750 miljoner ha. (Se Appendix I).

10.5 Vad kan göras för att förbättra kunskapen?

Mycket arbete återstår därför att göra innan kunskapen kan sägas vara "tillräcklig". Det mesta arbetet att förbättra skogsresursstatistiken måste göras på nationell nivå. Vissa åtgärder kan emellertid också göras på internationell nivå. Den viktigaste åtgärden är att skapa en Data Bank för världens skogsresurser. FAO är den naturliga platsen för en sådan Bank.

Denna Bank måste kontinuerligt samla in och uppdatera information om världens skogsresurser. Inledningsvis måste den koncentrera sig på att få fram den information som borde finnas på nationell nivå. Informationen måste samlas in på billigast möjliga sätt. Tillgängliga resurser lär nämligen förbli en begränsande faktor.

En mycket viktig uppgift i Bankens arbete är att lagra information på ett sådant sätt att den är lätt åtkomlig. Den information som insamlas måste då och då publiceras i lämplig form.

Noggrannheten av den insamlade informationen måste bedömas. För varje uppgift (siffra) krävs att det intervall där den sanna siffran sannolikt finns bedöms. Materialets osäkerhet måste klart framgå. Data Banken (dvs FAO) kan ha svårt att göra dennakritiska analys. Av detta skäl krävs att fristående forskare eller institut kontinuerligt underkastar materialet för en kritisk granskning.

Ett viktigt bidrag för att förbättra kunskapen om världens skogar måste vara att förbättra kunskapen på nationell nivå. FAO borde starta ett program för att skapa nationella data-banker i åtminstone alla u-länder.

10.6 Diskussion av möjliga förklaringar till det dåliga intresset för skogsresursinformation

Som framgått kan starka skäl ges för behovet och värdet av skogsresursinformation. Det finns också goda möjligheter att med enkla medel och utan alltför stora kostnader förbättra kunskaperna. Om en data-bank verkligen lyckas gräva fram den kunskap som finns på nationell nivå så skulle den globala bilden vara mycket bättre känd än nu. Trots detta så är intresset för att förbättra den internationella informationen överraskande svagt (och ofta även på nationell nivå).

Den mest logiska förklaringen till det svaga intresset skulle vara att skogsresursinformation är helt onödig (framför allt i u-länderna). Detta skulle betyda att alla mina resonemang är helt felaktiga. Det kan emellertid även finnas andra förklaringar.

- Kunskap behövs men resurserna för att utföra arbetet är otillräckliga.
- De makthavande förstår ej behovet.
- Använd metodik ger fel resultat.
- Behovet av kunskap om skogstillgångarna varierar mellan olika grupper i samhället (även i fråga om internationell statistik). Tillgänglig information kan även hållas hemlig av vissa intressenter.

Vad som inledningsvis diskuteras i rapporten är de behov som är kända och/eller som kan förklaras med logiska resonemang. Ur statens (Skogsstyrelsens) synpunkt bör bättre kunskap rent logiskt vara av stort värde. Det finns emellertid även intressen som anser sig betjänta av att kunskapen förblir begränsad (gäller både nationell och internationell nivå). Detta är sannolikt en viktig (men underskattad) bidragande orsak till den dåliga statistiken.

På nationell nivå kan statistik användas för kontroll eller planering som kan ge begränsningar i exempelvis företagens handlande. Privata företag vill ej ha kontroll och begränsningar. Med dålig statistik kan också obehagligheter (exv inom den statliga administrationen) döljas.

Inom många branscher (exv gruvindustrin, jordbruk) saknar multi-nationella företag intresse av att förbättra den internationella statistiken. De är i besittning av kunskap själva. De tjänar pengar på att ha bättre kunskap än andra. I-landsregeringar och multi-nationella företag kan ofta plocka fram den kunskap de tror sig behöva. Företag och konsultbolag kan känna resurserna bättre än FN-organ.

I internationella organisationers styrande organ är intresset för internationell statistik om resurserna ofta svagt. Av vad som sagts ovan kan det vara förståeligt om många i-landsdelegater inte ger behovet av bättre statistik hög prioritet. Eftersom u-ländernas kunskap om de egna skogarna är svagt så är det ganska logiskt att intresset för internationell kunskap också är svagt. Under dessa förhållanden anser sig u-länderna inte ha stor användning av internationell kunskap. De vill ej heller skylta med brister i sin nationella statistik.

De grupper (exv internationella organisationer) som vill ha bättre kunskap är ofta rätt svaga. Sker inget drastiskt är det sannolikt att kunskapen kommer att förbli dålig både på nationell och internationell nivå.

Här finns anledning att citera Gunnar Myrdal (1970):

"All kunskap liksom all brist på kunskap tenderar att avvika från sanningen i opportunistisk riktning".

Även intresset för kunskap är opportunistiskt. För tillfället är kunskapen någorlunda för i-länderna och urusel för u-länderna. Även intresset visar samma tendens. Spelar inte detta någon roll? För att u-länderna verkligen skall få kontroll över de egna resurserna krävs kunskap om det egna landet och om omvärlden. Saknas denna kunskap kan de bli manipulerade.

U-länderna är säkerligen betjänta av bättre kunskap om internationella förhållanden. I vilket fall som helst så skadas de inte av bättre kunskap. Däremot visar många exempel att de skadas av dålig kunskap. På grund av u-ländernas relativa svaghet är det FN-organisationernas skyldighet att förse u-länderna med tillförlitliga analyser av världssituationen. Hittills har de ofta samlat in statistik som är av primärt intresse framför allt för i-länderna. Den viktiga frågan är alltid huruvida bättre kunskap kan förbättra u-ländernas möjligheter?

Den befintliga statistiken tillåter inga (eller få) realistiska analyser. Med exempel kan allt bevisas. Om dessa sakernas tillstånd skall fortsätta måste det tas som ett tecken på bristande intresse för u-länderna. Brist på kunskap missgynnar de svaga.

APPENDIX I

Comments about the accuracy of world forestry statistics

Notes. This is an extract from a forthcoming article with a wider content. The results are preliminary and will most likely be adjusted before the final publishing of the complete report. The basic conclusions will not be changed to any greater extent.

General background

It is now generally agreed that knowledge about the world's forests is limited. In many studies, however, the existing estimates are utilized as if they were the absolute truth. Reservations about accuracy may be given in the introduction and then immediately forgotten.

In 1974 I published the report World Forest Resources. The difficulty in the beginning was to get hold of at least the approximate size of the closed forest area. The first information found was often later proved to be completely wrong.

World Forest Resources was written in a hurry during 1973. My intention was that it should be followed by a more complete version a year or two later. The main effort was put into finding information for the developing countries. The answers to FAOs WFI questionnaires (dispatched in 1968) were accepted for the developed countries.

What was published in the World Forest Resources was the information (published or not) which I trusted most. The information gathered was interpreted and adjusted so that, as far as possible, it met FAOs definition of closed forest. This could in many countries mean a considerable reduction of the so-called forest area. In the summary-tables I sometimes had to produce my own guesstimates. This was, however, not the rule.

I was aware that many of the figures I got hold of were outdated or very unreliable. I gave the year of the estimate (when it was known) and an accuracy classification for the area of closed forest, stand-

ing timber and man-made forest reported as the country-figures in the summary-tables.

I sometimes pointed out that an estimate (guesstimate) was e g 20 years old and that the true value now could be more than 40 per cent higher or lower (i e accuracy-class 5). No one seems to have bothered much about the accuracy-classification I gave. A figure written in a report is evidently taken as an exact figure.

The accuracy-classification means, however, that the report must not be interpreted as if the actual area of closed forest in the early 1970s was 2 800 million ha. It should be interpreted as if the closed forest area in the early 1970s was somewhere between 2 200 and 3 400 million ha. As I often pointed out that over-estimates were rare the upper range can be reduced to perhaps 3 000 million ha.

Since 1974 I have given adjusted regional figures in a number of articles (e g Persson, 1978 a & b). In these articles the world's forest area varies from 2 640 to 2 929 million ha. These large differences depend entirely on the difficulty of deciding what is the closed forest area of Brazil, Canada, USA and USSR. If these countries are excluded the difference between the estimates is at most 24 million ha.

FAO has recently published world figures in a couple of reports (FAO, 1978 b, FAO/ECE, 1979). In these reports the closed forest area varies from 2 835 to 2 970 million ha. Although these two reports agree rather well they utilize actually somewhat different definitions of closed forests.

The world's forest resources - the true picture

For the last ten years I have continuously collected information about the world's forest resources. This has been done by a screening of reports and articles, interviews, correspondents, travels and so on. I have now gone through all the material in my country files. In this way I have revised my earlier figures in the case of closed forest, man-made forest and open woodland. The result of this exercise is shown in table A.

Table A. The world's forest resources in the late 1970's. Mill ha.

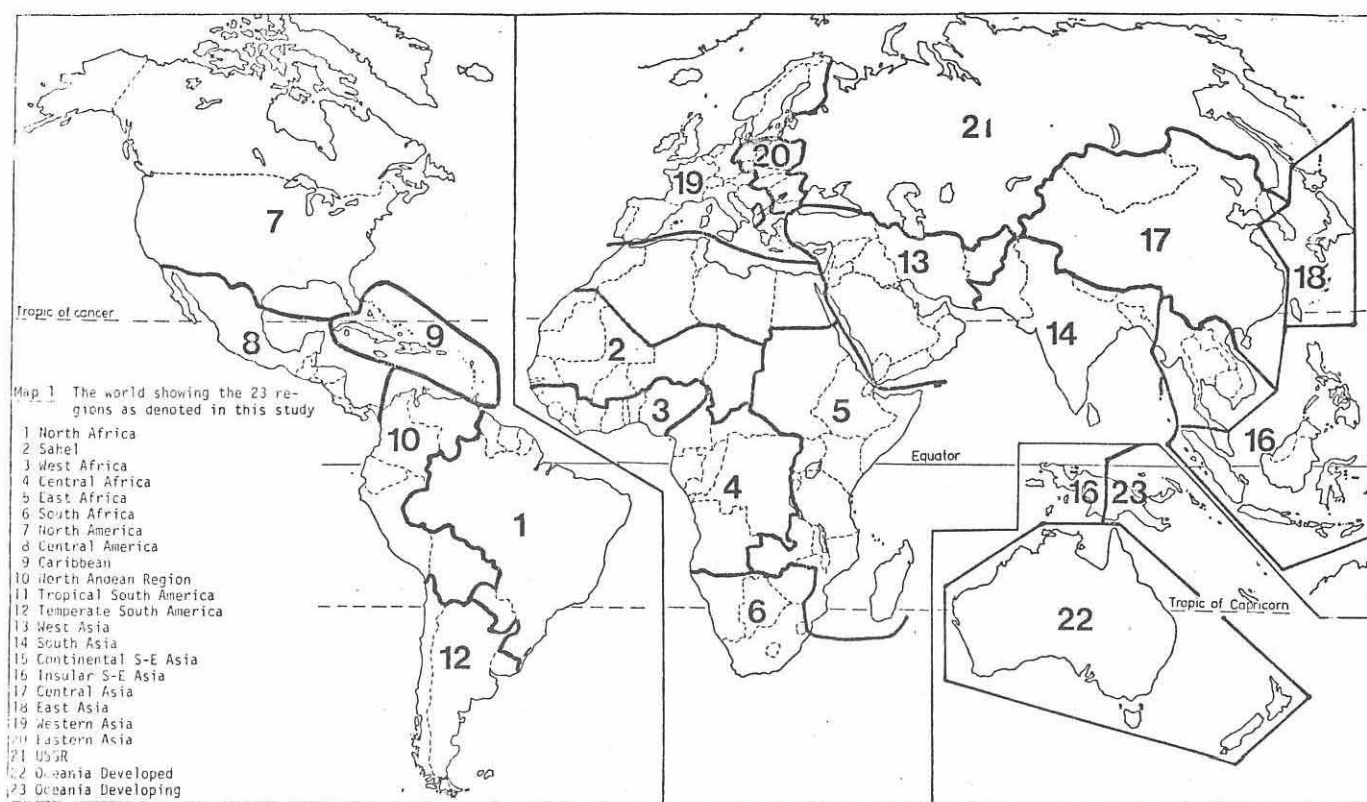
Region	Total area	Closed forest				Open woodland 1979	Man-made forest 1978
		WFR 1974	Revised figures 1979	Qualified guesstimate 1979	Accuracy		
Africa	3 031	196	190	170	140-227	780	3.6
North Africa	575	1.8	1.9	1.6	1.3-2.7	(6)	0.86
Sahel	557	0.5	0.2	0.2	0.1-0.4	(150)	0.03
West Africa	212	21	20	15	12-22	90	0.27
Central Africa	533	151	151	140	115-179	250	0.19
East Africa	844	20	15	13	9-21	220	0.90
South Africa	308	1.4	1.6	1.6	1.5-1.7	65	1.32
Islands	1	0.2	0.1	0.1	0-0.1	0.1	0.02
North America	1 934	630	460 ³⁾	460	440-550	200	(16.5)
Central America	278	60	53	41	32-57	20	0.3
Central America	254	56	51	39	30-54	19	0.12
Caribbean	24	3.4	2.8	2.1	1.6-3.6	1	0.19
South America	1 782	528	611	537	440-630	270	4.0
Andean	474	223	223	181	150-215	60	0.33
Tropical	939	292	376	345	280-400	170	2.52
Temperate	369	13	13	12	8-16	40	1.18
Asia	2 757	409	371	326	270-419	140	66
West Asia	684	11	12	10	8-12	15	0.50
South Asia	449	54	45	37	29-48	35	2.4
Continental S-E Asia	194	83	57	40	32-66	47	0.2
Insular S-E Asia	256	123	104	98	84-118	22	0.60
East Asia	51	34	33	30	29-32	1	11.97
Central Asia	1 125	104	119	112	90-140	18	50
Europe	487	140	140	137	129-140	20	25
Western Europe	385	112	112	109	102-111	20	17
Eastern Europe	102	28	28	28	27-29	1	8
USSR	2 240	765	770	700	620-770	200	(20)
Oceania	851	82	82	76	73-87	110	1.42
Developed	796	44	45	45	42-47	101	1.35
Developing	55	38	38	31	30-40	7	0.07
World	13 395	2 800	2 680	2 450	2 150-2 900	1 700 ¹⁾	140 ²⁾

1) The true value is likely to be in the interval 1 200-2 400 million ha. See comments under "open woodland".

2) The true value is likely to be in the interval 80-150 million ha. See comments under "man-made forest".

3) In 1974 large areas of "unproductive forest land" were included in closed forest. These areas have been omitted in the revised estimate.

The extent of the regions mentioned in table A are shown in map 1.



Closed forests

Before starting to discuss the information about closed forests given in table A it is necessary to point out that the results of a World Forest Resource Appraisal can vary considerably depending on the definitions used. In table A it is assumed that closed forest shall have a crown-cover of more than 20 per cent and open woodland a crown-cover of 5-20 per cent. This is a rather theoretic definition. Simplifying somewhat one may say that the definition of closed forest is meant to identify the wooded areas (or rather vegetation types) that can be of interest to industrial forestry but not excluding areas which cannot be exploited for environmental reasons. See further discussions in 3.2.2.

The continuous efforts to make a clear distinction between forest and open woodland depends on historic reasons. Closed forests are of interest for industry. The statistics for most countries made a distinction between forest and open woodland. At present it would be impos-

sible to identify the really dense forest (e g more than 50 per cent crown-cover) or different types of open forest. There has never been any interest in defining such border lines. There has hardly been any interest at all in describing open woodlands.

Only in cases when I have identified relatively reliable new sources have I revised my earlier figures (I talk here about the revised figures for closed forest). Minor adjustments have been made for a number of countries (around 60). According to the revised figures the total closed forest area is 140 million ha lower than in the 1974 estimate. The large changes have been made in the case of Brazil, Canada, USA and USSR. If these four countries are excluded, the new estimate is only 40 million ha lower than the 1974 estimate!

I consider that I have gathered a lot of new information for many countries. This new information is, however, not often in the form of new more reliable inventories. It is more often in the form of a better understanding of the general conditions.

I am convinced (or frankly speaking I know) that a number of the country figures generally used are serious over-estimates. Therefore, I have made a "qualified guesstimate" of the closed forest area in each single country. What is given is my personal belief. Some additional background comments to the "qualified guesstimates" may be needed.

- Many of the "official" country figures about the closed forest area are old. Some date back to the fifties or even earlier. We know that the closed forest areas are decreasing rapidly. If we intend to show the world's closed forest resources in the late seventies it is natural that we try to estimate the reduction of the closed forest area that has taken place since the date of the estimate.
- Many of the existing national closed forest area estimates have been reached by utilizing rather crude methods. They have for example often been calculated from vegetation maps. This method leads in most cases to over-estimates. New inventory results nearly always give lower estimates of the closed forest area than expected. It is likely

that the utilization of imageries from space-satellites can give over-optimistic estimates too.

- In many countries forest is a legal classification. Forest (or closed forest) and forest reserves are often considered as meaning the same thing. Yet forest reserves sometimes do not have a single tree left.
- For internal political reasons many countries want to show as large a forest as possible.
- A large forest area is often taken as a reason for national pride.

Further examples could be given. Experience of the type mentioned above is the background to my "qualified guesses".

Sometimes I believe that my "qualified guess" is not far from the actual truth. Sometimes I am extremely uncertain as to the accuracy of the guesstimate produced. For each single country I have therefore made guesstimates of the highest and lowest closed forest area I think theoretically possible. I would be "very much surprised" if the true area lay outside these figures. According to the max and min guesstimates the world's closed forest area is likely to be 2 150-2 900 million ha.

Table A contains guesstimates of the areas of open woodland and man-made forests. Due to the lack of space no detailed account of accuracy could be given. These details are given in table B. This table contains a summary of the "present knowledge" of the world's forests.

According to table B the closed forest area of the world is likely to fall in the interval 2 150-2 750 million ha. This interval differs somewhat from the one given in table A. The reason is that the interval in table A was a summary of the possible intervals for each country. It is most unlikely that all the country-figures utilized are over-estimated. The upper estimate has therefore been reduced to a more likely level. Although it is unlikely that all country figures are under-estimates the lower figure has not been adjusted upwards. My qualified guesstimate may after all prove to be too optimistic.

Open woodland

According to the crude guesstimates shown in table A the world's open woodland areas should cover roughly 1 700 million ha. This is a very unreliable figure. One reason is that we hardly know what we mean by open woodland. The information available about open woodlands is indeed very meagre. The reason is that inventories basically cover closed forests and the "commercial" parts of these forests.

It is difficult to make a clear distinction between closed forest and open woodland. It is still more difficult to make a meaningful distinction between "open woodland" and "scrub and brushland". When making the guesstimates in tables A and B I have meant to identify the areas that can be of importance as producers of household wood. (Many of these areas should of course not be utilized for any wood-production at all.) Included in this category should then be not only the "natural" open woodlands but also certain degraded types of closed forest, low-productive forests and so on.

Areas which can produce nothing than limited quantities of fuelwood should be placed in the "scrub and brushland" category. In this category one could possibly also include certain types of agricultural land which can produce small quantities of fuelwood.

The figures given can only be used taking into account a number of reservations. The most I dare to say is that "I would be surprised" if the actual area of open woodland as crudely defined above would not fall in the interval 1 200-2 300 million ha.

In addition to this there may be other areas (scrub and brushland, agricultural land etc) which carry some scattered wooded growth. Such areas may occupy vast tracts but any meaningful guesstimates can hardly be given. For the sake of completeness I have (in table B) included a total for "scrub and brushland". If the estimates of closed forest, open woodland, scrub and brushland are added together we reach a world figure of 4 400-7 000 million ha. It is, however, unlikely that the maximum figures for all these categories would prove to be correct. It is more likely that maximum in one category gives minimum in the next.

Table B. Selected features of the world's forest resources in the later 1970's. The true picture.

Type of information	Unit	Africa	North America	Central America	South America	Asia	Europe	USSR	Oceania	World total
Total area	Mill ha	3 031	1 934	278	1 782	2 757	487	2 240	851	13 395
Closed forest	"-	140-180	440-550	30-50	440-600	270-370	129-140	620-770	73-80	2 150-2 750
Open woodland	"-	600-1 000	160-220	10-30	200-400	70-210	15-30	100-300	80-140	1 200-2 300
Scrub and brushland	"-	-	-	-	-	-	-	-	-	1 000-2 000
Man-made forest	"-	2.0-3.6	12.0-16.5	0.1-0.3	2.5-4.0	35.0-70.0	19.0-25.0	10.0-20.0	1.0-1.4	80-140
Standing gross volume										
in <u>all land</u>	Bill m ³	20-60	43-55	2-9	58-147	14-50	14-17	73-102	4-11	230-450
in <u>closed forest</u>	"-	15-40	40-45	2-8	55-135	13-44	14-16	70-90	3-6	210-380
in <u>outside forest</u>	"-	6-20	3-10	0-1	3-12	1-6	0-1	3-12	1-5	20-70
Net-increment (closed forest)	Mill m ³	-	750-900	-	-	-	400-500	450-800	-	-
Gross-increment (closed forest)	"-	150-1 200	800-1 000	20-240	550-4 050	130-1 320	400-550	700-1 050	30-180	2 800-9 600
Wood production										
Industrial wood	Mill m ³	45-80	475-500	10-20	55-110	200-380	260-280	315-450	25-30	1 385-1 850
Fuelwood	"-	300-550	20-75	30-75	160-400	530-1 400	40-180	70-320	5-10	1 150-3 000
Fellings	"-	370-840	590-780	45-140	240-770	830-2 680	350-600	450-1 000	35-60	2 900-6 900
Annual change in closed forest area	Mill ha	-1 to -3	± 0	-0.5 to -1.0	-4 to -8	-5 to +3 ¹⁾	+0.1 to +0.5	± 0	-0.3 to -0.6	-2.5 to -17
Closed forest area the year 2000	"-	80-160	440-550	10-40	280-520	170-430	135-150	620-770	60-75	1 800-2 700
Adjusted figures		120-160	440-550	20-40	380-520	220-430	135-150	620-770	65-75	2 000-2 700

Note. Due to roundings the figures do not add up exactly. For explanation of the terms used see the text.

¹⁾ In this figure is hidden an increase of the closed forest area in Central Asia (1-5 million ha per year) and a decrease in the rest of Asia (2-6 million ha per year).

Man-made forests

Tables A and B contain a summary of the latest available information in respect of man-made forests. The figures have been reached after a screening of forestry journals, country reports, FAO reports, IBRD reports, etc. The figures should give the areas "in the late seventies" (1978). In some cases prolongation of figures from the middle seventies has been necessary (the "official" planting rates are "known" in a number of countries). The figures based on prolongations are naturally unreliable.

The figures given in table A often show the "official figures". The "official figures" have been adjusted to a realistic level when it is evident that a given figure is a misunderstanding.

Estimates of the total area of man-made forest (and the area planted each year) are often over-estimates. This is often caused by the fact that the area planted is calculated from the number of plants that have been sold or produced. Since a lot of plants never get planted and a lot die there is an error. Enrichment planting (in mature tropical forests and in plantations) is sometimes included in the figures. In several cases I have been informed that the same areas have been planted (and reported as planted) year after year.

Information about man-made forests also contains a "lie-factor". At each level in the hierarchy people want to show "progress" (information about man-made forests is often collected by questionnaires). A large area of man-made forest is also often taken as a reason for national pride. For internal political reasons many Forest Services want to show a large forest area and great progress. The tendencies mentioned above certainly do not cause under-estimates of the areas reported.

Under-estimates are rare. They may occur when the Forest Service has no control over how much shelter belts, fuelwood plantations, etc are planted.

This means that the figures given in table A must be considered as over-estimates. I believe that most figures can be over-estimated by as much

as 50 per cent (in e g Sweden this level of over-estimation is possible. This is the difference between the result of the official questionnaire method used by the National Board of Forestry and the result from statistically designed surveys carried through by the National Forest Survey).

In table B the "official figures" have been chosen as the upper limit. The lower limit has been reached by taking the conditions in each region into consideration. This means a reduction of the "official figure" by 25-50 per cent.

The figures include both afforestation and reforestation. In temperate countries reforestation often means the renewal of the same crop. In tropical countries on the other hand new forests are often established with exotic species. This means that it is rather difficult to get hold of information concerning man-made forests in temperate countries. Inventories do not always collect this information. In the tropics on the other hand, man-made forests are normally easy to identify.

When trying to discuss the world situation in the case of man-made forests the Chinese figures cause trouble. In China enormous plantations have been undertaken these last years. We do not, however, exactly know how much has been planted. China may have half the world's area of man-made forests. On the other hand the figures often quoted may prove to be over-estimated.

Growing stock

The available regional studies contain information about growing stock (wood volume, standing timber). No doubt the figures given mean rather different things. Some sources try to show something like the standing timber volume while others try to show the fuelwood volume (or perhaps the pulpwood-sized volume).

The figures have (in the case of Africa, Asia, Latin America and Oceania) been reached by multiplying the "forest area" (of a whole country or forest type) by the estimated growing stock per ha. The growing stock per ha has been decided after interpretation of the scarce inventory information available.

The result of the above described exercise must of course be most unreliable. First of all the forest areas are not exactly known (normally lower than the figures reported and utilized). Secondly the figures utilized for growing stock per ha can be either considerably higher or lower. Statistically designed inventories often show that a given area contains more wood than is commonly believed. The average growing stock in most regions, depends more on the human influence than on conditions in the undisturbed forest types. The human influence decides both the extent of remaining closed forest areas and the average growing stock per ha.

For the calculations in table B I have utilized the maximum and minimum figures for the area of closed forest and open woodland. Secondly I have estimated maximum and minimum values for the growing stock per ha. I have then used the different regional figures produced during the last years as a basis. I intended to make the figures as comparable as possible. The figures for growing stock, in theory, include the following: "The volume of standing trees, all species, all diameters, all ages and including bark".

I repeat the words "in theory". The definition gives the theoretic objective rather than an exact description of what is included in the figures. It might have been more realistic to say that broadleaved trees below 10 cm Dbh and coniferous species below 5 cm Dbh are excluded. In most countries small trees are not included in the inventories. Some of the regional reports do not give any definition of growing stock whatsoever (as it is a guess-work it is probably felt to be an unnecessary academic exercise).

The way of calculating the intervals for growing stock (e g min forest area times min growing stock per ha) used in table B may in theory be somewhat unlikely and give intervals which are too wide.

Table B indicates that the world's total volume of growing stock in the closed forests fall in the interval 210-380 billion m^3 . If the volumes in outside forest are included the interval may be 230-450 million m^3 .

Increment

Occasionally one can find estimates of "increment" in the world's forests. Such calculations must always be studied with suspicion. The reservations given must be many.

For North America, Europe and USSR one finds estimates of something which is called annual net-increment (this should mean volume of annual gross increment minus losses). At least in the case of USSR the figure given (about 900 million m^3 /year) most likely corresponds to gross increment (= volume of annual increment of all trees). It must be mentioned here that in unexploited (and unmanaged) natural forests the net-increment is by definition zero (increment equals losses).

To measure increment is difficult even if very sophisticated instruments and methods are used. The figures for North America and Europe, which are often quoted in reports are therefore by no means exact values. In the case of other regions one has no idea whatsoever what is the actual net-increment. In the case of gross-increment, guessing is somewhat more easy than in the case of net-increment. For Europe, North America and USSR rather wide intervals have been given in table B. The upper values are however rather conservative. In Europe, USSR and North America the increment figures given for different countries normally range from 1 to 3 per cent of the growing stock. These figures have in the case of Africa, Asia, Latin America and Oceania been utilized as the possible max and min values of growing stock. (Some studies in the tropics indicate an increment of the same size). According to this mathematical exercise the total gross-increment in the world's closed forests fall in the interval 2 800-9 600 million m^3 /year.

By more sophisticated methods and assumptions one may succeed in narrowing the wide interval given. The fact remains however, that we know extremely little. The situation becomes still worse if we try to discuss the possible long-term production of "valuable wood".

Sometimes estimates of the "growth potential" of the world's forests are found (forest area times average growth potential per ha). Such

calculations most likely give very unrealistic results. In most countries the forests are in rather bad shape. A very long period of intensive management is needed if they are going to utilize their growth potential to a considerably higher extent than now.

Wood production (removals and fellings)

According to FAO Production Yearbook 1977 the world's total production of roundwood was 2 555 million m³ in 1977. Of this volume 1 165 million m³ was said to be fuelwood. Roundwood figures are said to be given in "solid volume without bark".

It is necessary to briefly discuss the way in which production figures are collected at the national level. The production (or removal) of industrial wood is often calculated backwards from the production of wood industry products. Sometimes the consumption of wood is measured directly by the industry. Sometimes the "production" of wood is measured at points in the transport system. All the different methods have limitations. The conversion factors utilized are by no means exact. It is difficult to get hold of the consumption figures for small mills. Very often a large part of the consumption goes unrecorded. In summary one can say that there is a tendency that estimates of production (and consumption) are under-estimates. Over-estimates are rare.

The situation is much worse in the case of fuelwood. As fuelwood is cut and consumed locally, production is hardly ever recorded. The information we have comes from consumption surveys. Very few such surveys have actually taken place. The measurement problems in such surveys are great. It is difficult to make a good design of the sample. Far too little is normally known about the population. Far too little is known about seasonal variations in consumption. It is also difficult to measure the actual consumption. The "easiest" way is to measure the weight of the wood consumed. The relationship between volume and weight varies however according to species and time (water content).

Some years ago the actual consumption of fuelwood (and sometimes industrial wood) was heavily under-estimated in quite a number of countries. Only the recorded production was then given in these countries. In this

respect the situation has improved. Estimates of unrecorded production is now evidently in most cases included in the country figures.

It is however often said that the figures shown in the FAO Yearbook of Forest Products are too low. Keith Openshaw (1978) has utilized information from some recent sample surveys and produced his own estimates. His results are shown in table C.

Table C. Estimate of World Wood Consumption, 1976 (according to Openshaw)

Commodity	FAO	According to Openshaw	
	1976	Total	In developing countries
	Million m ³ (roundwood equivalent)		
Woodfuel ⁴⁾	³⁾ 1 184	3 050	2 460
Fuelwood	-	-	1 890
Charcoal	-	-	¹⁾ 570
Poles	204	300	²⁾ 196
Sawnwood	723	1 045	310
Panel products	178	178	6
Wood pulp products	235	235	35
Total	2 524	4 808	3 005

- ¹⁾ The consumption of wood for charcoal may be twice this figure because most of it is produced by traditional earth kilns which use about 12 m³ to produce one tonne and not 6 m³ as assumed.
- ²⁾ Some of this wood is in the form of branch wood and twigs which is not counted in inventory work. The under-estimate in charcoal could compensate for this over-estimate.
- ³⁾ In some studies (e g Arnold & Jongma, 1978) FAO utilizes adjusted estimates. The fuelwood production is given as roughly 200 million m³ more.
- ⁴⁾ I assume that these figures include bark.

This is not the place to analyse these figures in detail. At first glance these estimates may seem too high. In developing countries the per capita consumption of fuelwood would as an average amount to $0.85 \text{ m}^3/\text{capita}$ and year.

According to 7 surveys reported by Arnold & Jongma (1978) the per capita consumption of fuelwood was as a mean $1.5 \text{ m}^3/\text{year}$ (variation $1.00\text{--}2.29 \text{ m}^3/\text{year}$). These are evidently the surveys utilized by Openshaw (he has undertaken three of them himself). The countries in these surveys (Gambia, Kenya, Sudan, Tanzania (2 surveys), Thailand and Uganda) have relatively small populations (in all 75 million) and hardly any serious deficit of wood in large areas (closed forest area approximately 16 million ha and open woodland area approximately 80 million ha).

In large parts of the developing world on the other hand the population does not by far have the fuelwood they need. Parts of the Andean Sierra, North Africa, Sahel, West Asia, South Asia, Java and large parts of China are some examples. In these countries (with a population of about 2 billion) available reports indicate a consumption far below 1 m^3 per year and caput. Arnold & Jongma (1978) quote e.g. an Indian estimate (or guess-timate) of $0.38 \text{ m}^3/\text{year}$ and capita. An old survey in Libanon gave $0.17 \text{ m}^3/\text{year}$ and capita. For savanna regions is often given a fuelwood consumption of $0.6 \text{ m}^3/\text{ha}$ and year.

Let us assume that the per capita consumption of fuelwood in wood-scarce developing regions is $0.5 \text{ m}^3/\text{year}$ and is $1.5 \text{ m}^3/\text{year}$ in the developing regions with more abundant wood resources. From the examples given one may conclude that these figures are not completely unlikely. As the population in these regions amounts to roughly 2 000 and 900 million persons respectively the total consumption would amount to 2 350 million m^3 . This is approximately the figure given by Openshaw.

I will not deny that I feel the average figures quoted in the example above to be high. The average may well be half.

The figures given in FAO Production Yearbook can be considered as a possible minimum alternative. At the present level of knowledge Openshaw's figures can be considered as the possible maximum alternative. Openshaw's

totals for developed and developing countries have been distributed proportionally to the figures given by FAO (1979) and Arnold & Jongma (1978). The maximum and minimum alternatives discussed above are shown under wood production in table B.

What has been discussed so far is wood production (possibly wood consumption or wood removal). This term is often mixed up with felling. One can e g often see that the production figures in FAO Yearbook of Forest Products is compared with estimates of increment or standing gross volume. Then one tries to compare things which are (or at least should be) uncomparable. It is far too easy to state that the statistics are so bad that no other method of comparison is possible.

Let us see what can be the difference if one utilizes different "units of measurement". The example below is based on Swedish statistics (average for the years 1971-1976).

a) Consumption of roundwood (in industry, household, etc)	52.1 mill m ³ _{fub} ¹⁾
b) Wood taken from the forest (removal or production). For different reasons roughly two per cent of volume is lost before consumed.	53.2 "-
(Production of roundwood according to FAO (1979)	56.1 " m ³ _{ub}
c) The felling that corresponds to the production given under b. Tops and bark is included in this volume.	63.8 " m ³ _{sk} ²⁾
d) The felling shown under c and the trees that are left in the forest.	66.8 "-
e) Total drain (includes all felling and the natural drain).	71.0 "-

The Swedish National Forest Survey includes all diameters and all species in the inventory. The results are given with bark. For this reason it is the total drain that shall be compared with increment or standing gross volume.

1) m³_{fub} = Cubic metres solid volume under bark (actual volume of whole trunk or part of trunk exclusive of bark)

2) m³_{sk} = Cubic metres of forest (volume of whole trunks above the stump and including bark)

As the natural drain is completely unknown for most parts of the world's forests we must here confine ourselves to estimating the drain caused by exploitation (as large part of the world's forests are unmanaged I consider it of limited importance to estimate the total drain). In Sweden the figure for total felling (66.8 mill m³) is 19 per cent higher than the figure given by FAO (which differs 6 per cent from the official Swedish figure). In reality felling is 26 per cent higher than the production.

Such differences are likely to occur in most developed countries. In e g USSR Maydell (1976) indicates that felling is roughly 100 per cent greater than the production reported by FAO.

In the tropics there is evidently also a considerable difference between the volume produced (or removed) and the corresponding felling. Often large parts of the volume felled (and measured in the inventory) are left in the forest (Lanly & Lepitre, 1970). A lot of trees are felled for road-building. Many of the non-commercial trees are felled or destroyed during the selective felling. According to a rough guesstimate the production of 10 m³(r) in Gabon requires the felling of a standing gross volume of 50 m³, (as measured in an inventory including branches down to a minimum diameter of 7 cm).

According to these examples the figures for production must be increased considerably if one wants to show the corresponding felling. The multiplier 5 used in the Gabon example is unlikely in large parts of the tropics. In e g insular South-East Asia the production per ha is much bigger than in Gabon. The proportion felled for road-building etc must be smaller. To calculate the maximum alternative for felling a multiplier of 3 has been utilized in table B (for developing countries).

What has been said above concerns industrial wood. The situation is different in the case of fuelwood. First of all we hardly know the production. Secondly there should often not be much of a difference between felled and consumed volume. Sometimes parts of trees not included in inventories (e g branches) may be utilized for fuelwood. Sometimes part of the inventoried volume (or the volume included in standing gross volume) is left in the forest.

The figures concerning fellings given in table B is intended to be comparable with the figures for standing timber (as given in table B). To reach these figures the following multipliers have been used:

	<u>Industrial wood</u>	<u>Fuelwood</u>
Developing countries	1.5 - 3.0	0.9 - 1.1
Developed countries	1.2 - 1.4	1.0 - 1.1

Some of the maximum figures reached in table B seems very high. With the facts available at present it is not possible to make any reductions.

Changes in forest area

The decrease of the forest resources in tropical countries is now under intense discussion. We know that the forests are decreasing but we do not know by how much. (Most available estimates - some unpublished - vary from 5-25 million ha). Very few detailed country studies have been made. The results from these are often interpreted differently. Protectionists may "want" to reach as high a figure as possible while others may "want" a low figure.

It is important to define what is meant by a decrease in "forest area". The annual decrease should mean the difference between the area classified as closed forest at a given time and the area classified as closed forest one year later (if both classifications are correct). In theory this means that a decrease in one area and afforestation in another can give no change as an end-result. Sometimes one may of course want to show changes in the existing natural forests separately.

Many estimates of decrease in closed forest area may include decreases in the area of scrub, bush fallow, open woodland, etc. There is certainly often a considerably decrease in the area of such categories. These decreases should be shown separately. In reality knowledge about the actual decrease in such areas is close to non-existing. One must assume that the proportional decrease of such areas is at least of the order of the decrease of closed forest areas.

The figures given of the decrease in closed forest areas are often rather rough estimates. They are sometimes prepared by periodic comparison of estimates of the closed forest area. As improved knowledge of the forest areas often means that the forest area is actually less than was assumed, some figures giving the decrease in forest area may be over-estimations.

What is still more difficult to catch is the continuous degradation of the wooded vegetation that evidently takes place in many areas. To show this one would need to have the average standing gross volume in different land use and forest types. This data would have to be analysed at intervals. No such information exists at present.

The figures in table B about the decrease in closed forest area have been reached after a study of available information. According to available sources no important changes are likely in North America and USSR. The most recent sources indicate however the possibility of a slight decrease in the USA. Dagens Nyheter (1980-07-05) reports forest destruction in USSR.

In Europe on the other hand an increase of some million ha has been estimated (FAO/ECE, 1976). For developing countries (regions) the estimated decrease varies from 0.5 to 2 per cent per year. After analyses of the conditions in each region the max and min values for the annual decrease have been set.

If the minimum estimate of closed forest area is not far from the truth then the maximum value for decrease in forest area may prove to be close to the truth. In that case it is, however, not likely that this fast decrease will continue. The remaining forests will become more and more inaccessible.

The figures concerning annual decrease in table B are certainly very crude estimates. I doubt, however, that anyone can give a much better estimate. The extreme values are no doubt "extremes" but I believe most experts would be unwilling to swear that they are completely unlikely.

If the decrease of the closed forest area continues as now (2.5-17 mill ha/year) the area in the year of 2000 would amount to 1 800-2 700 million

ha. I find these values a little too extreme. It is most unlikely that an annual decrease of 17 million ha/year will continue for another 20 years. Large parts of the remaining forests are completely unsuitable for agriculture (e g due to soil, terrain). Large parts are also situated in low-populated areas (e g Central Africa, Amazonas). Most of the forests in the densely populated areas have already disappeared.

For the above reasons I have made the guesstimate that the closed forest area in the year 2000 will be in the range of 2 000-2 700 million ha. The original regional figures have been adjusted accordingly. In table B, I have given both the original and the adjusted figures.

Concluding remarks

The content of this Appendix is no doubt provocative. The opinions expressed in this Appendix may be found unnecessarily pessimistic. As I have failed to explain the accuracy of the statistics by utilizing accuracy classification of the figures I have now found it necessary to try to explain the accuracy in some other way.

It is a fact that I am chocked by the result of at least parts of this study. Especially the results concerning wood production are surprising. I see no possibility at present to reduce the width of the intervals concerning wood production and felling. In the case of "increment" and "changes in forest area" hard facts are so rare that the discussions must be very speculative.

The study indicates that it is of doubtful value to try to get hold of exact figures. Work must instead be devoted towards decreasing the width of the intervals step by step. The studies which utilize figures about the world's forest resources must accept that no exact figures can be given at present.

It is likely that more detailed studies can decrease the intervals given in table B. To cause a considerable improvement a lot of work will be needed.

APPENDIX II

Abbreviations and definitions

Agricultural area (in FAO Production Yearbook) is subdivided in three categories namely arable land (including fallow land), land under permanent crops and land under permanent meadows and pastures.

Closed forest (or forest): Land with a "forest cover", i.e. with trees whose crowns cover more than 20 per cent of the area, and not used primarily for purposes other than forestry. All open woodland as defined below are excluded even if trees cover more than 20 per cent of its area.

ECE: Economic Commission for Europe

FAO: Food and Agriculture Organization of the United Nations

Forest and other wooded areas: Areas covered with trees and/or shrubs and not used primarily for agriculture or other non-forestry purposes. Syn. Forest land, forest and woodlands, wooded areas.

Fuelwood: Wood in the rough (from trunks, and branches of trees) to be used as fuel for purposes such as cooking, heating or power production. Wood for charcoal, pit kilns and portable ovens is included here.

Industrial roundwood: The commodities are sawlogs or veneer logs, pit-props, pulpwood and other industrial roundwood.

Man-made forest: Includes forests established by afforestation, reforestation and artificial regeneration. Natural regeneration (with and without assistance) is not included.

Net increment: Average annual net increment equals gross increment minus losses.

Open woodlands: Land, other than closed forests, with trees whose crowns cover 5 to 20 per cent of the area, not primarily used for agricultural or other non-forestry purposes (such as grazing of domestic animals).

The category includes mainly savanna belts found north and south of the equatorial forest region. This is to distinguish areas which, besides their use as grazing land are able to produce a substantial supply of wood, at least fuelwood and poles for local consumption.

Open woodland as broadly defined above, may be covered with trees whose crowns cover more than 20 per cent of the area. Such areas are to be included in open woodland and not in forest. Syn. Savanna forest, savanna woodland.

Public forests: This category includes forests owned by national, state, and regional government, government-owned corporations and crown forests (state forests); and forests belonging to towns, villages, communes and other local authorities (other public forests).

Region: Means a continent (e g Africa) or some other large geographical area (e g Near East).

RLAT: FAO Regional office for Latin America

SIDA: Swedish International Development Authority

Standing volume: Volume of standing trees, all species, all diameters, all ages and including bark. Species which do not reach upright trunk forms (brushes) are not considered as trees. (Theoretic definition)

UN: United Nations

WFI: World Forest Inventory

WFRA: World Forest Resource Appraisal