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GENEVA TIMBER AND FOREST DISCUSSION PAPER 31

THE DEVELOPMENT OF EUROPEAN FOREST RESOURCES, 1950 to 2000: A BETTER INFORMATION BASE

by
Stefan Gold

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Timber Branch, Geneva, Switzerland

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THE DEVELOPMENT OF EUROPEAN FOREST RESOURCES, 1950 to 2000: A BETTER INFORMATION BASE

A study implemented in the framework of the European Forest Sector Outlook Study (EFSOS)

by
Stefan Gold

UNITED NATIONS
Geneva, 2003

Note

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Abstract

This study deals with the challenge of adjusting inconsistencies in the historical data series over time for the main forest resources parameters based on the UNECE/FAO Forest Resources Assessments (FRA) source data. It describes the methods used to improve the quality of long-term series based on national inventory data and assesses trends for a number of European countries. It attempts to identify driving forces behind major long-term changes in key forest resource parameters.

Acknowledgements

The implementation of the present study has been highly dependent on the quality of data and information provided by the countries, both concerning the assessment of historical trends in the development of main forest resource parameters and the assessment of driving forces behind those identified trends. National FRA correspondents and the UNECE/FAO Team of Specialists of Forest Resources Assessment collaborated actively on the challenging task of establishing a reliable statistical basis, providing a major contribution to the data harmonization process, and assisting in many cases with follow-up policy analysis. This is a remarkable example of using potential synergies between two work areas (EFSOS and FRA) of the integrated UNECE/FAO programme of work.

The secretariat wishes to acknowledge Professor K. Kuusela, who was the first to attempt to construct and analyse time series on the basis of FRA data. Professor Kuusela died in the autumn of 2003, just before completion of this work.

Mr. Stefan Gold, who worked initially as an intern, and then as a consultant, carried out the main part of the work. His work was supported by Mr. Rino Jans, SBH the Netherlands, based on additional funds provided by FAO headquarters.

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Preface

An understanding of the driving forces behind historical changes in forest resources is a necessary prerequisite to the forecasting of policy and market developments in the forestry sector.

The subject of this study has a special importance, as the management of forest resources is a long-term venture. Forestry methods and forest management practices of the remote past influence the present, and they will continue to influence future developments in the sector. In the same way, present forest management activities, as well as policy measures, will have a long-term impact on forest resources in the future. Thus, outlooks for forest resources provide the fundamental base for decision-making.

The data for this study have been gathered from the European forest resources assessments (FRA) carried out regularly by UNECE in cooperation with FAO over the last 50 years. However, the existing FRA datasets are not, for various reasons, comparable over time, and therefore no analysis of long-term changes based on comparable data over time exists so far. This study is a significant step towards providing such comparable information and analysing its contents. The work contributes in particular to estimating the level of wood supply, which would be sustainable over the long term. In the process of the study, national correspondents have improved the original inventory data and described forest management measures, as well as the linked policy and market issues.

This study, carried out with exemplary determination by Stephan Gold, is not however, the end of the process: the series presented are not yet completely comparable over time and many countries remain unanalysed. Mr Gold proposes follow-up actions in Section 5. Above all, future FRA work must be conscious of the necessity of maintaining comparability over time.

The study shows that forest resources of the region have expanded in terms of forest area available for wood supply, growing stock and net annual increment over the last half century. The analysis indicates that less wood has been harvested than grown, and that there is a physical potential – not necessarily to be equated with an economic or ecological potential - to increase wood supply from European forests.

The European Forest Sector Outlook Studies (EFSOS) are jointly carried out under the auspices of the UNECE Timber Committee and the FAO European Forestry Commission, and provide an input to the FAO global forest sector outlook study activities. The EFSOS programme represents an important contribution of the two organizations to the sustainable development of the forest sector in Europe.

Mrs. Brigita Schmögnerova
Executive Secretary
UN Economic Commission for Europe

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Abbreviations

CEEC	Central and eastern European Countries
CIS	Commonwealth of Independent States
cm	Centimetre
dbh	Diameter at breast height
ECE (UNECE)	United Nations European Commission for Europe
EFSOS	European Forest Sector Outlook Studies
ETTS	European Timber Trends Studies
EU/EFTA	European Union/European Free Trade Association
FAO	Food and Agriculture Organization of the United Nations.
FAQ	Frequently asked questions
FFRI	Finnish Forest Research Institute
FRA	Forest Resource Assessment
ha	Hectare
ISTAT	Italian National Statistical Office
m	Metre
m^3	Cubic metre (unless otherwise stated, over bark volume)
NBF	National Board of Forestry
ob	Over bark
OCF	Outside the country frame
TBFRA	Temperate and Boreal Forest Resource Assessment
ub	Under bark

Main findings

The aim of this analysis is to provide useful impacts to the outlook on European forest resources. In the light of that, the improvement of the quality of long-term historical inventory data lays the foundation for reliable analysis of changes in forest cover, growing stock, and annual increment stemming from policy and market forces.

To implement the current analysis, various difficulties had to be confronted. The historical FRA publications from the *Forest Inventory 1947* to the *Temperate and Boreal Forest Resources Assessment 2000* ("TBFRA-2000": UN-ECE/FAO, 2000) do not provide a long-term series of comparable data. This is mainly due to the fact that terms and their definitions change from one publication to the next. For getting a consistent set of data, the long-term data series for each country has to be adjusted to the same definitional basis, i.e. to the definitions used in the latest FRA publication, TBFRA-2000. Considering the obvious problems of reconstructing data reaching 50 years into the past, based on definitions just agreed to recently, this task could only be implemented at a certain level of aggregation for a reliable assessment of historical trends in forest resources. For this objective, the consistency over time of a country's data set is of greater importance than its complete correspondence to the TBFRA-2000 definitions.

This study could only be carried to its present stage by the assistance of an UNECE/FAO network of forest resources assessment specialists in the countries, who provided corrections to the FRA source data, harmonized national data sets, employing methods to adjust data to the current TBFRA-2000 definitions, and providing explanations as to why some differences are unresolved.

The harmonization process has provided a time series validated by national correspondents for 18 countries out of the 42 countries covered by the EFSOS programme. These 18 countries account for about 92% of the area of forest and other wooded land in all EFSOS countries (the percentage falls to 61% if the Russian Federation is excluded). The 18 countries are:

Austria	Hungary	Russian Federation
Belgium	Italy	Slovakia
Czech Republic	Netherlands	Sweden
Denmark	Norway	Switzerland
Finland	Poland	Turkey
France	Portugal	United Kingdom

The country results clearly show that definitional changes in the FRA working frame, and interpretation of definitions by successive national correspondents, are the main factors causing discontinuities in the time series data based on the original FRA data.

The process of harmonizing country data has led to the following observations that can be of importance for future work on data collection and harmonization:

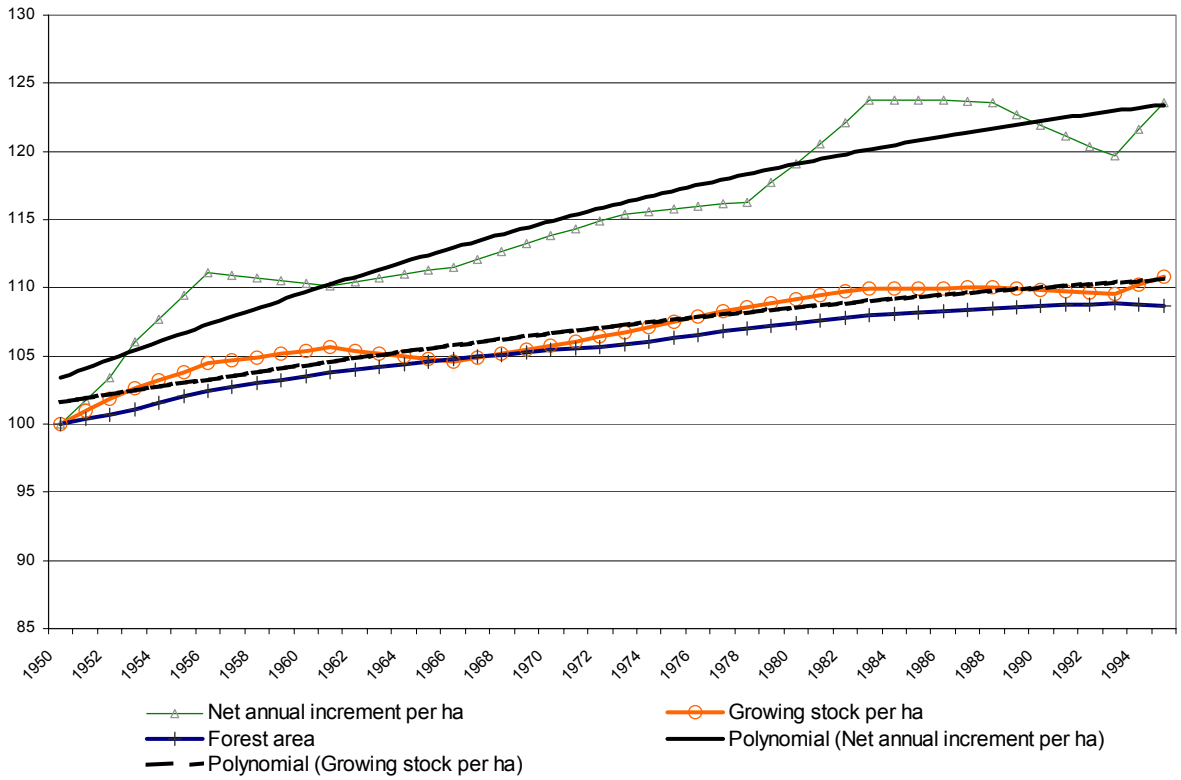
1. With the assistance of national correspondents, ex-post harmonization of forest resources data is possible and effective. As a result, more consistent time series data are now available for a number of countries. It is highly recommended to continue this process and extend it to other countries, even if it is a time consuming activity.
2. Looking at the harmonized time series, one can observe that the actual development of forest area, forest area available for wood supply, growing stock and net annual increment is more regular than the FRA source data would suggest. Abrupt changes in data can often be directly linked to changes in inventory methods or definitions. Generally speaking, growing stock and net annual increment were underestimated in many cases in the earlier FRA rounds in comparison to the TBFRA-2000 data. The change of the definition of forest (from 20% cover to 10% cover) and the significant improvement of inventory techniques may be considered the main reasons for these discrepancies.
3. Future changes in FRA definitions should be avoided as much as possible in order to facilitate long-term analysis. New definitions should only be used additionally, while maintaining the existing core definitions. The age class structure of forest cover and removals influence the development of growing stock and increment. Consistency checks of the relationship between growing stock, removals and net annual increment could improve the data quality.

Graph 1 gives a highly synthesised overview about the quantitative outcomes of the data harmonization process. The study shows that forest cover has expanded steadily over the last half century. Growing stock and net annual increment are characterized by a higher degree of volatility, which indicates that problems remain in the consistency of such inventory data over time.

Graph 1

Development of forest area, growing stock (per ha) and net annual increment (per ha) in Europe

(1950 = 100%)



Note 1: As not all countries could provide data series harmonized to the definition of "forest available for wood supply" as used in TBFRA-2000, data based on different definitions are processed in the graph (see Chapter 3 and Annex 5).

Note 2: For Denmark and Turkey only harmonized data for "gross annual increment" are available and thus used in the graph.

Along with the work on data harmonization, the assessment of factors behind the identified trends in historical forest resources data series has been carried out with the support of the network of FRA national experts. Comments, explanations and background information provided by the national correspondents have been processed on a sub-regional analysis. Grouping European countries into five regions facilitates discussion on a broader European point of view leaving behind national particularities.

Changes of forest resources are a response to shifts in the policy and market framework. Forest resources react with quite a high inertia to changes in the relationships between society and forestry. Average growing stock and increment is a long-term issue, depending mostly on the age class structure of forests and, related to that, on afforestation and clear cuttings, which can shift the age-class structure quite significantly. Growing stock further depends on removals (thinnings and clear fellings) and the growth in forest stands. Removals are mostly market driven, considering silvicultural constraints. Growth in stands depends on various exogenous factors, such as pollutions or climate change

The outcome confirms that Europe is characterized by a quite steady general increase of forest area over the last 50 years, the intensity of which, however, varies considerably between different countries and regions.

After World War II, major afforestation efforts were made to compensate for over cutting during the war and to achieve timber self-sufficiency of the affected countries. Policy driven land use change towards forestry and natural forest colonisation on abandoned agricultural land enlarged the forest cover. Since the 1970s, the growth of forest cover has slowed down significantly in Europe (except in the western European region). The accumulation processes have lost their intensity and have been progressively offset by deforestation in urbanized areas and the extension of human settlements and infrastructure into rural regions. At the same time, social and environmental functions of the forest have gained importance in comparison with the function of wood supply, leading to a policy driven improvement of the existing forest's quality by reinforcing silvicultural efforts rather than to an extension of the forest cover.

With the exception of the CIS countries, growing stock and increment (per hectare) have increased significantly throughout Europe, considerably exceeding the corresponding increase of forest area in most parts of Europe. The considerable increase of growing stock in the past can be explained by the fact that fellings and natural mortality have been lower than increment.

Growing stock and increment per hectare are influenced by a wide variety of factors, including fellings, natural mortality and various losses (due to storms, fires, insects etc.). However the age class structure of the forests and the relation of fellings to increment play a major role too. In large scale timber regions, there has been a substantial shift in the age class structure and tree species composition of forest over the last half century, which has had a decisive impact. Also the physical potential to supply wood has expanded due to the fact that over decades, less wood has been harvested than grown. This study does not examine the extent to which this physical potential can be mobilised taking account of all relevant economic, ecological, and social factors.

It is clear from the analysis in this study that the series presented are still only work in progress, and many problems of comparability and understanding remain to be elucidated, if the international community is to achieve a reliable picture of trends over time in the area, growing stock and increment of European forests. However, it appears that the progress achieved through this study by painstaking and detailed cooperation between national and international analysts has improved the situation to such an extent that it is preferable to make available these series and this analysis, imperfect though they are, than to remain with the confused and non-comparable data sets available at present.

1 Introduction

The Timber Branch of the UNECE Trade Development and Timber Division carried out this study in the framework of the European Forest Sector Outlook Studies (EFSOS) programme. This publication contains preliminary results for some selected European countries. Its aim is to open the discussion on the subject and to encourage further contributions by countries and experts in this area.

The objective of this ex-post analysis is to identify the driving forces behind the changes in main forest resources parameters (forest area, growing stock and increment) since the 1950s, i.e., it describes and if possible quantifies the impact from policy decisions, market behaviour and other exogenous factors on the evolution of forest resources in the past. The trends in the development of the forest sector and their driving forces, identified by the study, can be compared and contrasted between different countries and sub-regions, and should help to provide an outlook on the future development of the forest resources and forestry sector in the UNECE region.

This project follows on from the study *Forest Resources in Europe* carried out by professor K. Kuusela and the European Forestry Institute (Kuusela, 1994), which describes, in a quantitative way, the development of European forest resources in the period 1950 to 1990. This publication was statistically based on data from the various UNECE/FAO Forest Resources Assessments (1950-1990). Struggling to make data comparable within the multitude of countries in one FRA publication, the series of historical FRA publications does not provide a consistent set of data over time, because terms and their definitions have changed from publication to publication. The Kuusela study does not deal with policy analysis of driving forces behind the identified trends in forest resources. The reliability of its approach, mainly the compilation of input data about forest resources, was questioned due to the insufficient harmonization of the statistical basis. This is where the current project starts.

Generally, the analysis could be carried out following two approaches: firstly, by doing a quantitative analysis of the historical development of forest resources and afterwards asking which causes for this specific development can be found in the policy framework; and secondly, doing first a qualitative analysis of changes in the policy framework and then finding out in which way these changes may have influenced the development of forest resources.

The current study consists of two main components: (1) improvement of the quality of long-term inventory data, i.e. making figures comparable over time (to the extent possible); and (2) assessing the factors behind changes in forest resources.

2 Methodology

2.1 Statistical basis: consistency and comparability issues

The statistical basis for this study of *The Development of European Forest Resources, 1950 to 2000* are the various "time related" Forest Resources Assessment publications starting with the *Forest Inventory 1947* and the European Timber Trends and Prospects studies (ETTS), carried out by UNECE and FAO, as well as long-term national statistics. The transformation of the available FRA and ETTS data into a comparable over-time platform is a very difficult and ambitious task for the following reasons:

As terms and definitions have changed from publication to publication, it is not possible to get a comparable time series of data by simple compilation. For example, what was termed "forest available for wood supply" in TBFRA-2000 was reported (with some approximations) under various other terms in earlier assessments ("forest in use", "productive forest", "operable closed forest", "exploitable forest land") with changing definitions (see Annex 2). Even the same term can be based on different definitions, e.g. "forest in use" in *World Forest Resources 1953* and *World Forest Inventory 1958*. Taking these facts into account, it is necessary to remove, as much as possible, the data distortion due to "definitional" changes, in order to determine the "true" long-term trends, which can be used as a starting-point for a reliable policy analysis. The different interpretation of the changing definitions by the national correspondents make this task even more difficult.

The use of current national data series on the long-term historical development of forest resources also causes some serious problems. For example the data for the Scandinavian countries is generally of good quality and rather consistent over time. One can find in national yearbooks historical data covering at least the last 50 years, which are well harmonized. As these data in their original state are not usually comparable between different countries, they must be made comparable, for example by modifying them so that different national sets of data are based on the same terms and definitions as used in TBFRA-2000. Another approach in order to achieve comparability is to calculate index values (TBFRA-2000 = 100), thus showing relative values instead of absolute values. How thoroughly this task can be accomplished, is difficult to estimate, especially taking into account the lack of proper methodology, lack of sufficient resources and time constraints.

In addition to the lack of harmonization of historical FRA data and the non-comparability of national data between different countries, the actual availability of inventory data makes it even more difficult to distil data for the years 1950 to 2000 without missing periods. On the one hand, the study is confronted with data gaps for particular countries (especially in older publications, but also some recent publications). On the other hand data-tables for a lot of important terms are completely missing, even if the definitions of these terms are reported in the publication. Particularly in older publications (prior to 1970), the combination of important parameters is missing; one can find, for example, data for "growing stock on forest in use", but no data for "growing stock on forest" or "growing stock on accessible forest".

Arithmetic difficulties arise from the fact that the FRA publications have not been published at regular intervals. The following FRA publications have been published so far: *Forest Inventory 1947*, *World Forest Resources 1953*, *World Forest Inventory 1958*, *World Forest Inventory 1963*, *Forest Resources of the European Region 1970*, *Forest Resources of the UNECE Region 1980*, *Forest Resources of the Temperate Zones 1990*, *Temperate and Boreal Forest Resources Assessment 2000*. Additionally, within these publications, the inventories, to which the given data are referring, took place in different periods (depending on the different countries). These inventory periods differ significantly from country to country. Worse yet is that especially in older publications sometimes no year/period of reference is indicated in the data-tables at all. In these cases, it is a serious problem for analysts to decide to which year a figure should be assigned. To make comparisons and in order to build a graph, a period of reference must be transformed into a certain year of reference.

For getting usable time series data for the last 50 years, the disintegration and unification of states must also be taken into consideration. Especially after the breakdown of eastern European centrally planned economies and after the civil war in ex-Yugoslavia, national territories have changed significantly. The use of different inventory systems causes the same problem as described above: for example, the inventories of the former German Democratic Republic were fundamentally different from those of the Federal Republic of Germany and could not just be summed up in order to generate a long-term time series for Germany as a whole.

2.2 Terms and definitions: analysis of comparability

As a first step for solving the problem of non-comparability of data coming from different FRA publications due to changing terms and definitions, all terms and definitions of all FRA publications were compiled and analysed. This compilation is to provide an overview of terms and definitions used in FRA publications from the point of view of their comparability (see Annex 2). In this way, the extent of changes, which have taken place in the definitions over time, became evident. In this context, it is secondary that from publication to publication "special cases" as components of definitions (e.g. "tree along rivers") are included or excluded in a quite arbitrary way. This problem could be solved by the addition/subtraction of an estimated value according to the special natural and economic conditions of each country. The problem that is more difficult to solve is the fact that definitions were reformulated without considering prior definitions. That is one of the main reasons why terms and definitions are very difficult to compare. It happens that one finds in one publication one sentence to explain a certain term, whereas in another publication one has to read one page of detailed instructions of how to interpret this term. Of course, also the personal interpretation of these instructions (explanations of terms) by each inventory national team influences the results of an inventory without any chance for this study to take these deviations into account. Leaving aside all the difficulties mentioned above for follow-up work, the definitions were arranged in the following way:

After having compiled all definitions, they were classified by carefully comparing them with other definitions in the same publication as well as in other publications. The objective was to put for each of the main parameters (area, growing stock, net annual increment) the most similar definition into one time series from the *Forest Inventory 1947* to the *Temperate and Boreal Forest Resources Assessment 2000* (see Annex 3). The result of this exercise is a "first hypothesis" on how the data from various FRA publications should be compiled into a time-series. For the most difficult and most interesting parameter, forest area, the following terms were put into one time series:

"Accessible productive forest" [1947], "forest in use" [1953, 1958], "forest in use (for industrial or commercial purposes)" [1963], "operable closed forest" [1970], "exploitable (operable) closed forest" [1980], "exploitable forest" [1990], "forest available for wood supply" [2000]. It is obvious that although these definitions are not really comparable, they can be seen as a starting-point for a comprehensive follow-up harmonization. The other two parameters (growing stock, increment) are linked to the forest area parameter because of the different area base (for example: "growing stock on forest" or "growing stock on forest in use"). For the ongoing work, for example on the compilation of historical FRA data (see Chapter 2.3), the outline of this compilation of terms and definitions will be used as a first working hypothesis.

2.3 Compilation of historical FRA data (first working hypothesis)

The current analysis deals with the 18 countries covered in chapter 3 plus 9 others, making 27 countries in total (see Annexes 5.1 to 5.3). The compilation started with the most recent UNECE/FAO regional forest resources assessment TBFRA-2000.

In the category forest area the following parameters are reported: "forest and other wooded land", "forest", "forest available for wood supply" (as a "total" and split up in "predominantly coniferous", "predominantly broadleaved" and "mixed"), "forest in public ownership", "forest in private ownership".

The category growing stock contains the parameters "total growing stock", "growing stock on forest" and "growing stock on forest available for wood supply" (as a "total" and split up in "coniferous" and "non-coniferous").

The third category, net annual increment, covers "total net annual increment", "net annual increment on forest" and "net annual increment on forest available for wood supply" (as a "total" and split up in "coniferous" and "non-coniferous").

The compilation goes back successively, one publication after the other, to the *Forest Inventory 1947*, aiming to put terms with most similar definitions on one row. Some parameters reported in TBFRA-2000 have no "equivalents" in earlier publications; therefore, some cells necessarily are left blank (see Annex 4, for the case of Austria).

At this stage, all data were reviewed in order to replace "improbable" figures from FRA publications with more plausible information from the corresponding European Timber Trends and Prospects (ETTS) publications. Traditionally, UNECE/FAO ETTS projects followed the FRA projects and added value to the FRA statistics via updating and additional validation. Additionally, the publications have been reviewed, in order to find comments about the years/periods to which the tables are referring, even if there is no year/period of reference directly indicated in the table. It is very important to find a year/period of reference, because, without knowing how to assign a figure to a certain year, it is practically impossible to apply this kind of data for a quantitative analysis over time. However, for example in the *World Forest Inventory 1963* for the parameters growing stock and net annual increment no comments about years/periods of reference of the given data can be found.

For calculations or graphical illustrations one cannot work with given periods of reference, because it is not clear to which exact year in this period a figure should be assigned. Therefore, each period of reference has been transformed into a certain year of reference according to a method the secretariat agreed on: The year of reference should be fixed as that year which comes approximately after two thirds of the given period of inventory assuming a certain period for measurement in the forest and afterwards a certain period for data analysis. Following this rule, a given period of inventory 1990-1996 would be transformed into the year of reference 1994.

The table of historical FRA data compiled in the way described above is, however, not comparable between different countries for the simple reason that most countries have different years of reference, as FRA databases were originated from independently conducted national inventories. In order to match time series and correct the time gaps between the forest resources assessments themselves, the figures are interpolated individually for each country, which makes it possible to calculate a value for each year. In this way, the value of a parameter of one country for a certain year can be compared with that of all the other countries. Only by interpolation is it now possible to create reasonable graphs with various countries, covering the period from 1947 until the most recent inventory (which usually took place sometime in the 1990s).

The year 1947 is arbitrarily taken as the starting year, as in the first FRA publication, the *Forest Inventory 1947*, no comments about years/periods of reference for the data can be found at all. As this first FRA publication was published in 1948, it seems reasonable and plausible to assume that the data is from the early 1940s, or the time before the World War II. This assumption can be supported by the fact that in the *World Forest Resources 1953* (the next FRA publication), data for Finland was derived from an inventory taken in 1938. These data are for the parameters "forests", "forests in use" (as a "total" and split up in "coniferous", "non-coniferous" and "mixed woods") exactly the same as given in the *Forest Inventory 1947*. Obviously, the data came from the same inventory, which could permit conclusions about the probable year/period of reference for other countries listed in the *Forest Inventory 1947*. Since no precise date of inventory can be found for the data published in the *Forest Inventory 1947*, all these hypotheses are finally of a secondary meaning because they cannot be substantiated. In general, the question of the starting year has to be considered as secondary with regard to the objectives of our study.

Internal working graphs are created for the following main parameters: "forest available for wood supply", "growing stock on forest available for wood supply" and "net annual increment on forest available for wood supply" (as defined in TBFRA-2000 and "equivalent" terms of other FRA publications according to the first working hypothesis)[1]. These parameters are the most important and reliable for analysis because they are the most complete within the FRA publication series as a whole. Considering the last 50 years, there seems to be little point to have the most elaborate terms for the year 2000 without finding "equivalents" in older publications, which would permit to create a historical data series. The three parameters mentioned above make the creation of such a historical series possible. From the graphical illustration of the historical development of forest resources (by means of the three main parameters), it was now possible to get a visual idea of historical trends and, at the same time, to discover probable strong deviations caused by definitional changes.

[1] In this study all graphs showing the historical development of the parameters growing stock and net annual increment according to "FRA source data (first working hypothesis)" are based on data for "growing stock on forest available for wood supply" and "net annual increment on forest available for wood supply" (as defined in TBFRA-2000 and "equivalent" terms of other FRA publications according to the first working hypothesis).

In some cases it is easy to recognise deviations caused by these definitional changes, for example, when graph trends for all countries move unexplainably up or down in the same period. In other cases these deviations cannot be distinguished so easily. To find them, the historical FRA forest resources trends of a certain country may, for instance, be compared with harmonized historical national data of that country.

Concluding, one may say that these graphs offer a first rough picture both of the historical development of forest resources and of the obvious definitional errors in the historical FRA data. In this way, they visualize the results of this stage of the work.

2.4 Enquiry for assessing historical trends and changes in forest resources

After having compiled the definitions used in all FRA publications and the compilation of historical FRA data for main parameters, an enquiry was sent out to the countries. It contained the following material:

1. A cover letter explaining the reasons for the enquiry and the challenges, namely the non-comparability of historical FRA data.
2. More detailed explanatory notes called "Request for assistance in assessing historical trends in forest resources" (see Annex 1), which explain in a more detailed way to the countries' correspondents the current situation of changing terms and definitions in FRA publications, that has prevented the differentiation of "definitional" changes from "real" changes (e.g. changes in forest area as a result of deforestation and afforestation). Changes in the actual FRA data can be caused by a combination of both types of changes. That would make it impossible to assess the long-term historical trends, which should be the basis for the follow-up policy analysis. This request was accompanied by a simple table containing FRA data from the correspondents' home country with "forest available for wood supply", "growing stock on forest available for wood supply" and "net annual increment on forest available for wood supply" (as defined in TBFRA-2000 and "equivalent" terms from the other FRA publications). Since 1970, forest resources assessments have been published in regular intervals of 10 years. For the periods "around 1970" to "around 2000" data were simply taken from the respective forest resources assessments published around that time, neglecting the exact year/period of reference indicated in these publications. For the periods "around 1950" and "around 1960" data were taken from different FRA publications where the data's years/periods of reference came nearest to 1950 and 1960. This simple compilation of data should give an overview of actually available "raw" FRA data of the last 50 years to the correspondents (without using such things as interpolated values for an exact year).
3. An electronic Excel-file with the compilation of historical FRA data for the home country of the correspondent, a graphical illustration of the development of the main parameters and a compilation of definitions for each term used in the data sheet, which should serve as supporting material.

The countries' correspondents were first asked to review and complete their country data for 1990 and earlier periods in the simple table so that they would be comparable to those for the latest period (2000). This means they should be based on the same terms and definitions as used in TBFRA-2000. Secondly, they were requested to provide a consistent set of historical data based on national terms and definitions. The years/periods of reference may differ from those in the table, but a concrete reference year should be provided. The replies were analysed, and a chapter about historical trends of forest resources was drafted on each country. In a second stage, the countries were requested to verify this draft description of trends, mainly to validate the data and their interpretation. The second enquiry round was also used for gathering policy interpretations of the trends provided from the national correspondents.

2.5 Adjustment of underlying terms and definitions over time

In Chapter 2.2, a first hypothesis was presented on how the terms and data from various FRA publications were put into a time series. National data sources and the replies to the enquiry mentioned in Chapter 2.4 provided a source for a more robust verification of this first hypothesis. The data provided by national correspondents and national statistical yearbooks are considered as more consistent over time, ignoring the questions of comparability between different countries.

Three possible feedbacks could be distinguished:

1. A comparison between FRA source data and nationally provided harmonized data could confirm the first working hypothesis: national data is (approximately) the same as gathered from the various FRA publications, based on the first hypothesis.
2. National data sources and the replies by the national correspondents could provide data that did not confirm the first hypothesis, but provides a good base for the next different/better (or "improved") hypothesis about the compilation of data in time series. If the "improved" hypothesis could be confirmed by various countries and no other hypothesis for time-series appeared, then the outcome could be used for adjustments of FRA terms and definitions not only for the countries that replied, but also for other countries with implausible data based on the first hypothesis.
3. National data sources and replies to the enquiry could provide much different data, which may not be used for (1) and (2), but represents better data source for the respective countries and thus should be used instead of the time-series compiled from FRA publications. In this case, however, no conclusions could be drawn for the data of other countries.

In the course of this analytical work, a second and a third working hypothesis were elaborated in the case of Finland and Sweden by comparing harmonized national data from statistical yearbooks with FRA source data. The procedure of this work is described below.

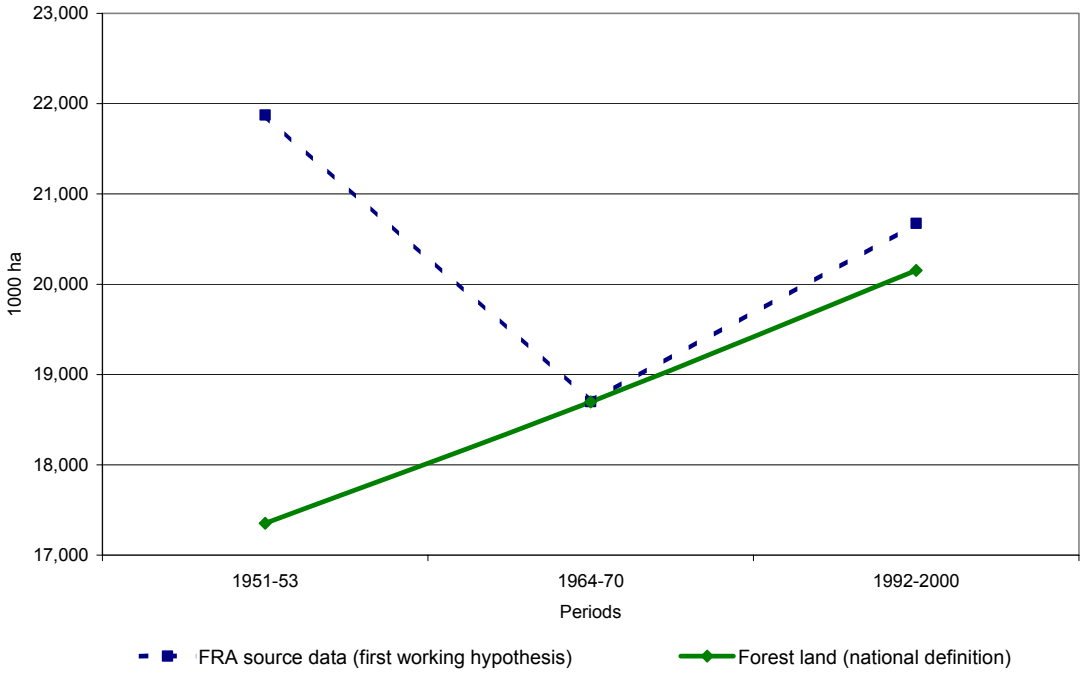
For Austria, Italy, and the Netherlands the validity of those preliminary working hypotheses is discussed in Chapter 3. However, this exercise finally had to be given up without a final outcome. It should be considered that, strictly speaking, the confirmation of two different working hypotheses in two different countries determines the conclusion of this exercise. At this stage, it is no longer sure which of the two hypotheses shall be applied for the improvement of FRA source data for a country that is not able to provide long-term consistent data for comparison.

Finnish case study

As for Finland, high quality historical forest resources data are available both in FRA publications and in national statistical sources, like the *Finnish Statistical Yearbook of Forestry 2001* (FFRI, 2001). This country has been chosen for a case study, which should give information about a possible methodology to harmonize the definitions used in the various FRA publications.

The first step was a quantitative comparison of Finnish national data for "forest land", "growing stock volume" and "annual volume increment" (terms of FFRI, 2001), found in the *Finnish Statistical Yearbook of Forestry 2001*, with data from FRA publications. As "growing stock volume" and "annual volume increment" refer in national data to "forest and scrub land" (terms of FFRI, 2001), whereas the long-term series of FRA source data for "growing stock" and "net annual increment" are only available with reference to "forest available for wood supply" of TBFRA-2000 and its "equivalents" of earlier publications, the results of this comparison should be used carefully. However, the comparison of the national parameter "forest land" with the FRA term "forest available for wood supply" of TBFRA-2000 and its "equivalents" of earlier publications provides some useful results (graph 2).

Graph 2
Development of forest area in Finland (I)



Similar to the Polish situation (see section 3.11), FRA source data concerning forest area of Finland shows generally higher values than the national data (graph 2). National data show a steadily growing forest area, a linear development, whereas FRA data do not show such a trend. The FRA figure for the period around 1950 is considerably too high. This fact makes it worth having a closer look at the FRA definitions used in the publications edited around that time.

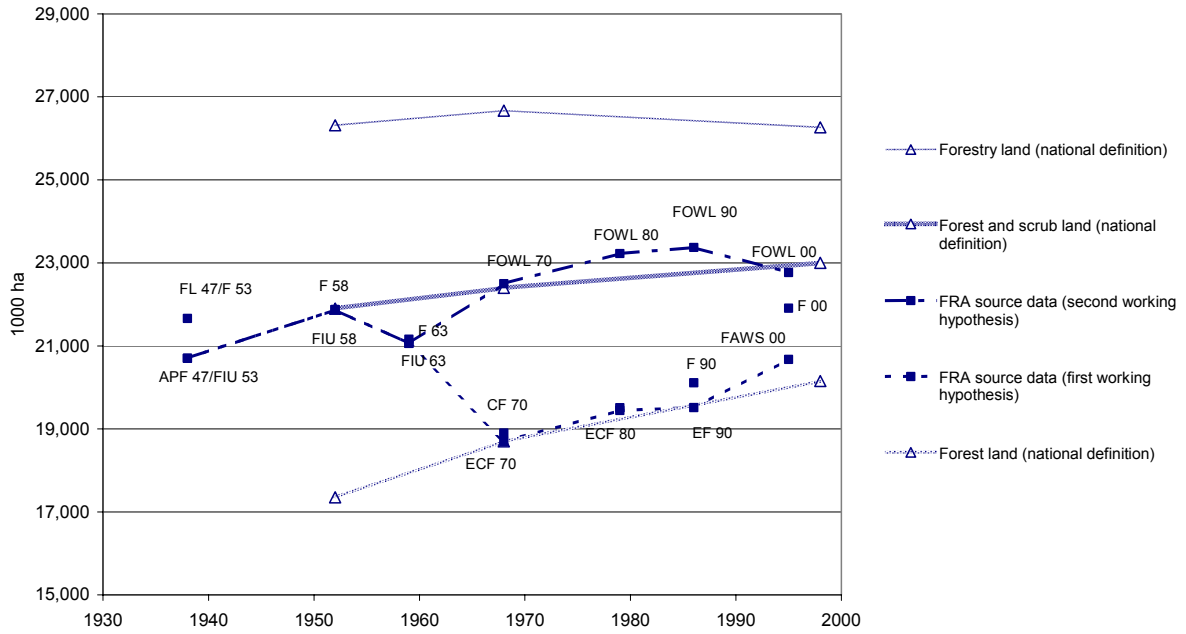
The hypothesis that definitions in the early Forest Resources Assessments (namely until the *World Forest Inventory 1963*) for the terms "accessible productive forest" [1947], "forest in use" [1953], "forest in use" [1958] and "forest in use (for industrial or commercial purposes)"[1963] are considerably less restricting than their assumed "equivalents" of the more recent FRA publications and in this way not comparable with them, is the starting-point for the follow-up analysis of definitions carried out for the case of Finland, which might allow conclusions for other countries as well.

The comparison of Finnish national data with FRA source data was sent to Finnish experts, who affirmed that the Finnish national data series for forest area, growing stock and increment, covering the period from 1950 up to today, are reasonably well harmonized and can be used effectively for the purpose of adjusting FRA definitions by comparing national data with FRA data and definitions.

For getting a historical overview of data and their definitions concerning forest area, provided both by FRA publications and by the Finnish yearbook, all data were entered as points in a system of coordinates according to their reference year and their value. Triangles represent national data and squares represent FRA source data. Each point was labelled with the exact term and its source. A second sheet contains the definitions for the used terms.

Graph 3

Overview of national and FRA source data for Finland (forest area)



Note 1: For abbreviations of terms used in FRA publications see Annexes 2 and 3.

Note 2: In the diagram, data for the terms “operable closed forest” (OCF 70) and “forest and other wooded land” (FOWL 70) from the FRA publication FAO, 1976 are replaced by data for the terms “exploitable closed forest” (ECF 70) and “forest and other wooded land” (FOWL 70) from the ETTS publication UN-ECE/FAO, 1986. As ETTS projects add value to the FRA statistics via updating and additional validation (see Chapter 2.3), in the analysis these data are considered referring to the FRA terms OCF 70 and FOWL 70 and to the FRA publication FAO, 1976.

Considering the harmonized data from the *Finnish Statistical Yearbook of Forestry 2001*, one interesting issue can be seen:

"Forest land" is showing a trend of steady, considerable growth over the last 50 years, and "forest and scrub land" a trend of slight growth, whereas "forestry land", containing "forest land", "scrub land", "waste land" and "roads, depots, etc." (all terms of FFRI, 2001), has been staying relatively stable within this period and has even fallen slightly since the 1960s. This means that the Finnish forest area has not grown extensively, but a larger part of the forest area has been brought into use and the level of use has intensified, which is reflected by a significant increase of growing stock and increment per hectare since the 1960s.

A contrasting picture is provided by looking at the harmonized Finnish national data for "forest land" and "forest and scrub land" versus the historical FRA data referring to terms which were assumed to be “equivalent” to “forest available for wood supply” of TBFRA-2000 (“forest in use” [1953, 1958], “forest in use (for industrial or commercial purposes)” [1963], “operable closed forest” [1970], “exploitable (operable) closed forest” [1980], “exploitable forest” [1990]). Values for these terms from the *World Forest Resources 1953* to the *World Forest Inventory 1963* are at a high level. In the next FRA publication, *Forest Resources of the European Region 1970*, the forest area has decreased suddenly and considerably by approximately two million hectares. After this, there is a slight increase of forest area until the *Temperate and Boreal Forest Resources Assessment 2000* (without, however, exceeding again the values of the 1950s and 1960s). The existence of these two developments on two levels in FRA source data (the first one until the *World Forest Inventory 1963* and the second one starting with the *Forest Resources of the European Region 1970*) suggests that a significant definitional change took place between the *World Forest Inventory 1963* and the *Forest Resources of the European Region 1970*.

By using this system of coordinates (as previously mentioned), and entering the data from the various FRA publications and the national Finnish yearbook, one can make a continuous-correlating trend line. This is accomplished by replacing the term "forest available for wood supply" and its assumed "equivalents" (from the FRA publication of the 1970s up to the TBFRA-2000) with the term "forest and other wooded land".

In this way the FRA data not only show the same trend-line as the national series for "forest and scrub land", but they also contain nearly the same data values. Without going deeply into the analysis of the definitions' contents, a row of "equivalent" terms from the *Forest Inventory 1947* to the *Temperate and Boreal Forest Resources Assessment 2000* can be utilized for Finland, which is different from the row fixed as working hypothesis in Chapter 2.2. See example below:

"Forest in use" [1953, 1958], "forest in use (for industrial or commercial purposes)" [1963], "forest and other wooded land" [1970, 1980, 1990, 2000]. This result is plausible, at least for the special case of Finland. The question, whether it can also be applied to other countries or not, requires more country case studies. For this stage of work the row of "equivalent terms" as described above should be fixed as a second working hypothesis.

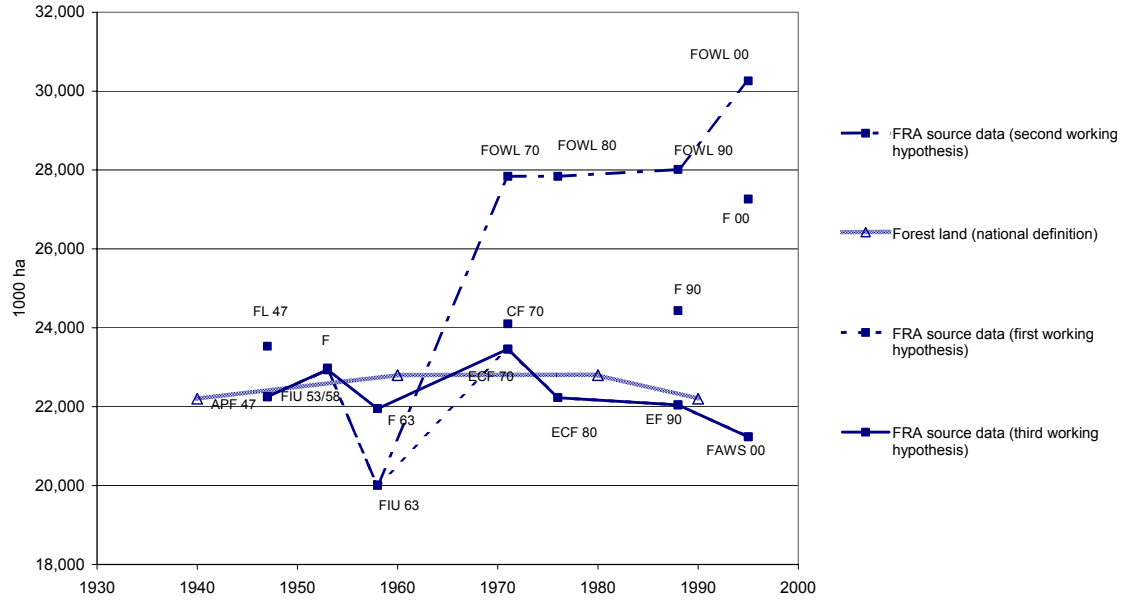
Swedish case study

The Swedish yearbook (NBF, 2000) provides a graphical illustration of the historical development of total area of "forest land" (term defined in NBF, 2000, p.311: "Land suitable for wood production and not primarily used for other purposes. Potential yield under ideal management conditions at least 1 m^3sk per hectare and year."), which covers the time from 1870 to 1990. Even if the source data on which this graph is based are not reported in exact figures, this diagram serves the purpose of comparing Swedish national data with data from historical FRA publications, because it clearly shows the major long-term trends in the development of the parameter forest area, neglecting minor fluctuations. Considering the national graph, one can see that forest area stayed rather stable in Sweden for the relevant period from the 1940s to today. From the 1940s to the 1970s forest area increased slightly, and then starting with the 1980s it decreased slightly. These changes, however, do not exceed three percent of the total volume of forest area, i.e. they can be considered as minor, especially in comparison with the significant increase of forest area, which took place in the late 19th century in Sweden. The reported decrease of forestland area in recent years (according to the national yearbook) is interesting and deserves to be looked at more carefully. The national source explains this recent trend by the fact that many large nature reserves have been established in Sweden. As wood production in nature reserves is prohibited or greatly restricted, these protected areas are no longer included in "forest land", but they are reported separately under the term "nature reserves and land under military supervision". (NBF, 2000).

For getting a better overview of available data referring to Swedish forest area, all data provided by FRA publications and the Swedish yearbook are entered into a system of coordinates according to their reference year and their value (graph 4). Triangles mark national data and squares mark data from the various FRA publications. The development of data related to forest area, reported in the FRA publications *Forest Resources of the UNECE Region 1980*, *Forest Resources of the Temperate Zones 1990* and *Temperate and Boreal Forest Resources Assessment 2000*, confirms the theory expressed in the Swedish yearbook; that the recent decrease of the national parameter "forest land", defined as "land suitable for wood production" (NBF, 2000), is mainly caused by the establishment of nature reserves. From the 1980s up to today, values both for the terms "forest and other wooded land" and "forest" are considerably increasing, whereas the data row composed by the terms "exploitable (operable) closed forest" [1980], "exploitable forest" [1990] and "forest available for wood supply" [2000] shows decreasing values. These terms are based on more restrictive definitions, which have all (very similar to the national definition of "forest land") the condition that forest area, in principle, must be available for exploitation.

Graph 4

Overview of national and FRA source data for Sweden (forest area)



Note 1: For abbreviations of terms used in FRA publications see Annexes 2 and 3.

Note 2: In the diagram, data for the terms “operable closed forest” (OCF 70) and “forest and other wooded land” (FOWL 70) from the FRA publication FAO, 1976 are replaced by data for the terms “exploitable closed forest” (ECF 70) and “forest and other wooded land” (FOWL 70) from the ETTS publication UN-ECE/FAO, 1986. As ETTS projects add value to the FRA statistics via updating and additional validation (see Chapter 2.3), in the analysis these data are considered referring to the FRA terms OCF 70 and FOWL 70 and to the FRA publication FAO, 1976.

A comparison of the long-term series of harmonized Swedish national data (showing for the parameter “forest land” a rather steady, until the 1970s slightly increasing and afterwards slightly decreasing development) with historical FRA data, should provide conclusions for the issue as to what FRA terms should be used to compose a row of “equivalent” terms from the *Forest Inventory 1947* to the *Temperate and Boreal Forest Resources Assessment 2000*. So far, two different rows have been explored and are defined as the first and second working hypotheses. According to the second working hypothesis, forest area first decreases in the 1950s, then in the 1960s it increases by 40% (meaning a significant increase onto a higher level). Keeping in mind the steady development of forest area according to the national source, this break in the graph is obviously caused by a considerable definitional change which takes place between the terms "forest in use (for industrial or commercial purposes)" of the FRA publication *World Forest Inventory 1963* and "forest and other wooded land" of *Forest Resources of the European Region 1970*. It can be concluded that the second working hypothesis (which was utilized for Finland) cannot be applied to the historical FRA data for Sweden.

Following the first working hypothesis, the development of forest area corresponds better to the graph based on national data. However, the values of historical FRA data are showing a considerable decline in the 1950s (like the values according to the second working hypothesis) and an increase in the 1960s approximately to the former level. This represents the only real interruption in the FRA graph, which is otherwise showing a broad correspondence (in trend and scale) with the national graph. The break is caused by the value for the term "forest in use (for industrial or commercial purposes") of *World Forest Inventory 1963*, which deviates because it is too low. However, the break in the historical FRA data series can be avoided by replacing the term "forest in use (for industrial or commercial purposes)" with the term "forest" from the same FRA publication.

Consequently, a new row of terms (from the *Forest Inventory 1947* to the *Temperate and Boreal Forest Resources Assessment 2000*), which are assumed to be "equivalent", can be classified as a third hypothesis, which represents a modification of the first hypothesis. This new row of terms is as follows:

"accessible productive forest" [1947], "forest in use" [1953, 1958], "forest" [1963], "operable closed forest" [1970], "exploitable (operable) closed forest" [1980], "exploitable forest" [1990], "forest available for wood supply" [2000].

2.6 Positioning of the study's approach in comparison with the existing publications on the subject

The initial idea for implementing the present study originated from a discussion on the study *Forest resources in Europe*, carried out by Professor K. Kuusela and the European Forestry Institute (Kuusela, 1994) which analyses in a comprehensive way the development of European forest resources in the period from 1950 to 1990 and discusses the implications of these results in terms of various aspects (future health of the ecosystem forest, forest policy and management, silviculture, as well as economic and environmental issues). As the scope of this study is rather large, the historical development of many forest resource parameters had to be assessed, which was difficult due to the fact that data that were missing, inconsistent or of poor quality (e.g. supplementary data on natural losses, logging residues) (Kuusela, 1994). The insufficient harmonization of the data was a problem which the author recognized and which is pointed out in his work. Still the reliability of the conclusions drawn from the analysis of the statistics in this study was questioned. Taking these experiences into consideration, the present study starts with a sustainable harmonization process of forest resources data for European countries, focusing on the three main parameters forest area, growing stock and increment. The ambitious project to improve the FRA source data base for those countries which are not able to provide harmonized national data series (by comparing FRA source data and national data for those countries where consistent national data sets are available and by elaborating in this way a certain methodology/hypothesis that can be applied to all European countries) finally failed. Even a slight improvement of FRA source data turned out to be impossible, taking into account the very special situation of each country having their own unique discontinuities and consistency challenges concerning forest resources data. This experience led to the decision to include exclusively harmonized nationally provided data for the analysis of trends in forest resources, which means that only those countries that have replied to an enquiry are utilized in the study. National experts have the best knowledge about inconsistencies in their own countries' data and, therefore, can provide the best approximations of the actual development of forest resources. In terms of making the data basis as consistent as possible, this approach represents progress from Professor Kuusela's publication, which, of course, included as well an effort to harmonize the statistical data basis.

Building up this UNECE/FAO FRA network of specialists in the countries has turned out to be a successful way to deal with the challenging issue of harmonizing historical forest resources data. It should be noted, however, that the objective of assessing reliable long-term trends in the development of forest resources on a country level implies the loss of comparability of data between different countries (caused by the fact that for several national correspondents it was impossible to provide data harmonized to terms and definitions as used in TBFRA-2000). This aim of comparability of absolute figures within different European countries might have been reached to a greater extent in Professor Kuusela's study, which is based on modified FRA source data. However, it should be taken into consideration that the present approach of working with national data could be considered sufficient for the purpose of reliably identifying major trends for the follow-up analysis. The focus of this analysis of driving forces behind the assessed changes in European forest resources is substantially different from Professor Kuusela's much more comprehensive follow-up discussion (which included various aspects relevant for forestry and society in general). The assessment of factors behind the identified trends in historical forest resources data of the present study has been carried out with the major support of the national correspondents as well. The national correspondents, as experts for their own countries, provided essential explanations and background information, which have been processed on a sub-regional analysis aiming to go beyond national borders for a broader overall European point of view of forest resource development over the past five decades.

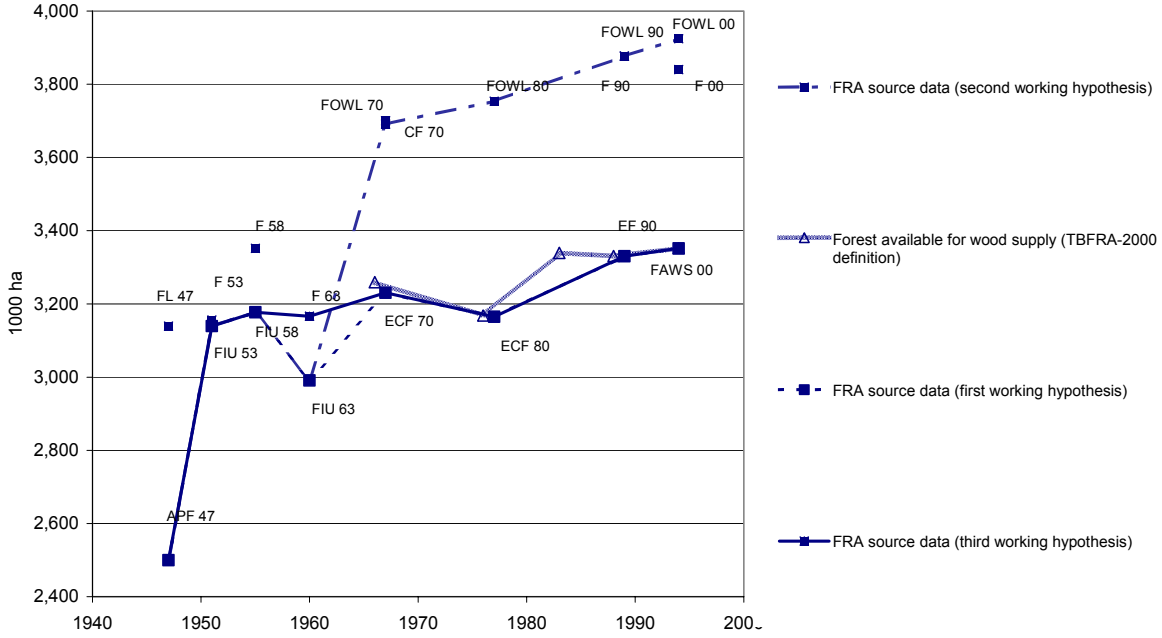
3 Assessment of historical trends and changes in forest resources of selected European countries

3.1 Austria

Austria has provided a set of harmonized national data covering the time from the 1960s up to today. For each reported figure an exact year of reference is indicated. The national parameter "forest available for wood supply" is based exactly on the same definition as used in TBFRA-2000 for that term, whereas the national parameters "growing stock" and "net annual increment" differ from the definitions of TBFRA-2000 regarding the condition that the diameter of trees must be at least five centimetres at breast height. Data referring to Austrian forest area, provided both by the various FRA publications and by the national correspondent, is shown in the diagram according to their reference year and value. Triangles mark harmonized national data and squares represent FRA data.

Graph 5

Overview of national and FRA source data for Austria (forest area)



Note 1: For abbreviations of terms used in FRA publications see Annexes 2 and 3.

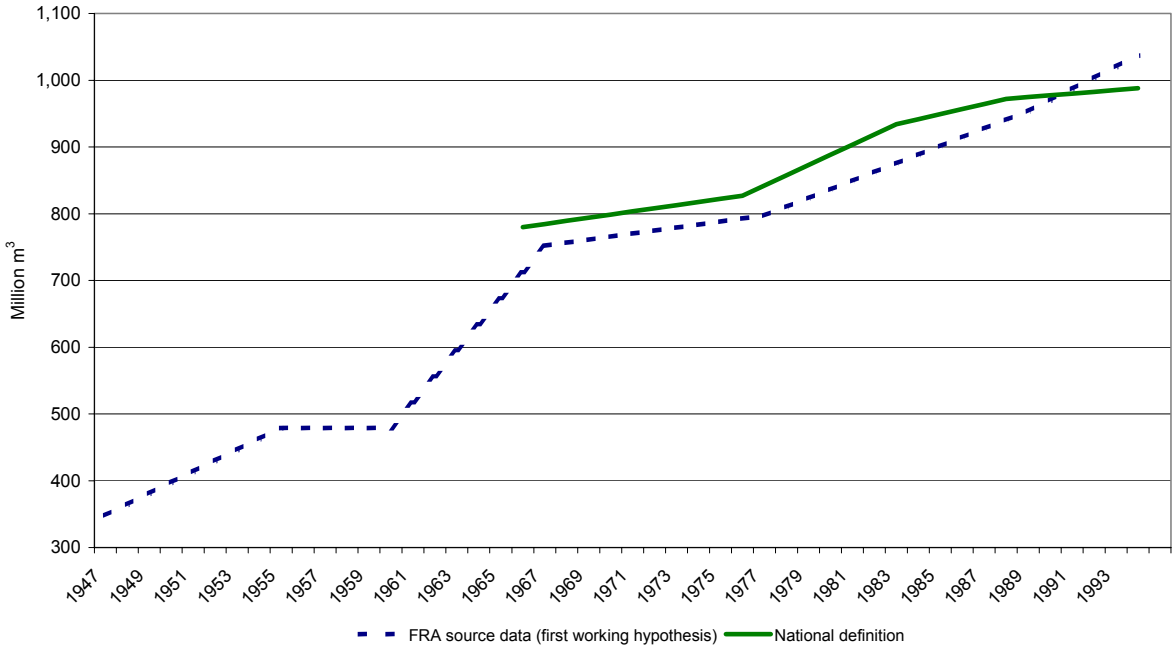
Note 2: In the diagram, data for the terms "operable closed forest" (OCF 70) and "forest and other wooded land" (FOWL 70) from the FRA publication FAO, 1976 are replaced by data for the terms "exploitable closed forest" (ECF 70) and "forest and other wooded land" (FOWL 70) from the ETTS publication UN-ECE/FAO, 1986. As ETTS projects add value to the FRA statistics via updating and additional validation (see Chapter 2.3), in the analysis these data are considered as referring to the FRA terms OCF 70 and FOWL 70 and to the FRA publication FAO, 1976.

It can be seen from graph 5 that the national data series corresponds quite well with the data row composed of the terms "operable closed forest" [1970], "exploitable (operable) closed forest" [1980], "exploitable forest" [1990] and "forest available for wood supply" [2000] concerning both the major trend and absolute figures. As the national data starts with the "Forest Inventory 1961-1970" and does not contain figures referring to earlier years, it is not suitable for proving the correctness of the different working hypotheses dealing with the issue of what terms should be used to get a row of "equivalent" terms from the *Forest Inventory 1947* to the *Temperate and Boreal Forest Resources Assessment 2000*.

However, keeping in mind the steady, slight increase of forest area over the last 30 years according to national sources and assuming the same development for earlier years (not covered by the national data set), the evolution of forest area according to the second working hypothesis (see Chapter 2.5), which is marked by a strong increase in the 1960s, can be considered as improbable. On the other hand, the national graph showing the historical development of forest area since 1966 could be continued consistently back to the year 1950 by using the row of FRA terms and their values suggested by the third working hypothesis (see Chapter 2.5).

Graph 6

Development of growing stock in Austria



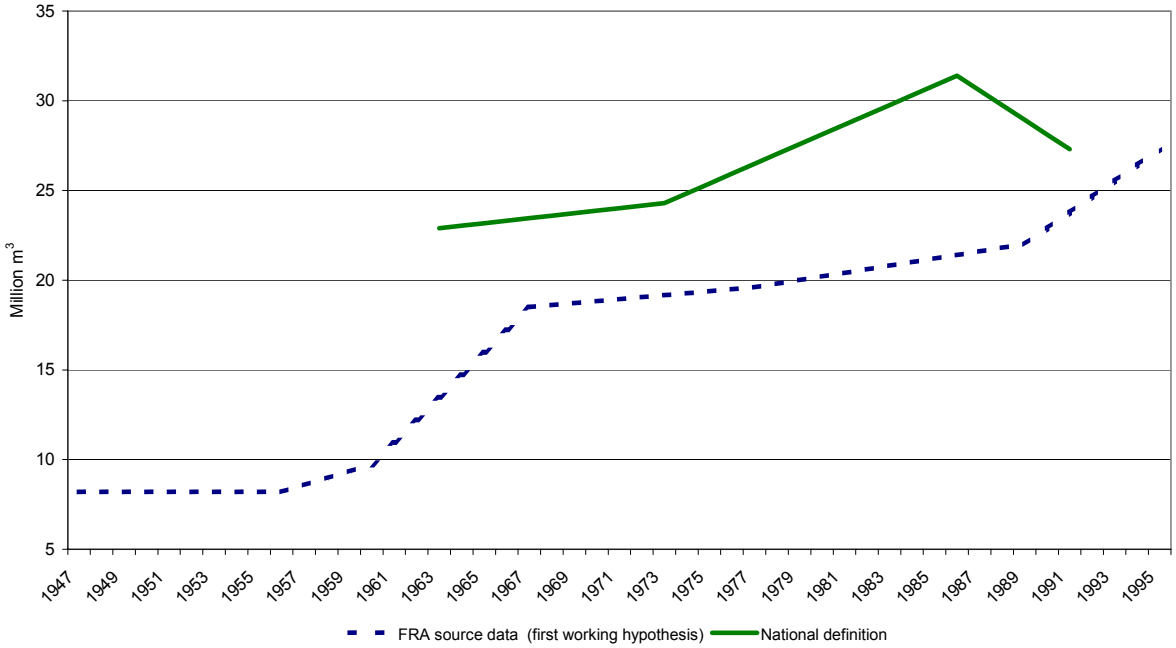
Concerning the parameter "growing stock", FRA source data as well as national data report a constant increase since the 1960s (graph 6). According to national data, the average pace of this increase is about 0.8% per year. Until the late 1980s, the values of national data were slightly higher than the values of FRA data, i.e. the national graph lies parallel with and above the FRA graph. However, the latest forest inventory (TBFRA-2000) reported a bigger volume of "growing stock" than the national source. This may be caused by the fact that the definition of TBFRA-2000 for "growing stock" includes all trees with a diameter over zero centimetres (DBH) (see Annex 2), whereas the national definition is more restrictive, as it excludes trees with a diameter less than five centimetres (DBH).

Although there is the same discrepancy between FRA and the national definitions concerning the term "net annual increment", TBFRA-2000 and the latest national forest inventory show the same data value (graph 7). From the 1960s until the late 1980s "net annual increment" in Austria's forests was constantly increasing, both according to the various FRA publications and according to the national source. The absolute figures of the national data are considerably higher than those of FRA data. From the 1980s to today, the national source reports a decrease of "net annual increment" whereas the FRA graph shows an even intensified increase. The recent decrease of "net annual increment" according to the harmonized national data set is reflected by the weakened increase of "growing stock" in recent years.

Summarizing the trends in Austrian forest resources in the last three decades, the area of "forest available for wood supply" increased moderately. A comparison of "net annual increment" and "removals" shows that "removals" have been structurally lower than "net annual increment", which explains some of the increase of "growing stock", even taking into account the fact that net annual increment is measured over bark and removals under bark. However, other factors, such as age structure and species composition of the forest, may have an impact on the volume of "growing stock" as well.

Graph 7

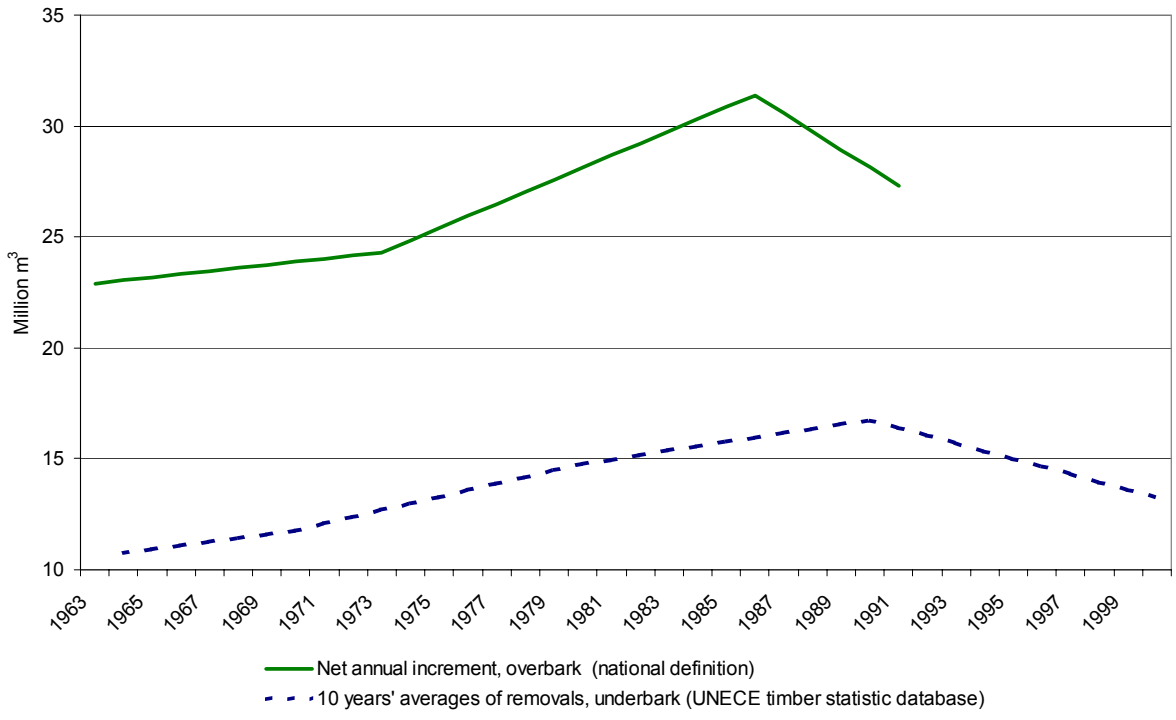
Development of net annual increment in Austria



"Removals" are lower than might be expected, on the basis of the overall increasing development of "growing stock" and "net annual increment" (graph 8). This fact shows clearly that this parameter is mainly influenced by demand for timber in the marketplace. As the area of "forest available for wood supply" stayed rather stable, the pre-1980's increase in "net annual increment" was obviously not caused by a considerable change of this parameter. Therefore, changes in the age structure and species composition of Austrian forests may be assumed to be the key driving forces for this development.

Graph 8

Development of net annual increment and removals in Austria



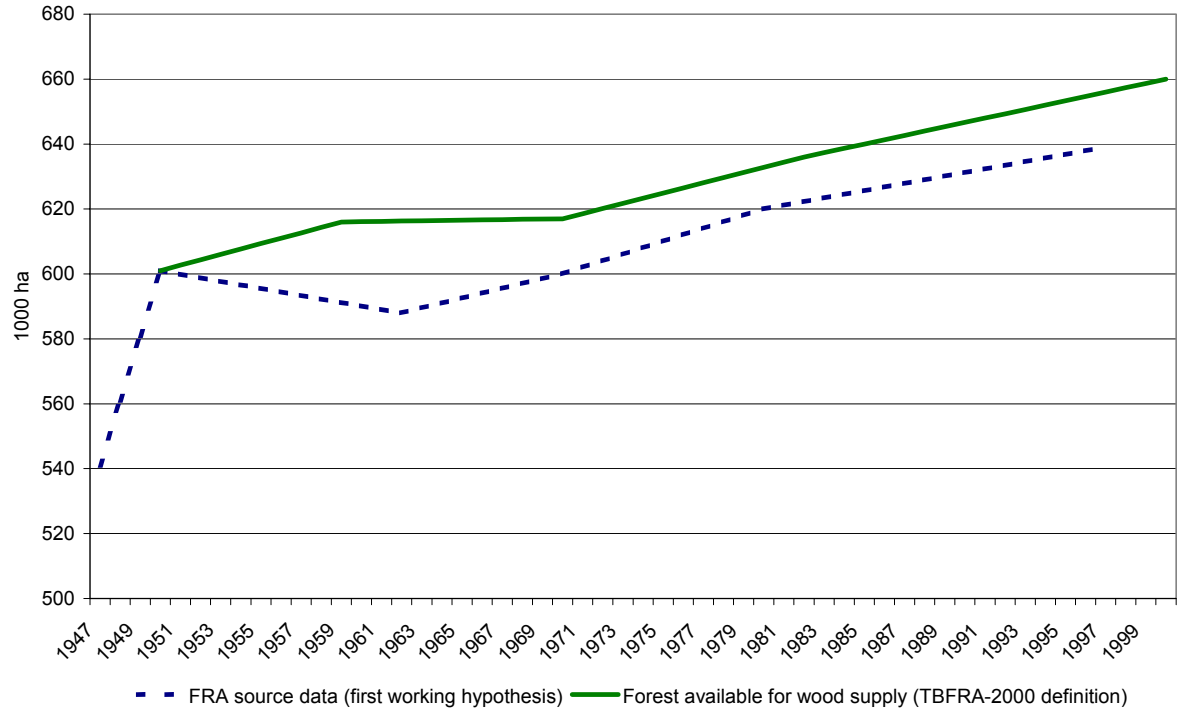
3.2 Belgium

The reply to the enquiry provided by Belgium contains historical data for "forest available for wood supply", "growing stock" and "net annual increment" covering the period from 1950 up to today. The national correspondent pointed out the difficulty of revising the historical data as the first Belgian forest inventory was not implemented until 1980 and only dealt with forests in Wallonia. Data for the three decades before 1980 came from statistics, which were realized by analysing questionnaire surveys.

Concerning the parameter "forest available for wood supply", the data series has been harmonized to the definition as used in TBFRA-2000. Regarding "growing stock", historical data, which formerly referred to commercial volumes (definition not available), have been revised so that the value for each year is now comparable to that for the year 2000, the definition of which is: the volume of growing stock over bark with a minimum 7cm diameter at breast height and 7cm minimum top stem diameter. The data series for "net annual increment" could not be revised and made more consistent over time because of the lack of national data. The correspondent reports that the new data with reference year 2000 should not be understood as a change with regard to the data reported in TBFRA-2000 (with a reference year of 1997), but just as more accurate values, due to the Belgian inventory scheme.

Graph 9

Development of forest area in Belgium



Regarding a comparison of the area of "forest available for wood supply" according to national data and FRA source data, it can easily be seen that both data sources are showing the same major trend; a slight increase of the values during the last 50 years (graph 9). It is obvious that both the low level of "forest available for wood supply" reported for 1947 and the slight drop in 1963 (according to the various FRA publications) are not very likely to be true. Aside from these discrepancies, one may state that the FRA source data series contains no major discontinuity artificially caused by definitional changes as the trend line is very similar to that of the revised national data, but with consistently lower values.

The overall change to the area of "forest available for wood supply" in Belgium during the whole 50-year period is a slight increase with an average pace of 0.2% per year. Within this period, a phase of stagnation in the 1960s alternates with phases of increases (differing just slightly in their pace of growth). It can be seen that the reported increase of "forest available for wood supply" in Belgium is caused both by a real increase for

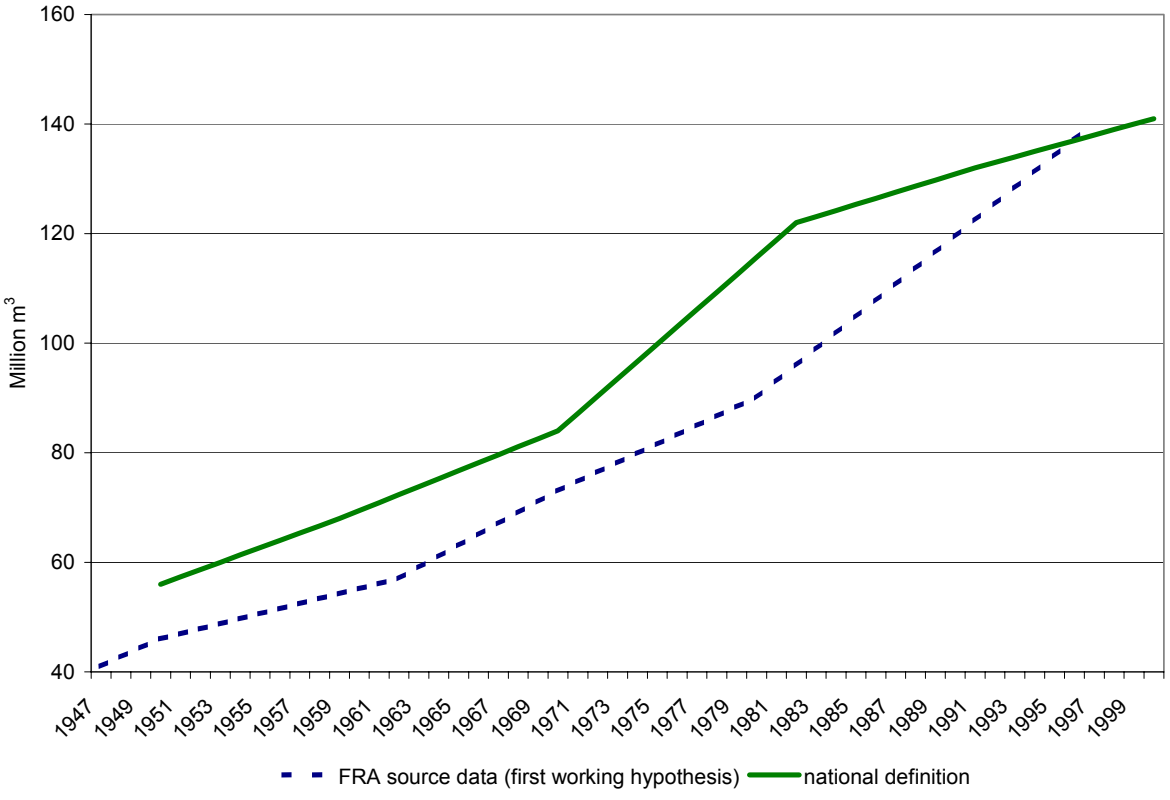
example due to afforestation efforts and by improved measurement techniques. Taking into account this ambiguity of the statistical increase of area of "forest available for wood supply", it is rather difficult to estimate which part of the reported change is a result of higher accuracy. As this phenomenon can be observed in a very similar way for the parameter "growing stock" of Belgian forests, this could lead to the hypothesis that the values of forest resources parameters have been generally underestimated throughout Europe in the past. Corresponding to the observations made also, for example, for the development of Czech forest resources, the existence of this underestimation – also in the nationally provided, (as far as possible) harmonized data sets – can be assumed as very probable for many European countries. However, any kind of quantification of its impact on the historical data series is a very challenging and sometimes impossible task.

The increase to the area of "forest available for wood supply" in Belgium (of about 15 thousand hectares during the 1950s) was caused by progressive afforestation of agricultural lands. This transformation of agricultural lands into forests virtually stopped in the 1960s, which is reflected by stagnating values. Data referring to the years 1950, 1959 and 1970 are provided by "General censuses of agriculture and forest", which rely on cadastral data and information requested from the forest owners. In 1982, forest area was estimated from field sampling in areas classified as forest on maps of the National Geographical Institute.

At the first sampling, it turned out that about 10% of the private forest area was not recorded as forest area in cadastral data. This difference of actual and reported forest area was not observed for public forest managed by the forest administration. One may assume that the reported increase of forest area between 1970 and 1982 is almost completely caused by this change of inventory technique. From the 1980s up to today the development of forest area was affected by new afforestation efforts in rural areas and by deforestation in urbanized areas (mainly in the north of Belgium). The overall increase in forest area reported shows that the enlarging of the forest area outweighs reductions. However, consideration must be given to the fact that field sampling was extended into the whole region during that time and as a result, 12 thousand hectares of new afforestation was recorded.

Graph 10

Development of growing stock in Belgium



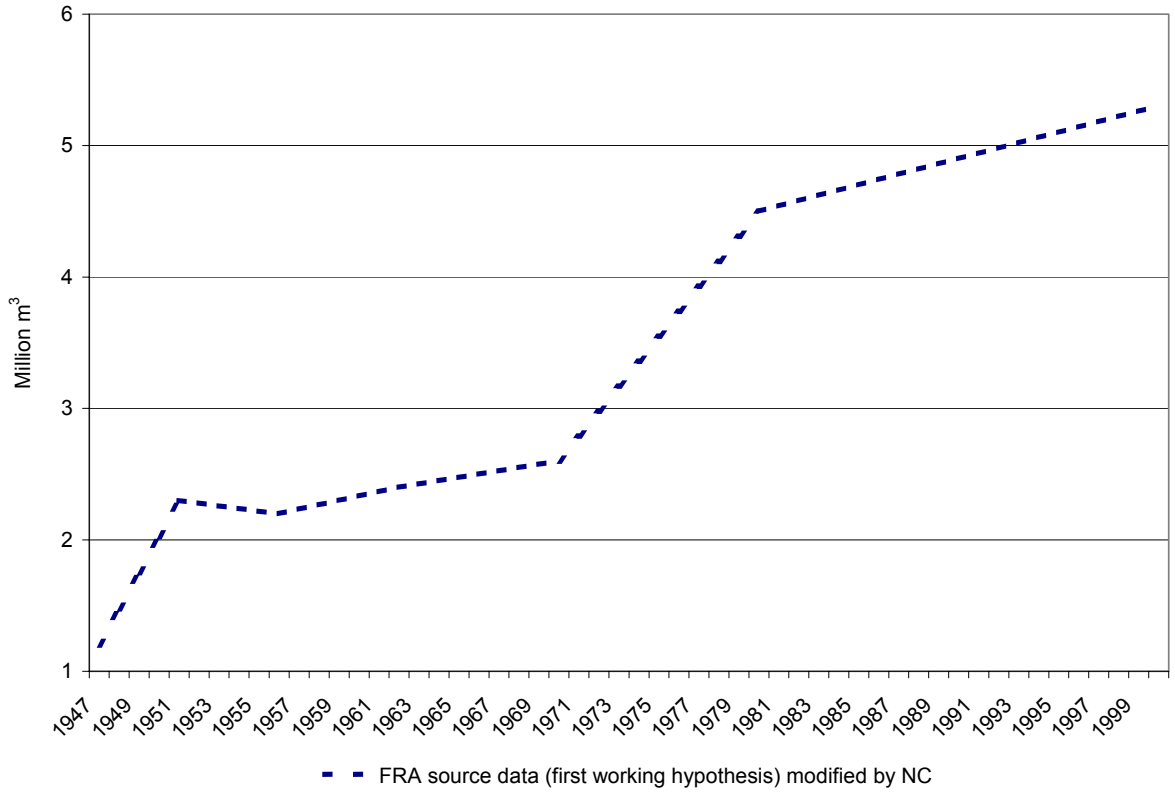
The slight increase (of about 10% of its starting value) to the area of "forest available for wood supply" from 1950 to 2000 is in contrast to the strong increase to the volume of "growing stock" (which more than doubled during the period). Also for this parameter no considerable discrepancies regarding the developing trend can be found between FRA source data and harmonized national data (graph 10). Data values are constantly lower according to FRA source data. The increase of "growing stock" (according to national data) is characterized by a steady growth that accelerates in the 1970s. This increase can be explained for the last three decades by the transformation of a large part of coppice into high forest since 1970. It can be assumed that not all of the reported increase of "growing stock" between 1982 and 2000 is due to actual increases of this parameter because a large area of young coniferous stands were not measurable in 1982 but were in 2000. This caused a 12% increase in the volume of growing stock, whereas in the same time the coniferous forest area decreased by 8%.

As no harmonized national data series is available for "net annual increment", FRA source data (modified by the national correspondent by adding a more accurate value for the year 2000) must be used for the assessment of historical trends (graph 11). Excluding data referring to 1947, the parameter shows a very similar pace of growth as "growing stock". It doubled since the 1950s; however, the increase develops in stages; a strong increase during the 1970s versus periods of low increase from 1950 to 1970 and from 1980 up to today.

Most of the reported strong increase in NAI in the 1970s is likely due to a real increase of this parameter, as this phenomenon can also be seen for "growing stock". Instead of the development in stages as depicted by FRA source data, a smoother progression of "net annual increment" may be assumed for the period from the 1950s to 2000 (the total extent of growth should be retained however).

Graph 11

Development of net annual increment in Belgium



3.3 Czech Republic and Slovakia

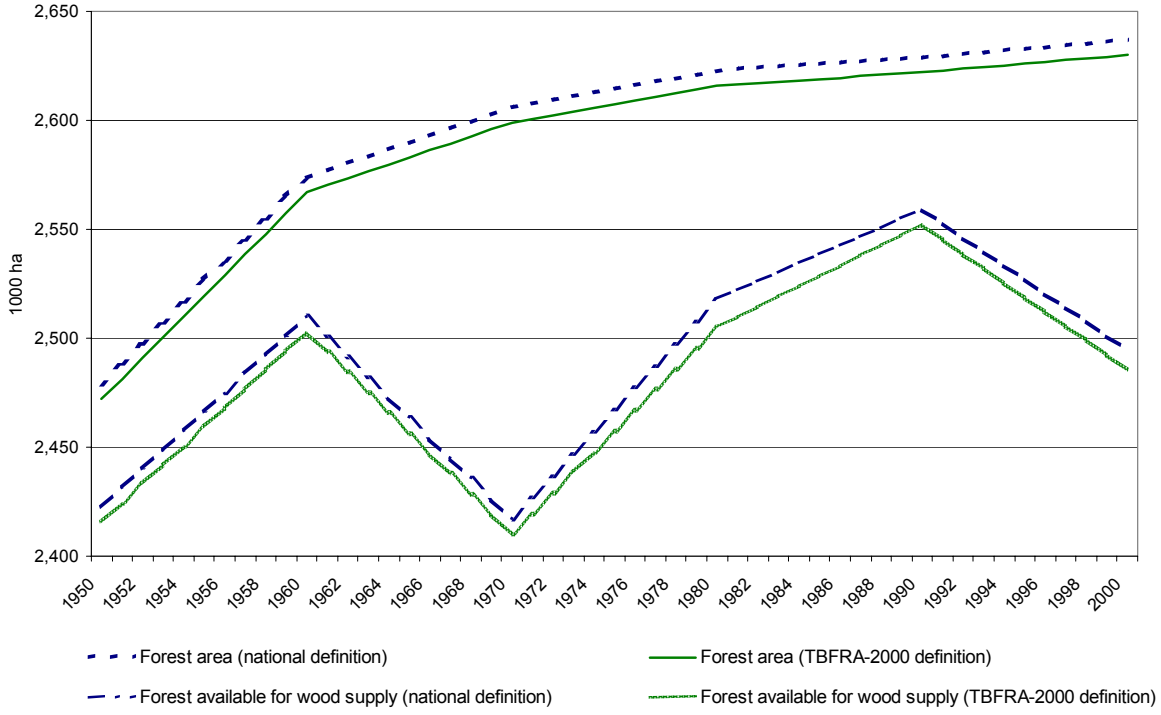
3.3.1 Czech Republic

The Czech Republic provided a set of data based on national definitions and a set of data based on the definitions used in TBFRA-2000 (both covering the period from 1950 to 2000) for "forest area", "forest available for wood supply", "growing stock" and "current (national definition)/net (TBFRA-2000 definition) annual increment". The national correspondent notes that the national Czech definition for the term "forest" is very similar to the definition of "forest" used in TBFRA-2000. However there are some minor differences:

TBFRA-2000 requires an area be bigger than 0.5 hectare to be considered as a "forest", whereas in the Czech Republic a "forest" can be smaller, depending on how the individual land lot is registered in the cadastre. The influence of this issue on the reported volume of "forest area" is negligible given that less than two thousand hectares is affected by this difference in classification. More important is that approximately six thousand hectares of the dwarf pine forest is not considered as "forest" according to the definition of TBFRA-2000. The national and TBFRA-2000 definitions do agree however, that protection forests, national parks (since 1970: Krkonose 4400 ha; since 2000: Ceske Svycarsko 1700 ha, Podyji 2200 ha, Sumava 9000 ha) and small-scale protected areas (area of approximately 35000 ha) are considered as "forests not available for wood supply".

Graph 12

Development of forest area in the Czech Republic



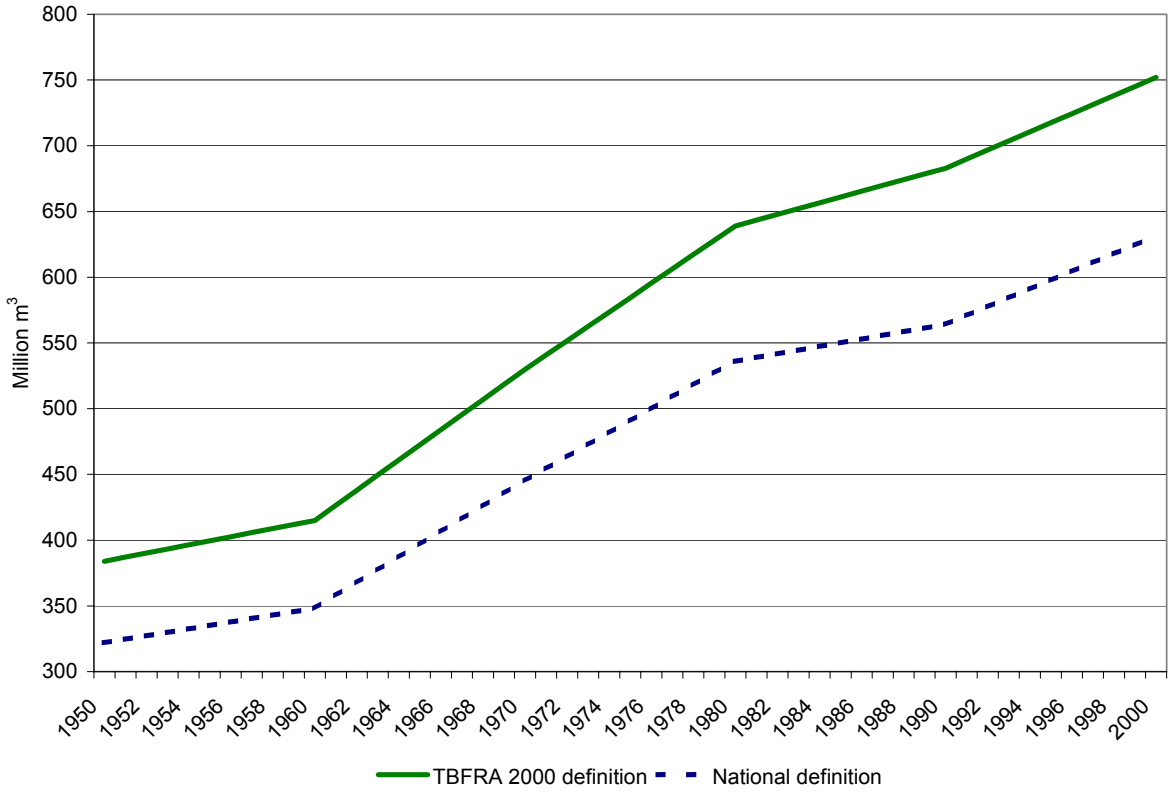
Due to the broad correspondence of national and TBFRA-2000 definitions, one can observe a homogenous historical development of the parameter "forest available for wood supply" according to both sets of definitions (graph 12). The trendline based on data harmonized to definitions of TBFRA-2000 lies constantly around 10 thousand hectares below the national trendline, which is caused by the minor definitional differences described above.

"Forest available for wood supply" increases in the 1950s, and then decreased in the 1960s to the level of 1950. The area then increased from 1970 to 1990 followed by a decrease until today. Without going deeply into the policy analysis of factors behind these changes for "forest available for wood supply", it can be assumed that the quantitative development of this parameter is strongly affected by the volume of established

forest protection areas, keeping in mind that the parameter "forest", being composed of "forest available for wood supply" and ″forest not available for wood supply", is constantly increasing during the period from 1950 to 2000.

Graph 13

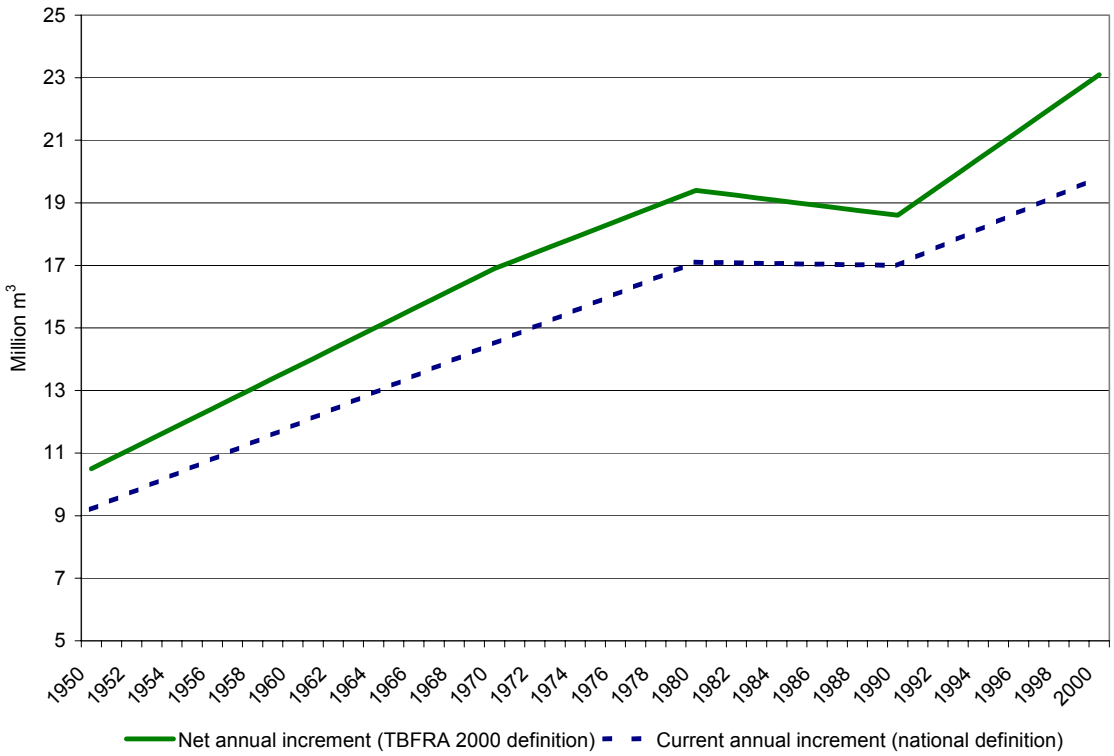
Development of growing stock in the Czech Republic



"Growing stock" shows a rather steady increase since 1950, both according to national definitions and according to TBFRA-2000 definitions (graph 13). However, the national graph is based on considerably lower data values than the TBFRA-2000 graph. This is because the national definition of "growing stock" means timber under bark with a minimum top diameter of seven centimetres, whereas TBFRA-2000 reports "growing stock" as over bark and includes all trees with a diameter over zero centimetres.

Analogous to "growing stock" and "forest available for wood supply", "net/current annual increment" shows the same historical trends according to both sets of definitions (graph 14). "Net/current annual increment" is constantly increasing from 1950 to 1980, in the 1980s the development stagnates and afterwards an increase can be observed again. The national volumes are significantly under those from TBFRA-2000 for the same definitional differences mentioned above for "growing stock”.

Graph 14
Development of annual increment in the Czech Republic



The national correspondent pointed out that the Czech Republic does not (in general) have any classification of forest concerning its availability for wood supply. The changing market situation for wood and wood products does not allow a fixed rule for "economic availability", as all forests can be considered economically profitable on condition that the market price is high enough. Concerning the technical feasibility, there are no restrictions on exploitation, as all forests are accessible. Taking these facts into consideration, the reported availability of forests for wood supply is only depending on restrictions imposed by the respective forestry legislation. As listed below, these have changed several times in the last five decades in the Czech Republic.

Before 1964 the total forest area was split up into production forest (management group I), forest with limited yield regulation (management group IIA) and forest without yield regulation (management group IIB). In management group IIB forests, no felling was planned for site conditions and/or management regulation, i.e. this forest was considered to be not available for wood supply. However, in the case of natural disasters, like storms, the timber from this "protected" forest usually was removed and used.

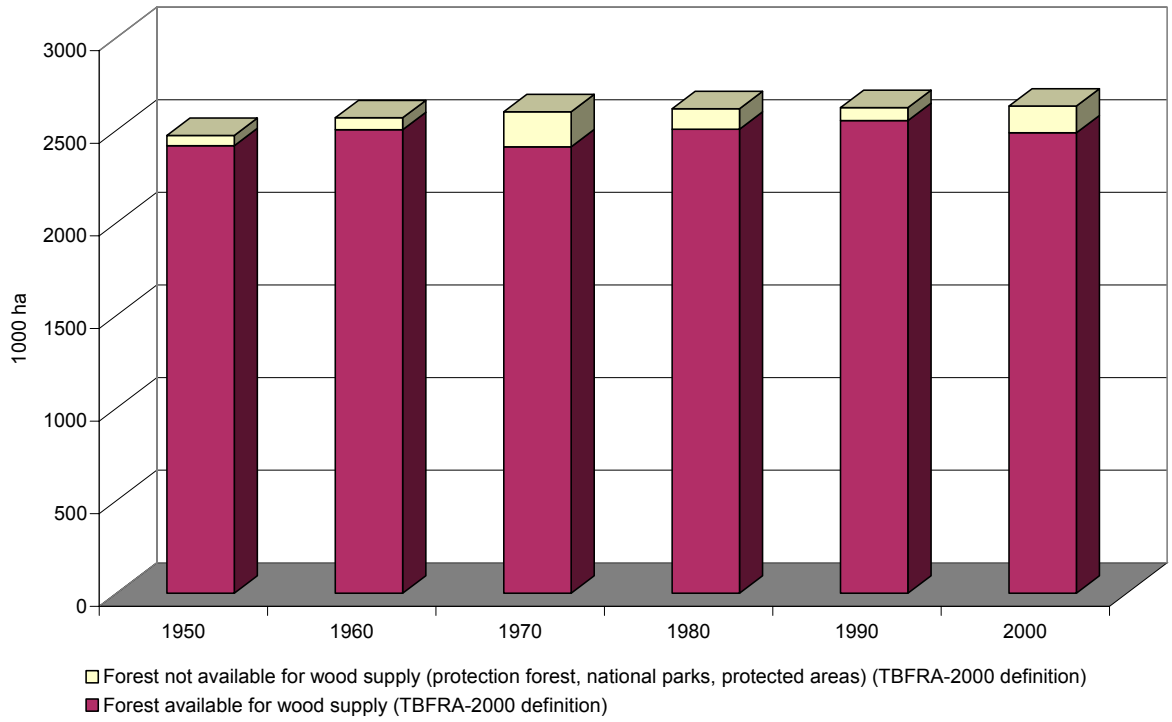
In 1964 a new system of so-called "forest categories" was introduced in the legislature, splitting up the total national forest area into three main categories (Category 1: "production forest", Category 2: "protection forest", Category 3: "forest for special purposes"), which are subdivided according to criteria such as site conditions etc. Only the category of protection forest was reported as "forest not available for wood supply", which reflects rather truly the real situation; forests for special purposes were, in principle, available for exploitation, as felling was restricted only by the management objective and not by the law. The definition of the category of protection forest – especially concerning the criterion, for which site conditions may be a reason for classifying a forest as a protection forest – was changed by the forestry acts passed in 1978 and 1996. Already in the 1970s a systematic mapping of forest site types covered the whole territory of the Czech Republic.

The forestry act of 1978 included more forest site types in the second category of protection forests, which seems retroactively to have been applied to the data from the forest inventory of 1970. This would explain the major drop in "forest available for wood supply" reported that year. Due to air pollution damage, a part of the forest area belonging formerly to the second category of protected forests was re-categorized as a special subdivision of the third category of forests (Category 3e, introduced in 1978). This re-categorization had an

impact on the data for 1980 and even more on the data for 1990. It resulted in a considerable increase of "forest available for wood supply". In the forestry act of 1996, this Category 3e was abolished causing the increase of the area of protection forests classified as second category forests approximately to the level of 1980. In addition to that, three new national parks (covering 17 thousand hectares, of which 11 thousand hectares are first zone areas without human interference) were established in the 1990s. Moreover, the new legislature defined protected areas like reserves and monuments (covering approximately 35 thousand hectares) that are officially classified as special purposes forests as "not available for wood supply" even if for some special purpose felling was permitted. These reforms have caused the recent decrease of the area of "forest available for wood supply" (graph 15, Table 1).

Graph 15

Development of forest available for wood supply and forest not available for wood supply in the Czech Republic



Considering these changes in forestry legislation, it can be stated that it was the increase of total "forest area" that was responsible for the increase in "forest available for wood supply" between 1950 and 1960. The changes to the area of "forest available for wood supply", in the period from 1960 up to today, was mostly a result of political decisions (which forest area shall be classified as protected forest and thus may not be available for wood supply).

Table 1

Transformation of national data to TBFRA-2000 definitions (*forest* and *forest available for wood supply*)

(1000 ha)

	1950	*1960*	*1970*	*1980*	*1990*	*2000*
Forest area (national definition) Czech Statistical Institute reports	2479	2574	2606	2623	2629	2637
- dwarf pine stands and stands under FRA area and size limit	7	7	7	7	7	7
Forest area (TBFRA-2000 definition)	**2472**	**2567**	**2599**	**2616**	**2622**	**2630**
- protection forest	56	64	185	107	66	92
- national parks			4	4	4	17
- protected areas						35
Forest available for wood supply (TBFRA-2000 definition)	**2416**	**2503**	**2410**	**2505**	**2552**	**2486**

The volume of "growing stock" is based on a summary of the national forest management plans. According to this, the real stock volume of all the forest stands in the Czech Republic is summarized. The average size of one stand is at present 1.36 hectare. In the past the average size fluctuated, but never exceeded four hectares. The increase in the volume of "growing stock" reported for the period between 1950 and 1980 is very likely caused by the continual improvement of measurement methods. From 1950 to 1960 records on forestland were made more precise, and after 1960 assessment methods of the existing stock were made more precise by using Bitterlich's relascope, and by fully callipering mature stands. This fact, seen in the case of the Czech Republic, could support the assumption that in the whole of Europe, the volume of "growing stock" was considerably underestimated in the 1950s and 1960s. The reported increase of the volume of "growing stock" during that time could primarily be a result of technical improvements to mensuration techniques.

The Czech national correspondent reported that only the increase of "growing stock" between 1980 and 1990 represents a true increase. This was caused by the growth of increment in the whole of Europe during that time (maybe due to the fertilizing effects of pollution). After 1990, the continued increase reported in the data might partly reflect the true development in Czech forests. The data were, however, also affected by the privatisation of forest management planning, implying a tendency toward cheaper assessments implemented by young and less experienced employees, and a complete electronic processing of the forest management plans.

Table 2

Transformation of national growing stock data to TBFRA-2000 definition

(million m^3)

	1950	*1960*	*1970*	*1980*	*1990*	*2000*
Growing stock, summary of the forest management plans (7 cm under bark)	322.0	348.0	445.0	536.0	564.0	631.0
+ 10% bark	32.2	34.8	44.5	53.6	56.4	63.1
Subtotal with bark	**354.2**	**382.8**	**489.5**	**589.6**	**620.4**	**694.1**
+ 8.35% additional volume increment 0-7 cm	29.6	32.0	40.9	49.2	51.8	58.0
Growing stock (TBFRA-2000 definition)	**383.8**	**414.8**	**530.4**	**638.8**	**672.2**	**752.1**

The "current increment" is calculated by using yield and increment tables (based on sample plots) which were mostly measured since the 1950s. The "current increment" must be reduced by 20% of the salvage felling volume (volume removed in the event that damages caused by storms, etc. occur) in order to get the value of "net annual increment". Before 1980, Schwappach's tables, published in the early 20th century, were used for calculating the increment. Since 1980, the process of calculating the increment has been done by growth models, which have been re-evaluated recently.

The national correspondent pointed out that "current increment" does not represent any criterion for sustainability, as this parameter is strongly affected by the age structure in the existing forests. The forests in the Czech Republic have to deal with an abnormal presence of stands reaching maturity. This is the reason for the strong increase in increment in recent years, which hides the drop of potential fellings that will occur during 40 years after the "current increment" will have been felled. For avoiding misleading conclusions, the sustainable quantity of fellings must be compared with the "average increment" which reflects the production potential of forest sites and is not influenced by age structure irregularities.

Table 3
Transformation of national data on net annual increment to TBFRA-2000 definition
(million m^3)

	1950	*1960*	*1970*	*1980*	*1990*	*2000*
Current increment (min. top diameter 7 cm, under bark)	9.2	na	14.5	17.1	17.0	19.8
- 20 % of salvage felling	0.4	na	0.3	0.8	1.4	0.4
Subtotal - felling debris	**8.8**	**na**	**14.2**	**16.3**	**15.6**	**19.4**
+ 10 % bark	0.9	na	1.4	1.6	1.6	1.9
Subtotal over bark	**9.7**	**na**	**15.6**	**17.9**	**17.2**	**21.3**
+ 8.35% additional volume increment 0-7 cm.	0.8	na	1.3	1.5	1.4	1.8
Net annual increment (TBFRA-2000 definition)	**10.5**	**na**	**16.9**	**19.4**	**18.6**	**23.1**

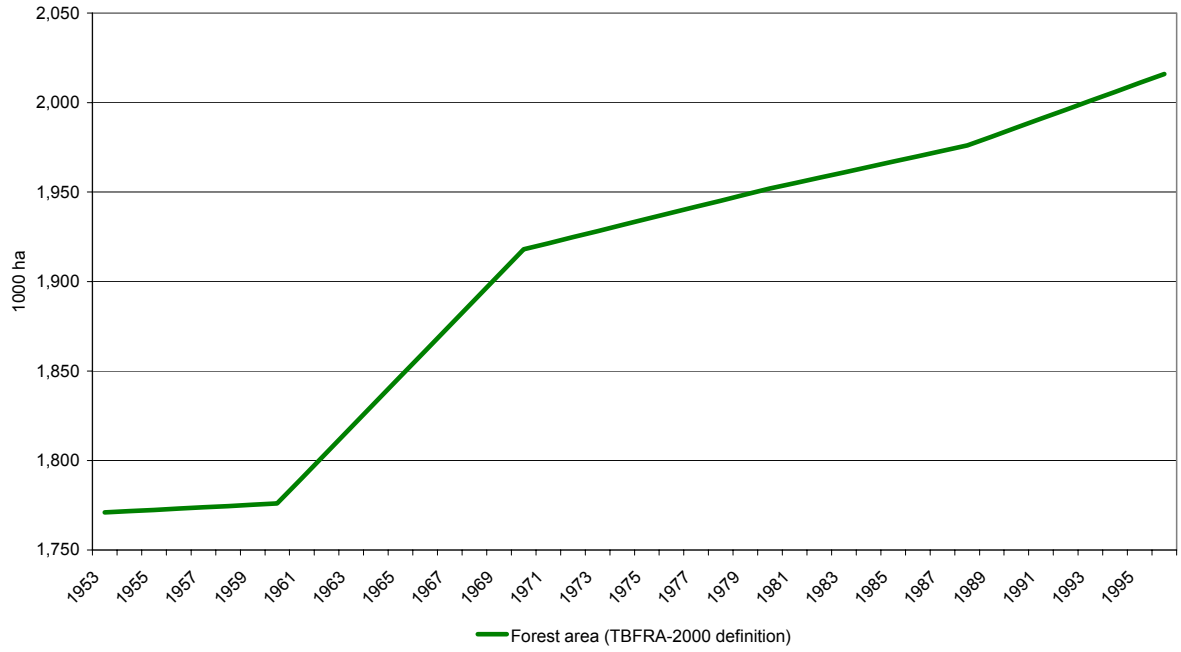
3.3.2 Slovakia

The national correspondent of Slovakia provided a table of historical data that was taken directly from the different National Forest Inventories. Over-time inconsistencies are not corrected and no adjustments to the definitions of TBFRA-2000 were made. The data, containing "forest area", "growing stock" and "current annual increment" and covering the time from 1953 to 1996, were then adjusted to the definitions used in TBFRA-2000. The results of this harmonization are shown in a second table.

The correspondent reported that concerning "forest area", no adjustments of the primary data had to be done, as the national definitions are compatible with the definitions of TBFRA-2000. Concerning the volume of "growing stock", the correspondent indicated that data taken from the National Forest Inventories of 1980 and 1988 were converted using the coefficients derived by Petráš from under bark to over bark with regard to the age structure and tree species composition (PETRÁŠ, R., HALAJ, J., PAJTÍK, J., 1990). For 1996, the same figure as in TBFRA-2000 was taken. However, data for "growing stock" (including the figure for 1996 reported in TBFRA-2000) still do not correspond completely to the definitions in TBFRA-2000 because trees which are less than 8 cm at breast height and dead trees are excluded (see comment in TBFRA-2000. p.219/220: "Specification of known deviations from TBFRA-2000 definitions: When determining the standing volume a pre-set minimal diameter of 0 cm (of breast-height diameter) was not fulfilled as Slovakia's current forest management practices are based, in determining growing stock, on callipering of stands from minimal registration diameter of 8 cm.") The same (still existing) deviations from the definitions of TBFRA-2000 can be found for the parameter ″current annual increment", which equals, according to the correspondent, the "net annual increment" of trees greater than 7 cm in diameter at breast height (excluding dead trees).

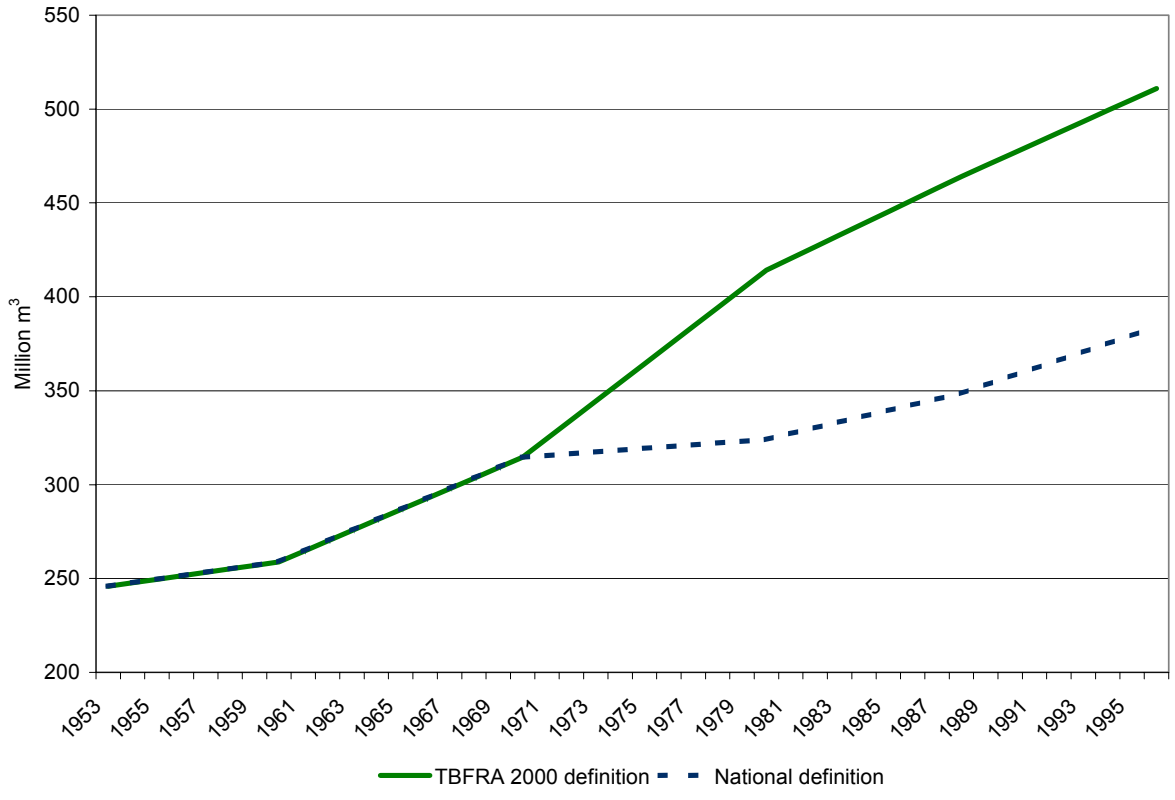
Source data of the various National Forest Inventories for "current annual increment" were adjusted to the definitions of TBFRA-2000 in the following way: Since no information about the volume of "current annual increment" was available for 1960, the figure given in the table with harmonized data for that year is an expert estimate extrapolated from a comparison of growing stock, age structures and increments from 1953 to 1980. In 1970 data were only given for high forests available for wood supply. Therefore, the volume of increment in coppice and protection forests was estimated by an expert on the basis of growing stock and area. The estimated volume was afterwards added to the reported figure. Analogous to the parameter "growing stock", a conversion of the volume of "current annual increment" from under bark to over bark was necessary for 1980 and 1988, and was carried out according to the same method described above. For 1996 the figure indicated in TBFRA-2000 was taken. All these adjustments facilitate the assessment of historical trends for forest area, growing stock and net annual increment.

Graph 16
Development of forest area in Slovakia



The parameter "forest area", for which no adjustment was necessary, is showing a sustained increase from 1953 to 1996, which intensifies remarkably in the 1960s (graph 16). The volume of "growing stock" also increased according to both sets of data (graph 17). However, the increase is much stronger following the adjusted data series (the volume of 1996 is more than the double the volume reported for 1953).

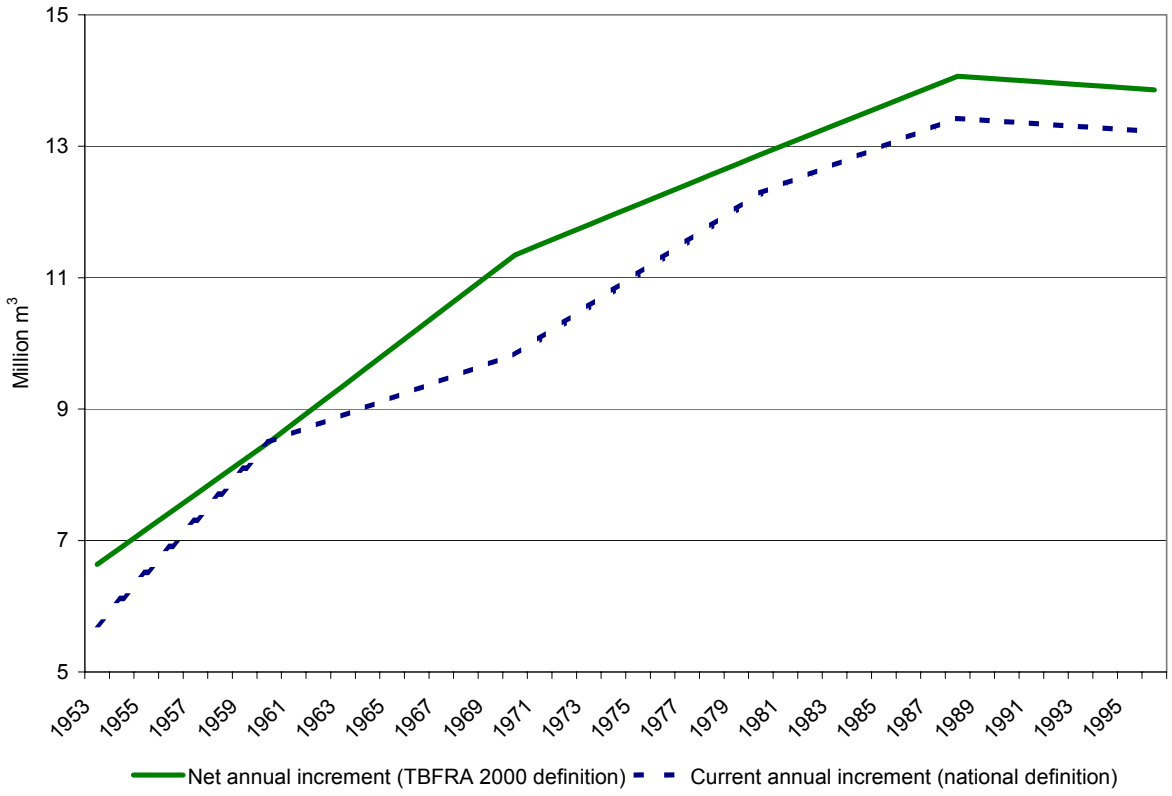
Graph 17
Development of growing stock in Slovakia



The data series based on national data and the data series based on adjusted data for "current/net annual increment" have the same major trends (graph 18), a rather strong increase of volume until 1988 followed by stagnation in the rate of increase. While the trend is the same, it can be seen that the values of the data adjusted to the definition of TBFRA-2000 are higher than the values of national source data.

Graph 18

Development of annual increment in Slovakia

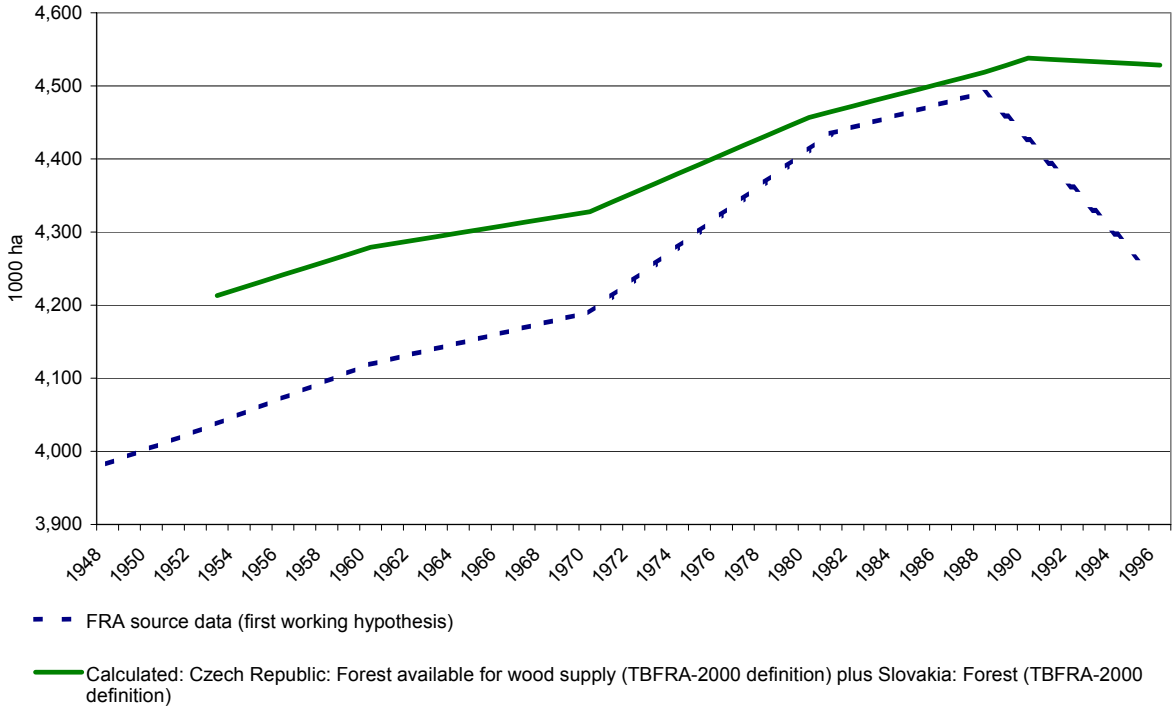


3.3.3 Former Czechoslovakia

As in the various historical FRA publications (apart from TBFRA-2000) data are only available for the whole area of former Czechoslovakia and are not split up into the area of today's Czech Republic and today's Slovakia, a comparison of adjusted national data with FRA source data is only possible by adding, for each year, interpolated values of the data series provided by the Czech and the Slovakian national correspondents. In the analysis of such a comparison, it must be considered that nationally provided Czech and Slovakian data do not correspond precisely in terminology and definitions. For example, values for the term "forest area" of Slovakian data were added to values for the term "forest available for wood supply" of the Czech data, which are based on a more restrictive definition. These discrepancies are, however, of minor importance considering the purpose of assessing major trends in the development of forest resources.

Graph 19

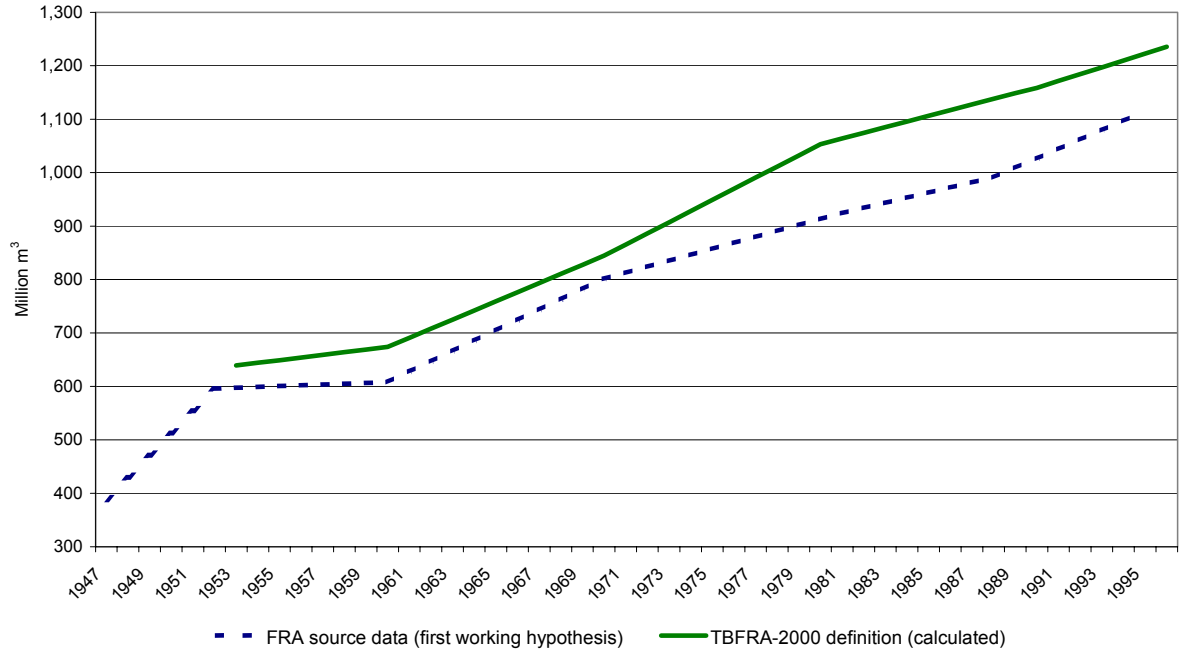
Development of forest area in former Czechoslovakia



Considering the development of forest area in the former Czechoslovakia, it can be seen that the data series taken from FRA publications (first working hypothesis, see Chapter 2.2) has the same upward growth trend as the adjusted national data until 1988 (graph 19). The strong decrease of forest area according to FRA source data in recent years (which is not corresponding to the stagnating development according to national data) may be caused by the fact that FRA source data reports the value for the term "forest available for wood supply" of TBFRA-2000, whereas national data is distorted by the addition of values for two different terms: "forest area" (Slovakia) and "forest available for wood supply" (Czech Republic). The decrease of "forest available for wood supply" in recent years in the Czech Republic according to harmonized national data, which is assumed to be (at least partly) caused by the establishment of protection areas, makes such a trend also for the whole of former Czechoslovakia quite probable. This thesis, however, cannot be verified, as harmonized national data for the term "forest available for wood supply" are not available for Slovakia. Also for the parameter "growing stock", FRA source data and harmonized national data have the same trend, a constant and considerable increase into the 1990s (approximately double the volume of the 1950s). Aside from the absolute figures, it can be stated that FRA source data for "growing stock" corresponds quite well with the nationally provided data (graph 20).

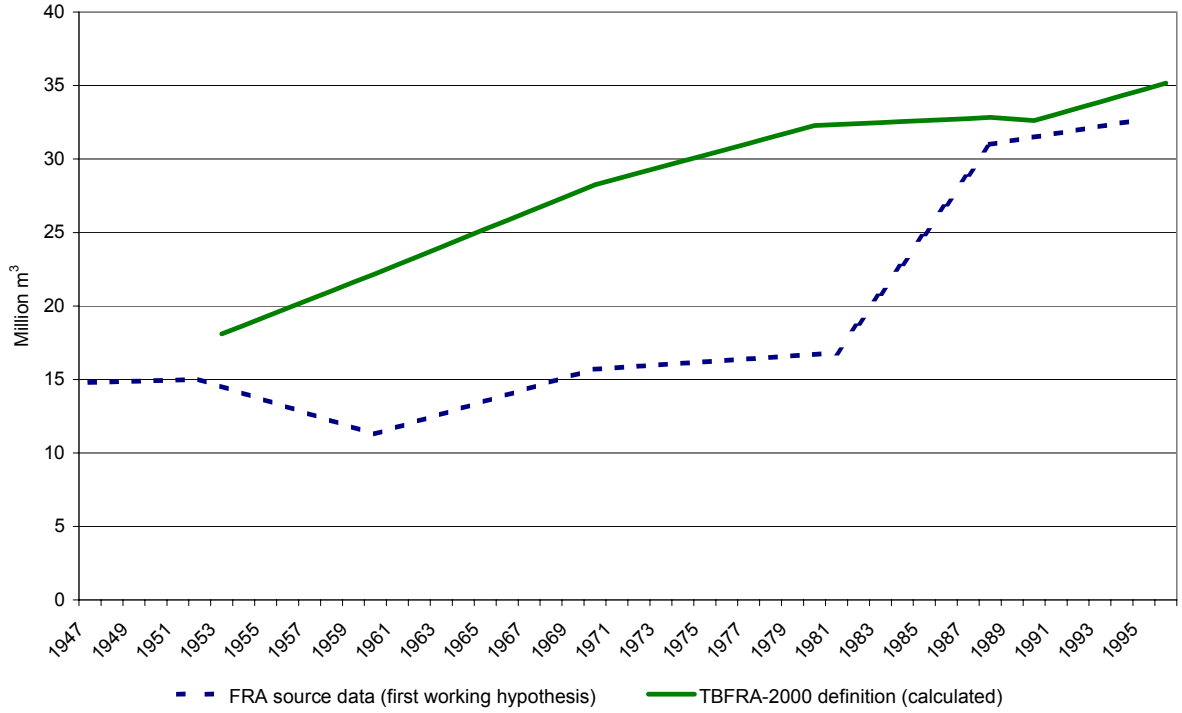
Graph 20

Development of growing stock in former Czechoslovakia



Graph 21

Development of net annual increment in Czechoslovakia



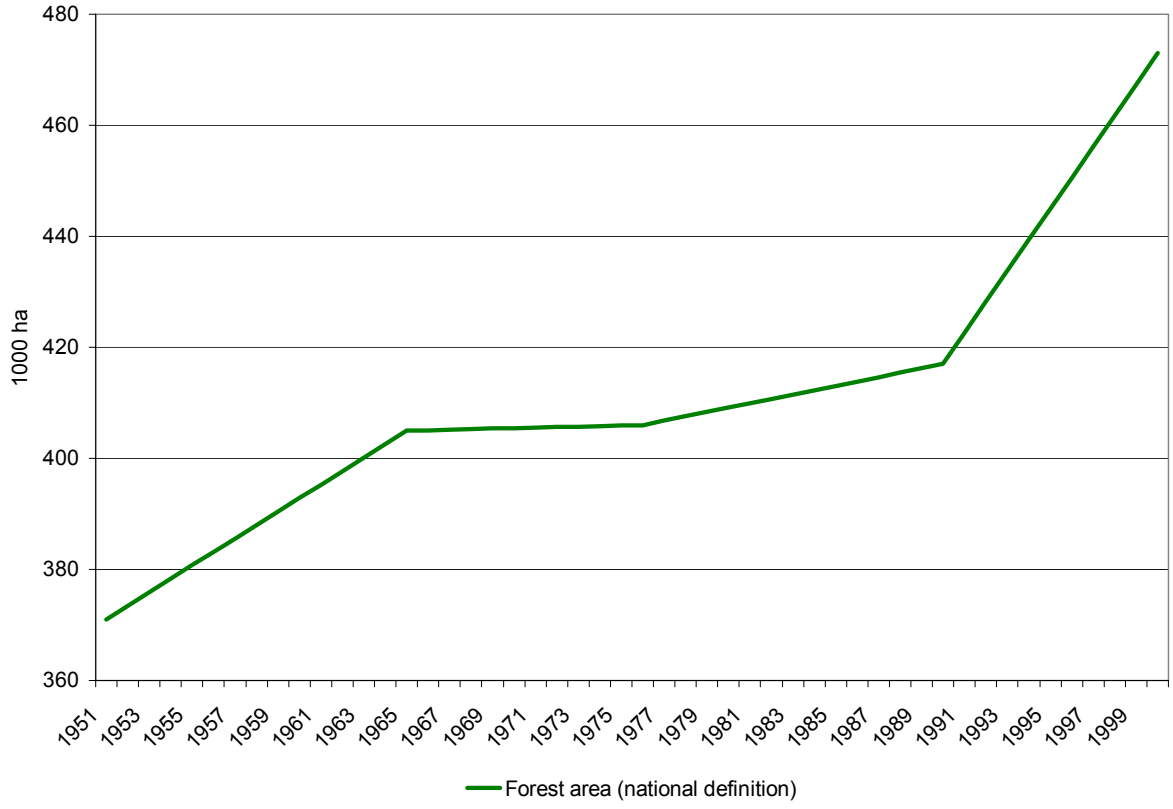
According to harmonized national data, the volume of "net annual increment" in what was the former Czechoslovakia is showing a sustained increase during the last 50 years (graph 21). This clear trend is not reflected very well by the data series based on FRA source data because the rate of increase is stagnant from the 1950s to the early 1980s and then climbs very strongly up to the level of the nationally provided data. This is likely caused by inconsistent definitions and measurement methods. Summarizing the comparison of national data with FRA source data for forest area, growing stock and net annual increment, it can be concluded that FRA source data is principally reflecting the major trends assessed by the harmonized nationally provided data.

3.4 Denmark

Demark has provided a set of historical data for "forest area" (area with forest cover), "growing stock" (total volume to 0cm top diameter) and "gross annual increment" (no reduction for mortality or cuts) covering the period from 1951 to 2000, which is based on forest census data from Statistics Denmark with the reference years 1951, 1965, 1976, 1990, 2000. The data have been completely re-analysed with similar methods of calculation concerning standing volume and increment.

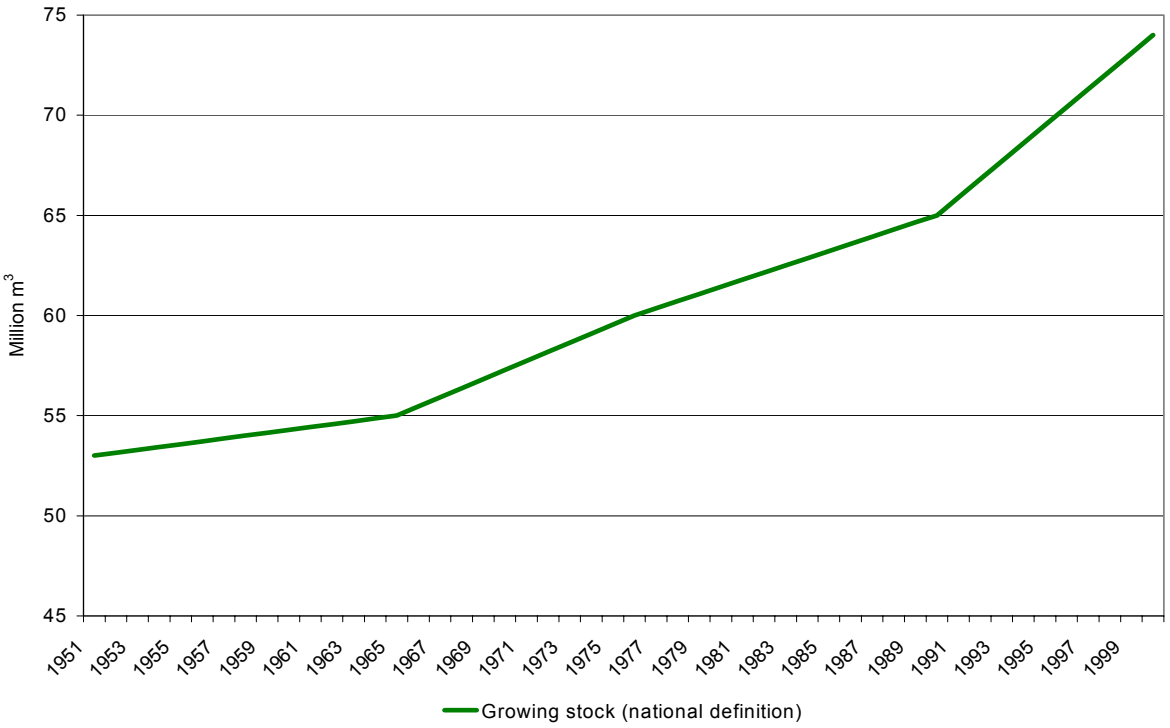
Graph 22

Development of forest area of Denmark



The development of "forest area" shows a considerable increase after World War II and a very strong growth in the last decade (increasing 13% since 1990), whereas from 1965 to 1990 only minor changes to "forest area" took place (graph 22). Major afforestation efforts in the 1950s and 1960s are a well-known phenomenon in many European countries. The increase in “forest area” from 1990 to 2000 of 41,000 ha is caused partly by afforestation (estimated to be approximately 28,000 ha in the period) and partly by a change in the population sampled. The forest census up to 2000 was based on questionnaires sent to known forest owners. The number of known forest owners increased from 1990 to 2000. This uncertainty should be considered when evaluating the changes of the period from 1950 to 2000.

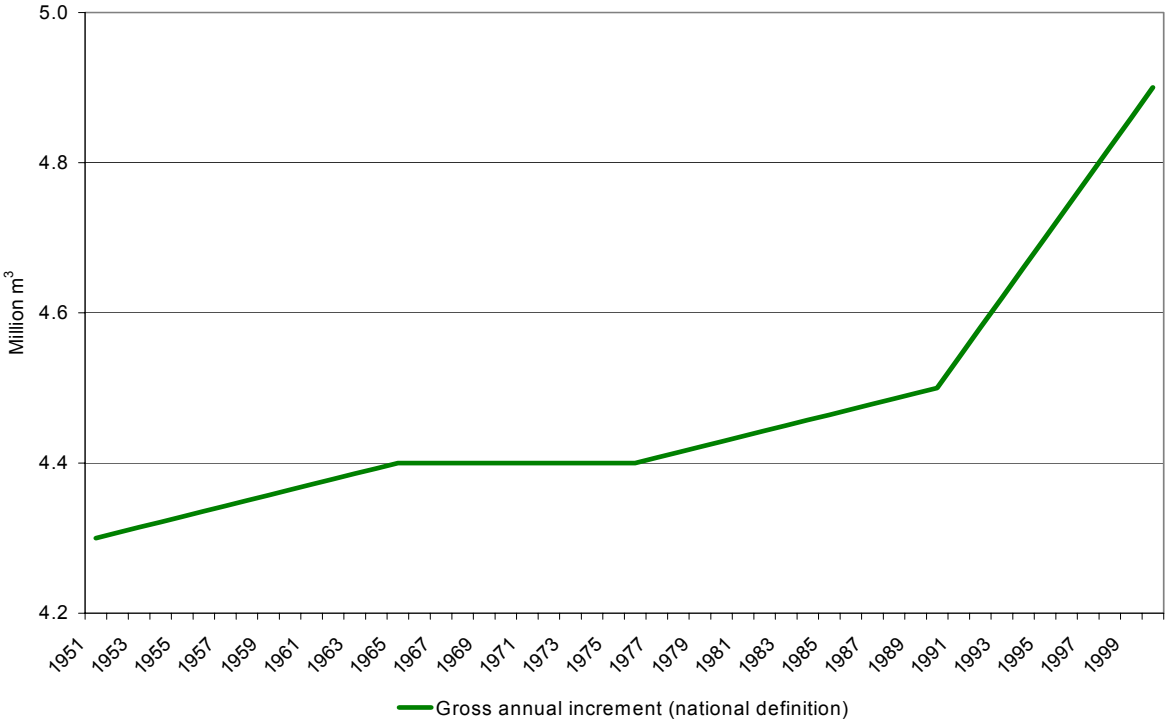
Graph 23
Development of growing stock in Denmark



The parameter "growing stock" shows a slight increase up to the mid 1960s, after which the growth trend accelerates and reaches its highest levels in the 1990s (graph 23).

The evolution of "gross annual increment" without exception reflects the historical trends for "forest area", which would lead to the conclusion that the quantitative increase of "gross annual increment" is largely driven by the respective increase of "forest area" in the past five decades (graph 24).

Graph 24
Development of gross annual increment in Denmark

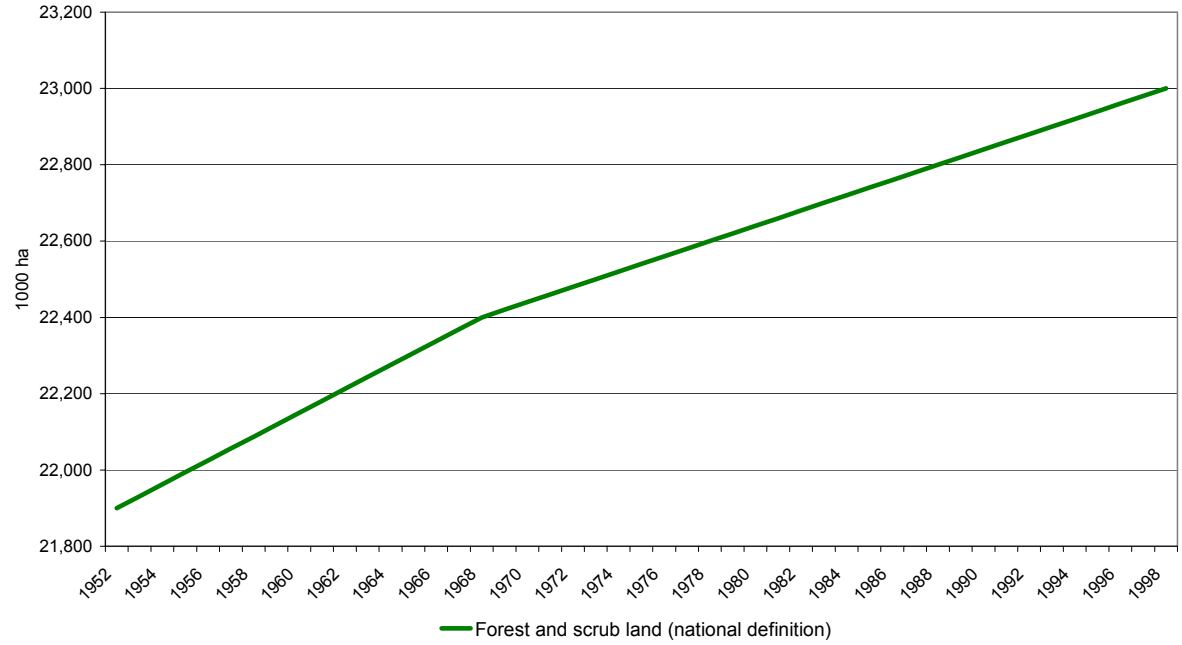


3.5 Finland

From the historical data set provided by the *Finnish Statistical Yearbook of Forestry 2001* (FFRI, 2001), the parameters "forest and scrub land", "growing stock" and "annual volume increment" (which are based on national definitions) have been chosen for the assessment of trends in Finnish forest resources.

Graph 25

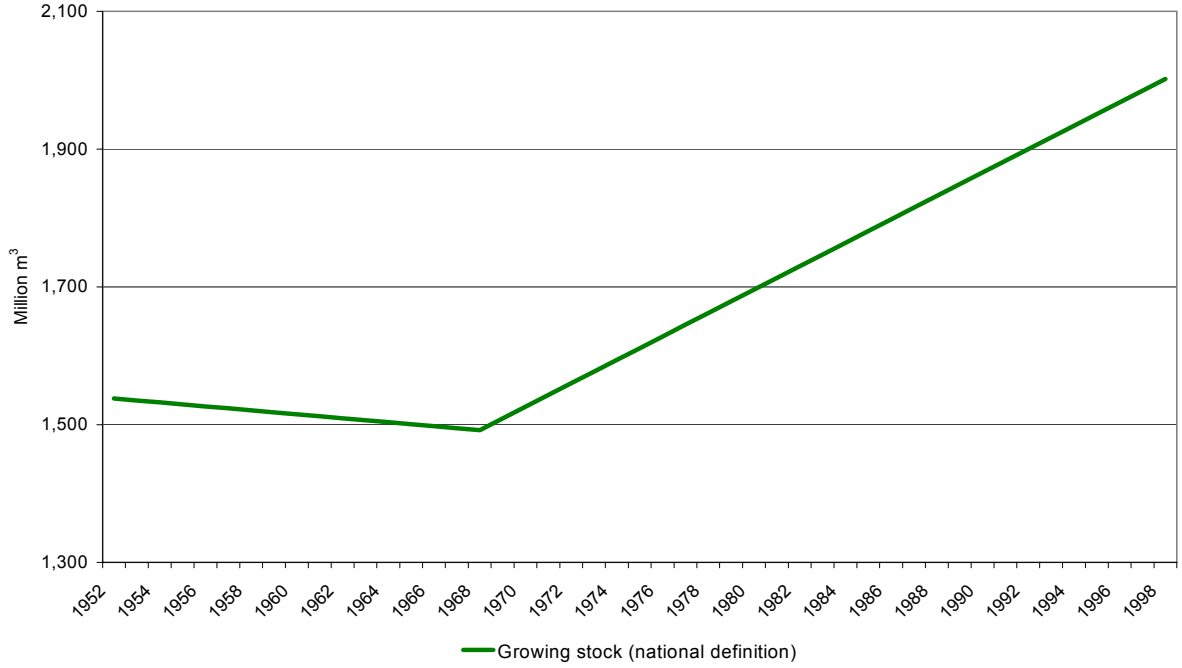
Development of forest area in Finland (II)



Regarding the expansion of forest area in Finland, two different phases of growth can be distinguished (graph 25). Up to the late 1960s, forest area was increasing rather rapidly, whereas from the 1970s up to today a slower rate of increase could be observed. Contrary to this development, "growing stock" which decreased during the 1950s and 1960s increased considerably through to today (graph 26).

Graph 26

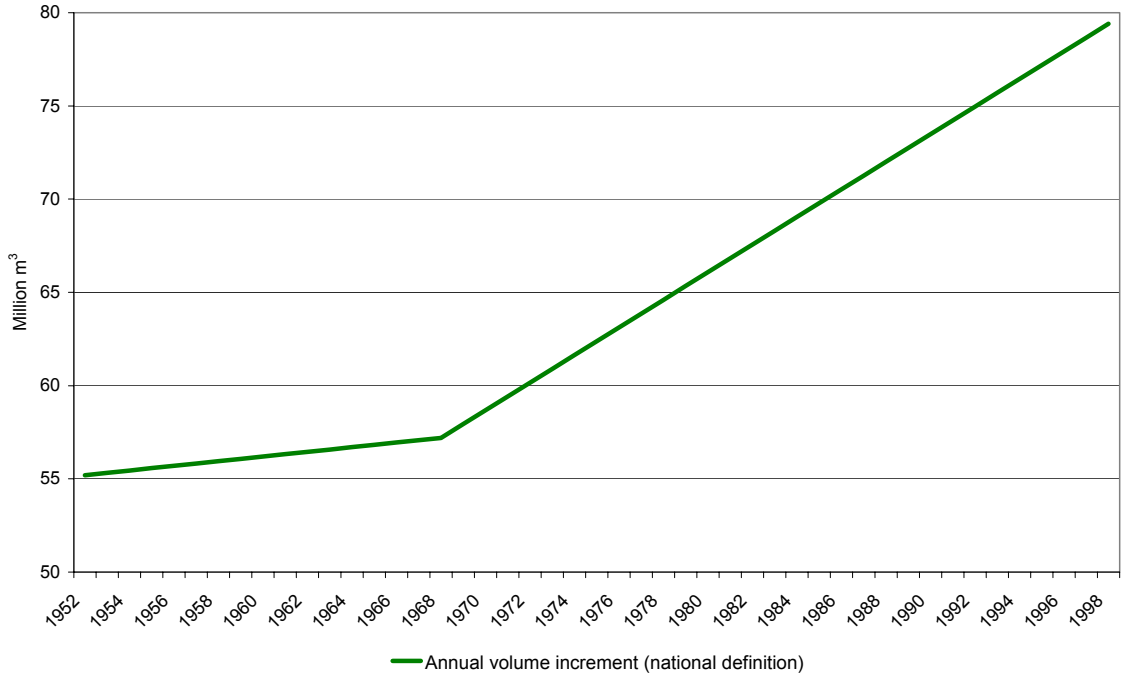
Development of growing stock in Finland



Similar to the parameter "growing stock", "annual volume increment" shows a very slight increase up to 1968, then in the period from 1968 to 1998, the rate of growth of the "annual volume increment" increased considerably (graph 27). Considering the development of these parameters, data are reflecting the major afforestation efforts that took place in Finland after World War II. These efforts caused a considerable growth in forest area, but had not yet provided an equivalent increase in growing stock and increment. The areas planted in the 1950s had started producing significant increment with some twenty years' delay, at just the time when the growth of forest area had lost its former intensity.

Graph 27

Development of annual volume increment in Finland



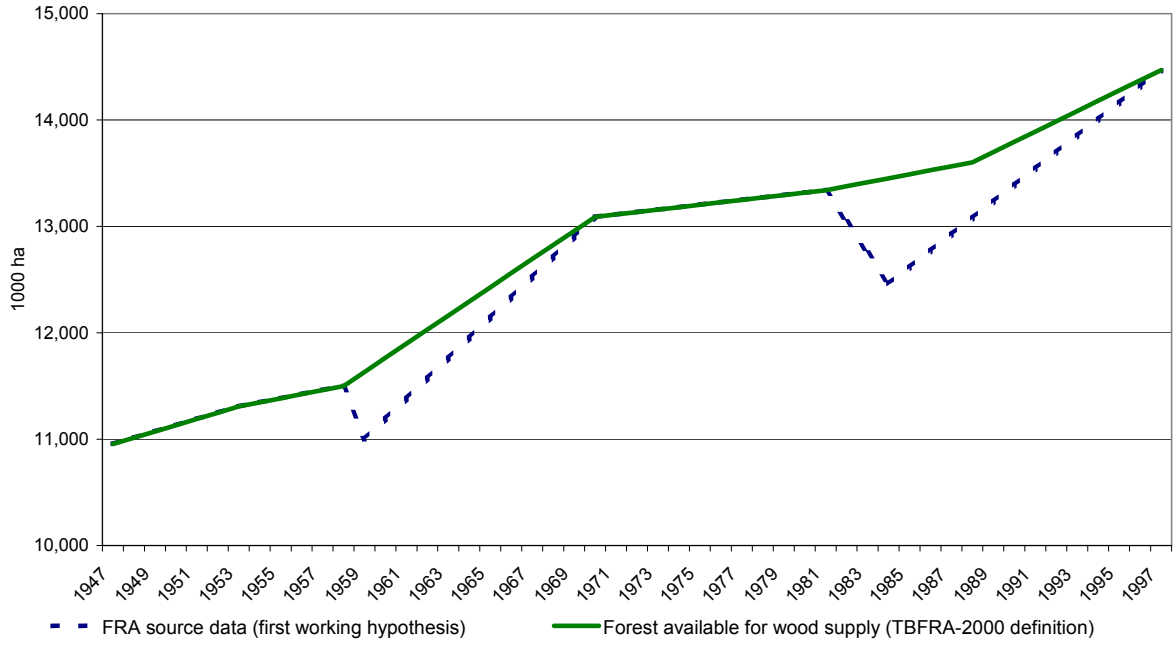
3.6 France

The compilation of historical FRA source data, which was attached to the enquiry, has been reviewed by the national correspondent of France, and it has been sent back with corrections. The revised version of this data compilation serves well for assessing the long-term historical trends in the development of forest resources in France.

FRA source data report for the data row referring to terms and their definitions, which are assumed to be "equivalent" to "forest available for wood supply" of TBFRA-2000 according to the first working hypothesis, an increase over the last 50 years. This general upward growth trend can easily be discerned; however, it is interrupted in the late 1950s and early 1980s by an abrupt drop which may indicate discrepancies in definitions and methods of measurement rather than reflecting the real developing trends of the parameter (graph 28). By replacing the value for "exploitable forest" given in the FRA publication *Forest Resources of the Temperate Zones, 1990* with a higher value (suggested by the national correspondent) the trend line of forest area can be smoothed in accord with its major tendency of increase. This correction proves that the decline of forest area in the early 1980s (according to FRA source data) is an artificial phenomenon. It is likely that the break in the increase of forest area in the 1950s also has artificial reasons. After further consultation with the national correspondent concerning this issue, it was decided to drop the data for 1959.

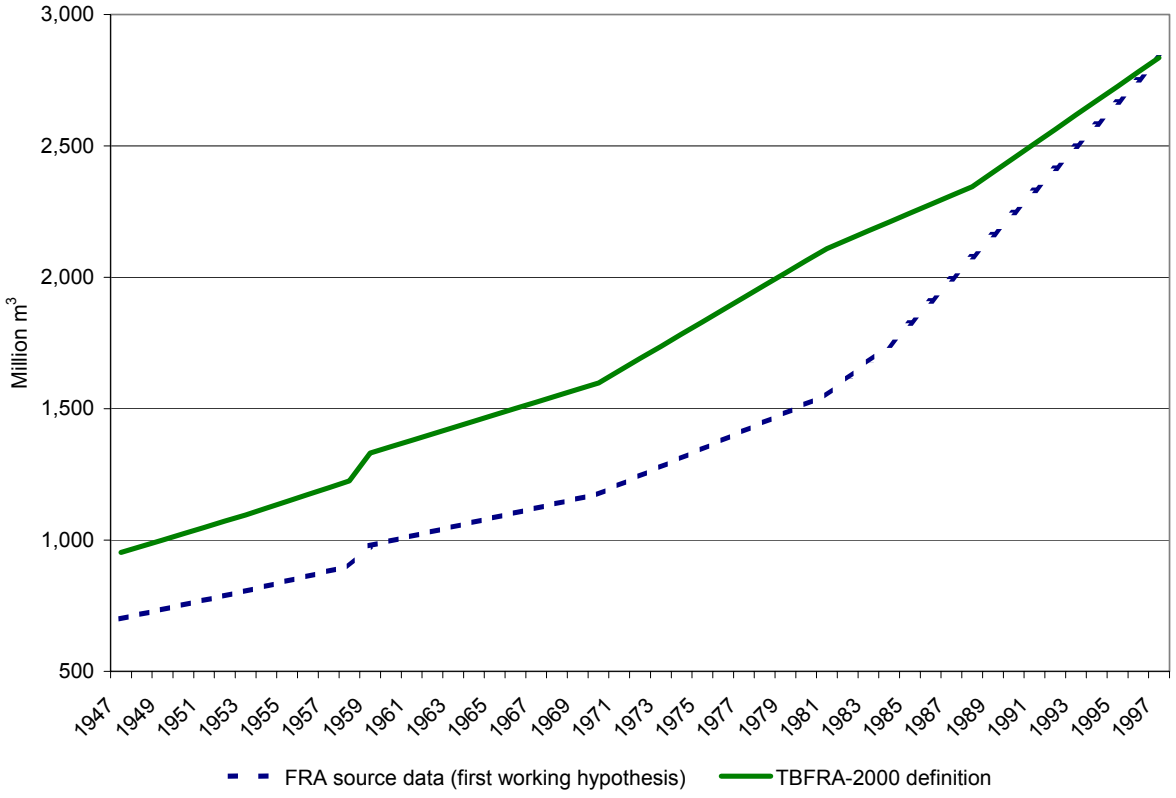
Graph 28

Development of forest area in France



Graph 29

Development of growing stock in France

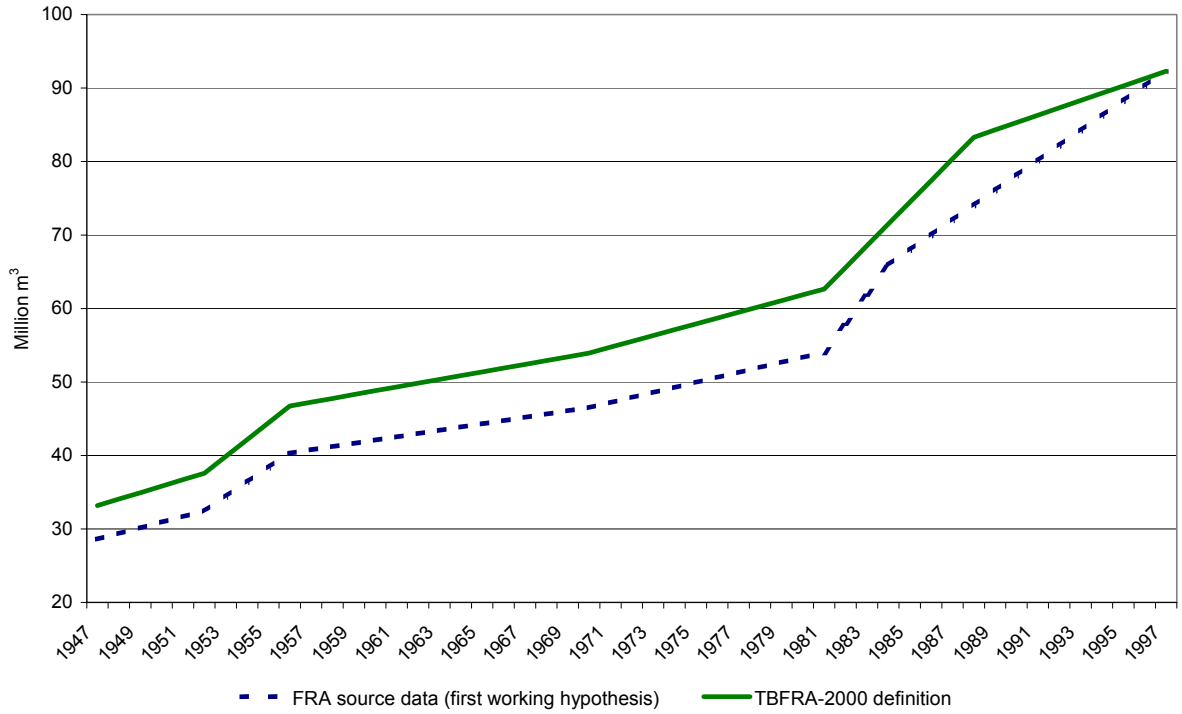


According to the data series improved by the national correspondent, "growing stock" has developed almost linearly. The value of this parameter has tripled in the period covered. The graph based on FRA source data shows this constant increase as well, but as an exponential trend rather than a linear trend. Values of

historical data provided by the national correspondent are consistently higher than values of FRA source data. It can be seen that "growing stock" has been constantly underestimated in the historical FRA publications. The biggest differences can be found for the 1970s and early 1980s.

Graph 30

Development of net annual increment in France



For the parameter "net annual increment", national data based on TBFRA-2000 definitions show constantly higher values than FRA source data (graph 30). Analogous to "growing stock" the parameter "net annual increment" has been underestimated in the historical FRA publications. The differences, however, are less significant, and on a consistent level. It can be seen in graph 30, which shows the historical evolution of "net annual increment" in France, that both data series develop in a parallel way, constantly increasing, from around 30 million m³ in 1947 to around 90 million m³ in 1997, i.e. the volume of "net annual increment" tripled in the period covered.

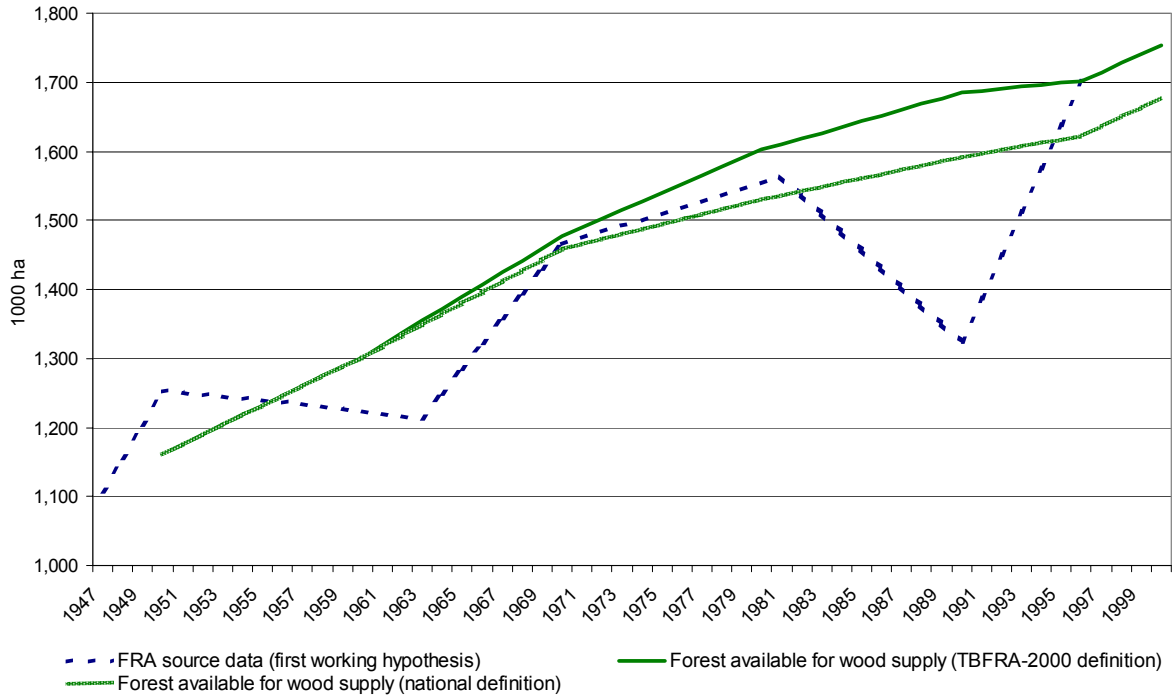
3.7 Hungary

The national correspondent of Hungary has provided one set of historical data harmonized to the definitions of the terms "forest available for wood supply", "growing stock" and "net annual increment" as used in TBFRA-2000 and a second set of data based on national definitions (both covering the period from 1950 up to today). He pointed out the difficulty of getting a comprehensive data set for this 50-years' period, as several changes in the data collection system have taken place in the past. The first forest inventory with full coverage was not implemented until 1970, so area data for earlier periods rely on sources different from those of the post-1970 period and are impossible to harmonize to the definition of "forest available for wood supply". As for "growing stock" and "net annual increment", pre-1970 data covers only the production forests. Consequently, the pattern of development can hardly be described for the whole period. Therefore, the national correspondent recommended that these data be used very carefully for the follow-up policy analysis and to focus mainly on the development of forest resources in the last three decades.

For "growing stock" and "net annual increment", the figures based on TBFRA-2000 definitions and national definitions are identical. This is a result of the broad correspondence of these two definition sets. Although the area of "forest available for wood supply" is slightly larger according to the definition used in TBFRA-2000 than it is according to the national definition, this discrepancy does not have any impact on the value of "growing stock" and "net annual increment", as it is caused by the inclusion of some permanently non-stocked or forest-related areas, like clearings and alleys.

Graph 31

Development of forest area in Hungary



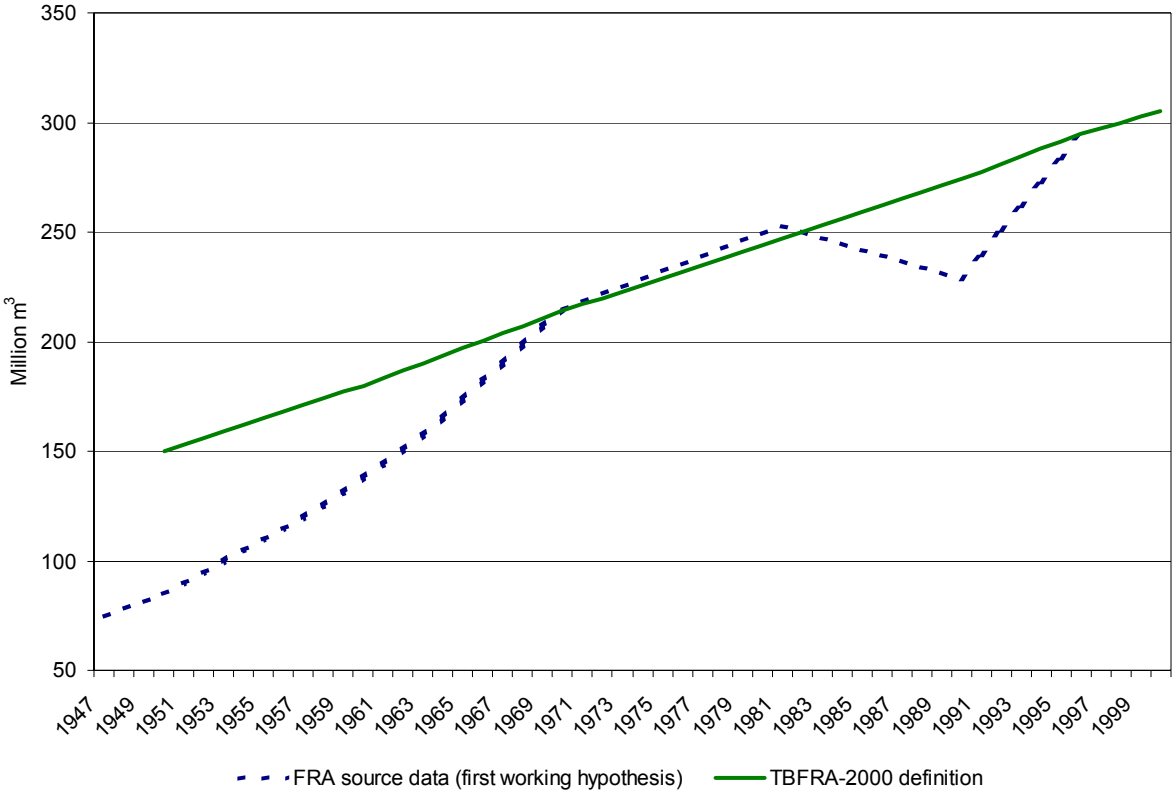
Comparing the development of the area of "forest available for wood supply" over the last 50 years according to FRA source data (first working hypothesis) with the two nationally provided data sets, two obvious discrepancies appear (graph 31). In 1963 and to a greater extent in 1990, the graph being based on FRA source data shows a considerable drop in hectares of forest area. The national correspondent reports that the drop in the early 1960s is not likely to be true as the total "forest area" increased between 1947 and 1963 by about 263 thousand hectares. The area of protected forests has also stayed rather stable in this period according to national sources. The strong discontinuity shown for the year 1990 is due to a misunderstanding concerning the definitions, as the Hungarian FRA team was assuming that the term "exploitable" is defined as forest and other wooded land with the primary function of wood production, whereas this term is officially defined in the FRA publication *Forest Resources in the Temperate Zones 1990* as: forest and other wooded land on which there are no legal, economic or technical restrictions on wood production. The application of the more restrictive definition explains the reduction of about 250 thousand hectares in the area of "forest available for wood supply" in 1990 according to the historical FRA source data series, but also the drop in the values for "growing stock on forest available for wood supply" and "net annual increment on forest available for wood supply" in 1990. These discontinuities have been removed by the national correspondent in the harmonized data sets.

According to the data sets consistent over time for "forest available for wood supply" a permanent but declining growth of the value of this parameter can be seen within the period covered. This tendency correlates very strongly with the intensity of afforestation. Starting with the 1970s - the point in time from which the comparison is meaningful - the values of the data harmonized to the definition of TBFRA-2000 are slightly higher than the values of the data based on national definitions. Both data series, however, show the same major trend of development. The increase of the difference between TBFRA and national data is explained by the fact that larger TBFRA forest area includes larger non-stocked territorial elements excluded from the national definition.

Regarding "growing stock" and "net annual increment", the values of these both parameters have doubled in the last five decades, according to nationally provided data. "Net annual increment" is following a very similar evolution as area of "forest available for wood supply" (a slowing rate of increase) (graph 33), whereas "growing stock" shows a rather linear growth (graph 32).

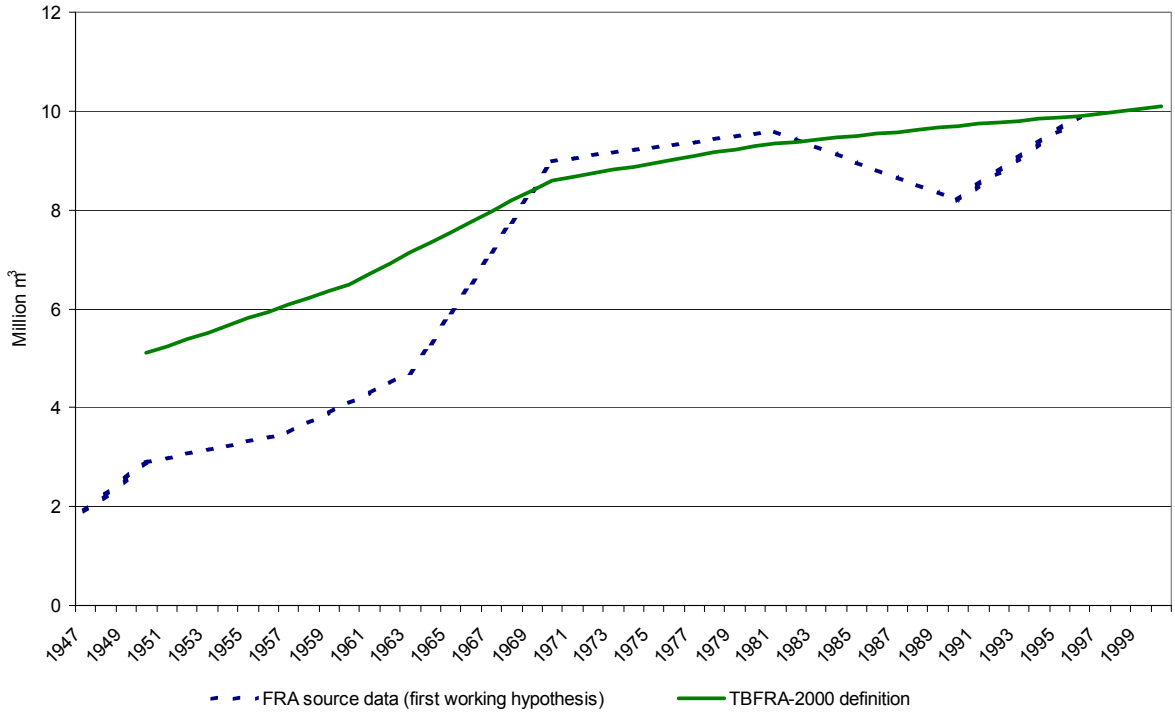
Graph 32

Development of growing stock in Hungary



Graph 33

Development of net annual increment in Hungary



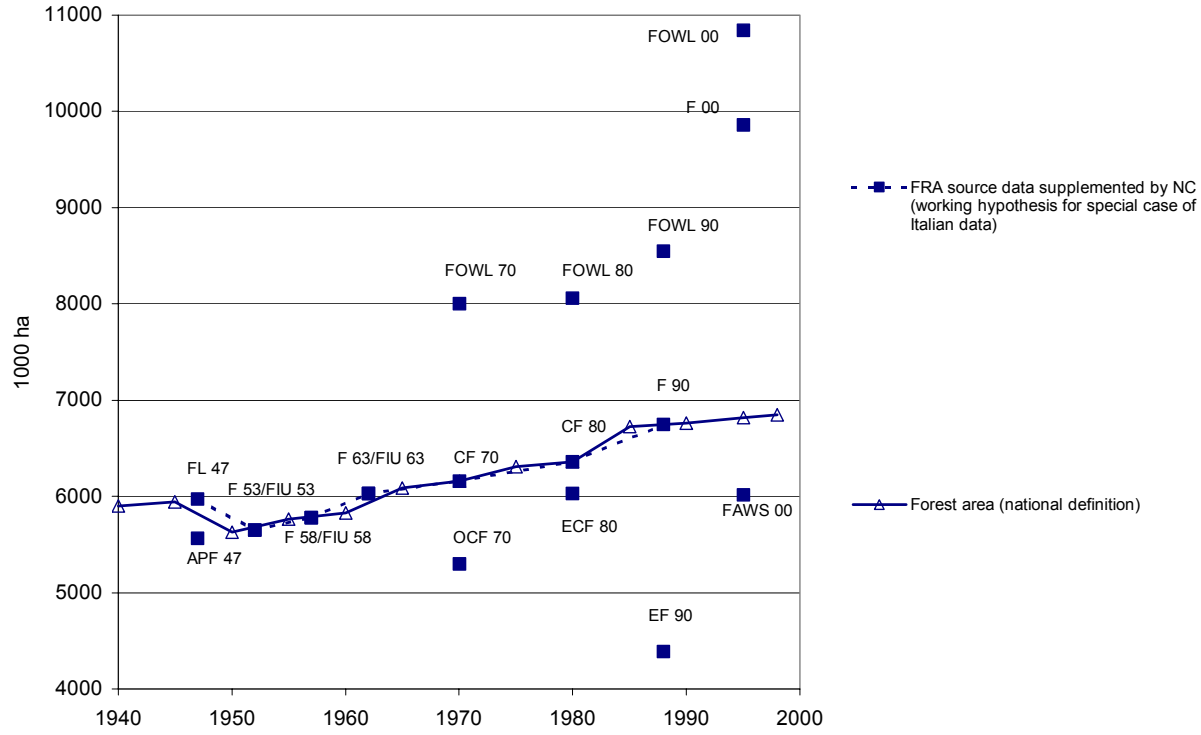
3.8 Italy

After having reviewed the compilation of historical FRA source data (see Chapter 2.3) for the main parameters forest area, growing stock and net annual increment, the national correspondent of Italy has supplemented important terms, which are missing in the FRA publications. For example, he added the term "closed forest" to data taken from the FRA publication *Forest Resources of the UNECE Region 1980* which is analogous to the term "closed forest" used in *Forest Resources in the European Region 1970*. Together with some corrections of data values, these revisions represent a considerable improvement of the statistical basis. Additionally, a set of harmonized national data covering the time from 1870 to 1998 was provided for the category forest area. This table reports (in intervals of five years) values for the term "total forest area", split up in "high forest" and "coppice" (for the whole 20th century) as well as the separation into "coniferous", "non-coniferous" and "mixed" (starting with the year 1950). A comment on the table states that the figures refer to ISTAT definitions in use until 1999.

The modified FRA source data concerning forest area was compared to this harmonized national data by entering all data as points in a system of coordinates according to their reference year and value. In this diagram triangles represent national data and squares the improved FRA source data (graph 34).

Graph 34

Overview of national and FRA source data for Italy (forest area)



Note: For abbreviations of terms used in FRA publications see Annexes 2 and 3.

Considering only the national data series, it can be seen that the parameter "forest area" decreases in the period from 1945 to 1950; afterwards it shows a slight increase until today. On the other hand, according to the first and third working hypothesis (see Chapters 2.2 and 2.5), forest area is developing erratically since the 1960s, as values are arbitrarily moving up and down from one FRA publication to another. Following the second working hypothesis (see Chapter 2.5), the FRA data series shows the same major trend as the national data series, but the very strong increase of the 1960s indicates a lack of definitional correspondence between the term "forest in use (for industrial or commercial purposes)" of the FRA publications *World Forest Inventory 1963* and the term "forest and other wooded land" of *Forest Resources of the European Region 1970*.

As the national correspondent has supplemented missing terms to the compilation of historical FRA source data (see Chapter 2.3), an additional row of "equivalent" terms from the *Forest Inventory 1947* to the *Temperate and Boreal Forest Resources Assessment 2000* may be assumed for the special case of Italian data. See below:

"Forested land" [1947], "forest" [1953, 1958], "forest (stocked forest land)" [1963], "closed forest" [1970, 1980], "forest" [1990, 2000]. Neglecting the term "forest" of TBFRA-2000, the FRA data series composed of the values for the terms mentioned above corresponds very well to the harmonized national data series, showing almost the same figures and trends for the historical development of forest area in Italy (e.g., a decrease of forest area around 1950, an accelerated increase in the early 1960s and again in the 1980s).

3.9 Netherlands

The correspondent of the Netherlands provided a national set of data for "forest available for wood supply", "growing stock" and "net annual increment" covering the time from 1960 up to today. These data are harmonized, i.e. they are based on the same terms and definitions as used in TBFRA-2000. The correspondent reports that around the year 2000, the area of forested lands in the Netherlands was 314,000 ha (according to the definition of TBFRA-2000). Additionally, there is an estimated area of forest not available for wood supply of about 25,000 ha (e.g. forested villa-parks, brushwood). As former national forest surveys had used other terms and definitions, a classification into "forest available for wood supply" and "forest not available for wood supply" for the whole time series is not feasible without some assumptions, which, however, (taking into account the relatively small area of "forests not available for wood supply") do not much influence the results.

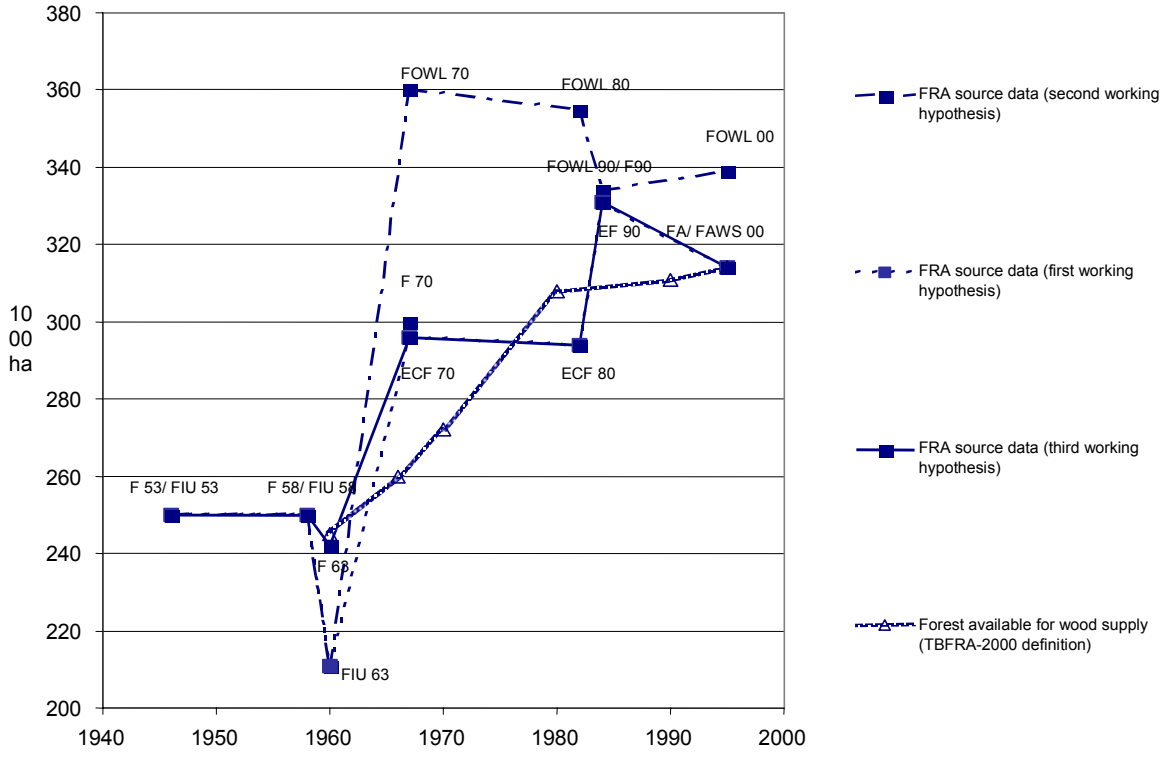
The graphs based on FRA source data for forest area, growing stock and net annual increment were compared to the graphs based on harmonized national data. The national data series shows constantly increasing values for forest area from 1960 to today. The growth is quite strong until 1980 (when the rate of growth slows). Regarding the FRA data series according to the three different working hypotheses, the following results can be seen:

The second working hypothesis, elaborated in the case of Finland (see Chapter 2.5), cannot be applied to the Netherlands. Between the term "forest in use (for industrial or commercial purposes)" of the FRA publications *World Forest Inventory 1963* and the term "forest and other wooded land" of *Forest Resources of the European Region 1970* forest area increases by about 70%. This discrepancy can only be plausibly explained by a very strong definitional change.

The FRA data series following the first working hypothesis corresponds principally to the trend of the national graph, but it does not show its constant increase (graph 35). The considerable decrease in forest area in the late 1950s can be avoided by applying the third working hypothesis, which replaces the value of the term "forest in use (for industrial or commercial purposes)" of the first working hypothesis with the value of the term "forest" (*World Forest Inventory 1963*). However, the decrease of forestland from the 1980s until today (according to FRA source data) represents a major contradiction to the national trend of increasing forest area. This reported decrease is obviously caused by a lack of harmonization of FRA definitions. The national correspondent has stated that it is very unlikely that there has been at any time during the period of 1950 to 2000, a decline in the area of forested lands in the Netherlands, as there have been large scaled afforestation activities while forest law prevents uncompensated deforestation.

Graph 35

Overview of national and FRA source data for the Netherlands (forest area)

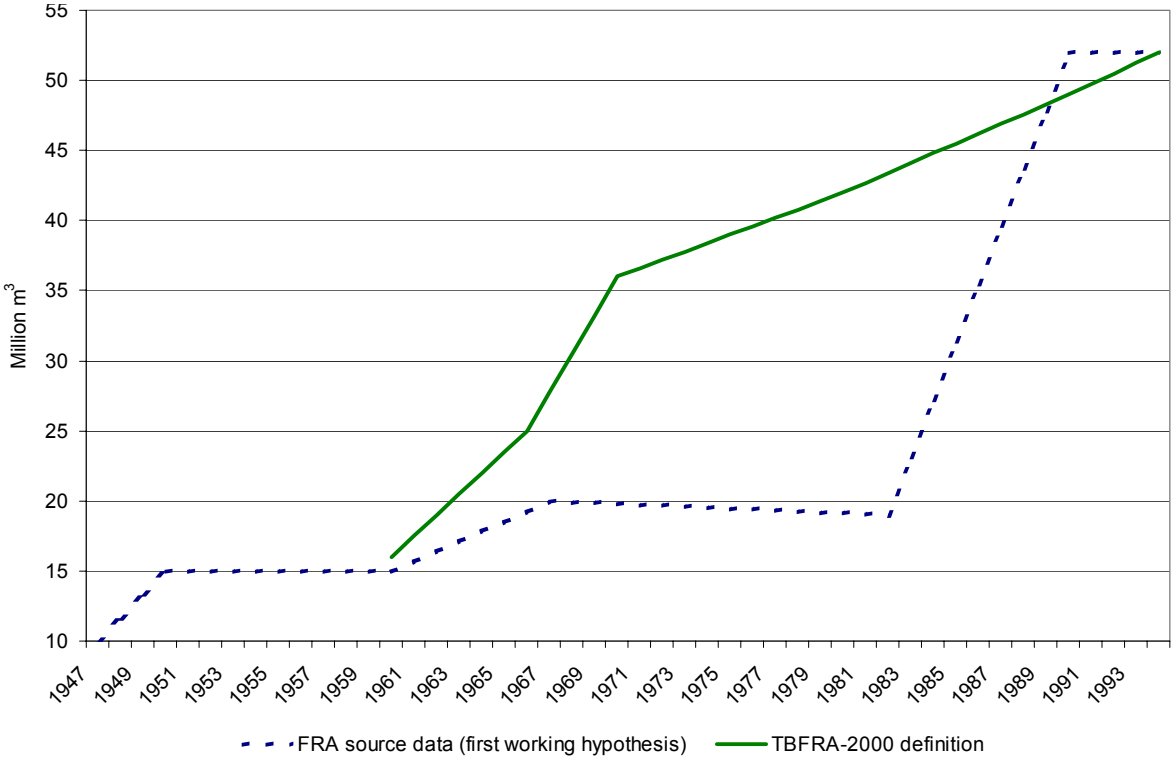


Note 1: For abbreviations of terms used in FRA publications see Annexes 2 and 3.

Note 2: In the diagram, data for the terms "operable closed forest" (OCF 70) and "forest and other wooded land" (FOWL 70) from the FRA publication FAO, 1976 are replaced by data for the terms "exploitable closed forest" (ECF 70) and "forest and other wooded land" (FOWL 70) from the ETTS publication UN-ECE/FAO, 1986. As ETTS projects add value to the FRA statistics via updating and additional validation (see Chapter 2.3), in the analysis these data are considered referring to the FRA terms OCF 70 and FOWL 70 and to the FRA publication FAO, 1976.

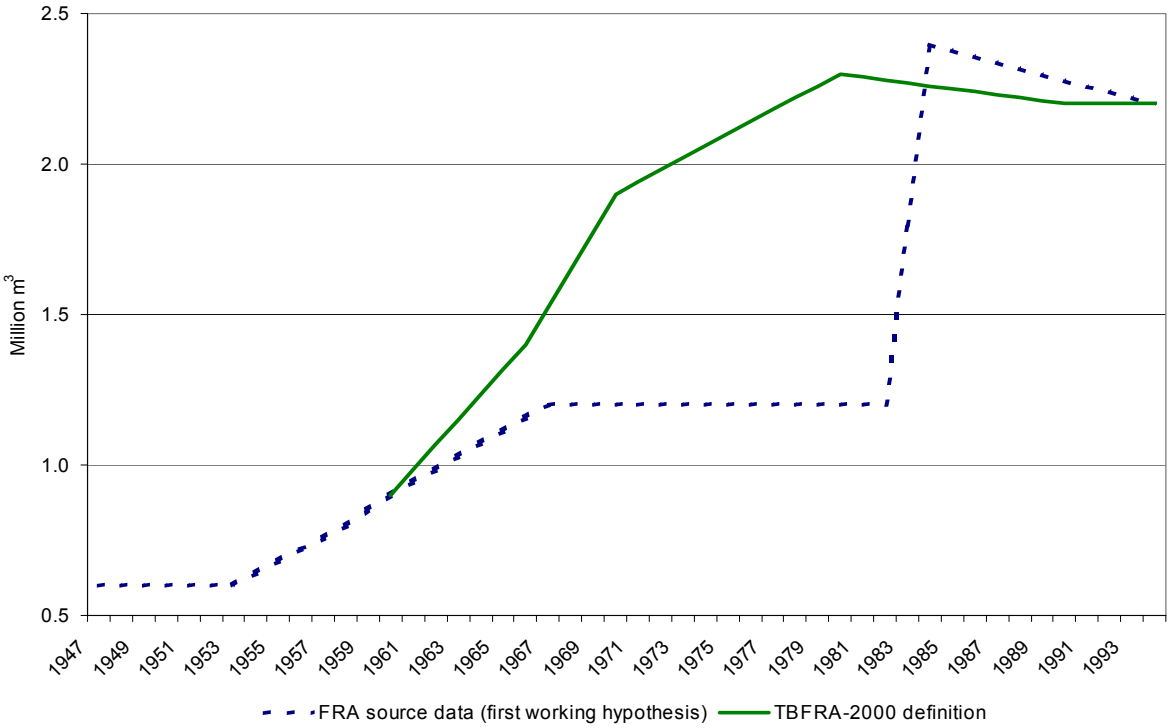
Graph 36

Development of growing stock in the Netherlands



Concerning "growing stock" and "net annual increment" FRA and national data series principally show the same major trend. "Growing stock" is constantly increasing during the covered time. "Net annual increment" increases until the 1980s and then reaches a plateau (graph 37). The national data set shows a smoother evolution of "growing stock" and "net annual increment" than the FRA source data (which shows an unbelievable increase in the early 1980s).

Graph 37
Development of net annual increment in the Netherlands



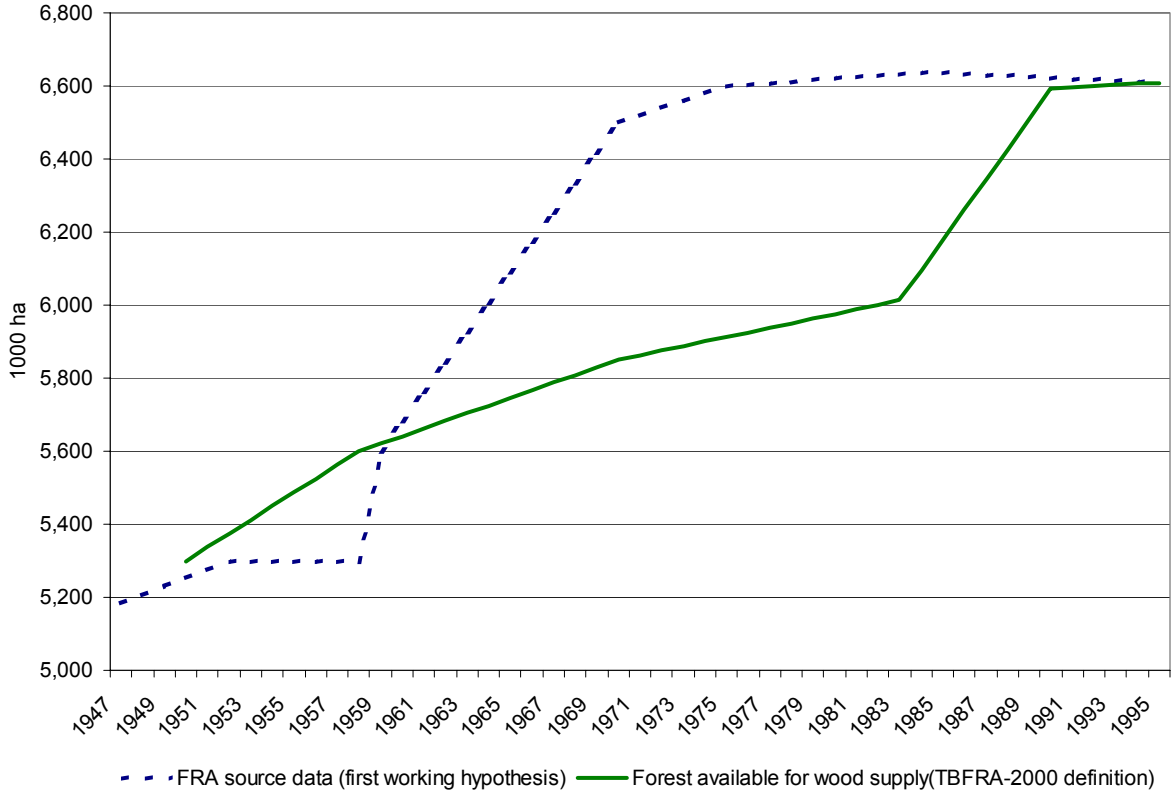
The national correspondent explains the general increase of the parameter "growing stock" (graph 36) by the fact that forested area is constantly increasing and growing stock of already existing forests is increasing as well, because in the whole period from 1950 to 2000 the level of growth has exceeded the level of cut.

Reasons for the growth of "net annual increment" are, of course, the increase in forest area, but also the development of forests and the fertilizing effects of (in particular) nitrogen from agricultural emissions. It has been pointed out by the Dutch expert that the sudden increases of "growing stock" and "net annual increment" in the 1980s (according to FRA source data) does not reflect the real development and were caused by a change in measurement and data processing methods.

3.10 Norway

The reply provided by Norway contains data for "forest available for wood supply", "growing stock" and "net annual increment", which have been harmonized (to the extent possible) to the definitions as used in TBFRA-2000. A challenge, which might slightly taint the reported growth from the actual growth, can be found in the fact that the concept "available for wood supply" has changed over time and cannot be derived exactly from the inventory data. So a number of assumptions and approximations have to be made to provide this information. The data covers the period from 1950 to today. For the case when no exact year of inventory was reported, the given periods of reference have been transformed into certain years of reference, not according to the method described in Chapter 2.3, but simply by calculating the mean year of a given period. This method was used because, as the national correspondent points out, the given inventory periods do not include the data analysis, but only the fieldwork itself.

Graph 38
Development of forest area in Norway



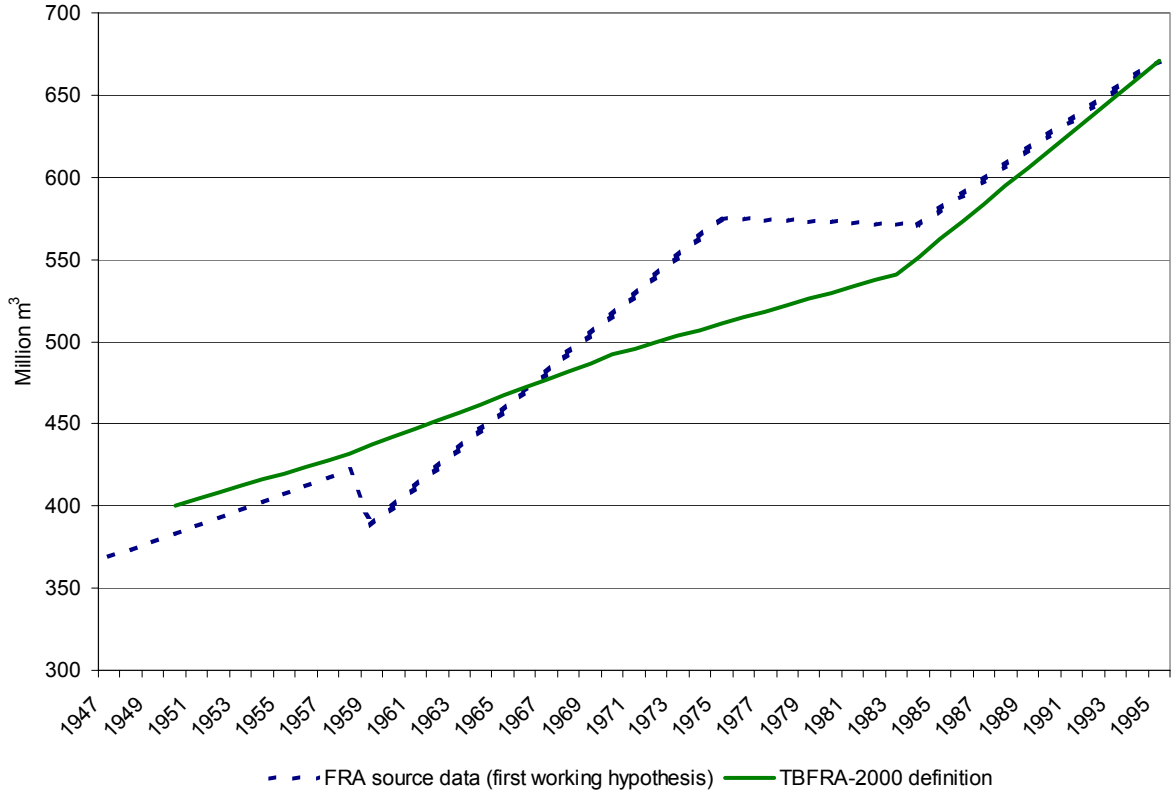
Comparing the development of the area of "forest available for wood supply" according to FRA source data and national data, it can be seen that the strong increase of this parameter in the 1960s reported by FRA source data does not reflect the true evolution (graph 38). Harmonized national data show a sustained increase of "forest available for wood supply" over the whole period covered, which can be subdivided in four phases and with different trends.

In the 1950s the graph shows considerable growth, which weakens from the 1960s to the early 1980s. In the late 1980s the growth rate intensifies dramatically for a short period, followed by a levelling out in recent years. Some of the reported increase in the 1980s may be due to challenges in the implementation of the inventories. Norway has quite a lot of low-productive forests that represent borderline cases between forest and other wooded land. In some of the inventories, there may have been more focus on surveying the more valuable forests, while some of the low-productive forest areas may have been left out. The forests have generally been surveyed up to the "coniferous forest limit", and the judgement of this limit has been up to the fieldworkers and their supervisors. According to the national correspondent, there is no guarantee that this judgement has not changed over time.

Concerning "growing stock", both data sets report the same major trend, a considerable increase during the period (neglecting some minor discontinuities obviously due to definitional changes in FRA source data) (graph 39). Nationally harmonized data show a linear growth from 1950 to the early 1980s, which intensifies afterwards without losing its constant character. Thus, the value of this parameter develops from 400 million m^3 in 1950 to around 670 million m^3 in 1995. Aside from some irregularities in FRA source data, both data sets correspond well for the parameter "net annual increment" (graph 40). Regarding the long-term consistent national data, the values of this parameter grow exponentially until 1990 (when the rate of growth slows again). Particularly striking is the strong increase of the late 1980s, which can also be seen in the development of "forest available for wood supply" and "growing stock".

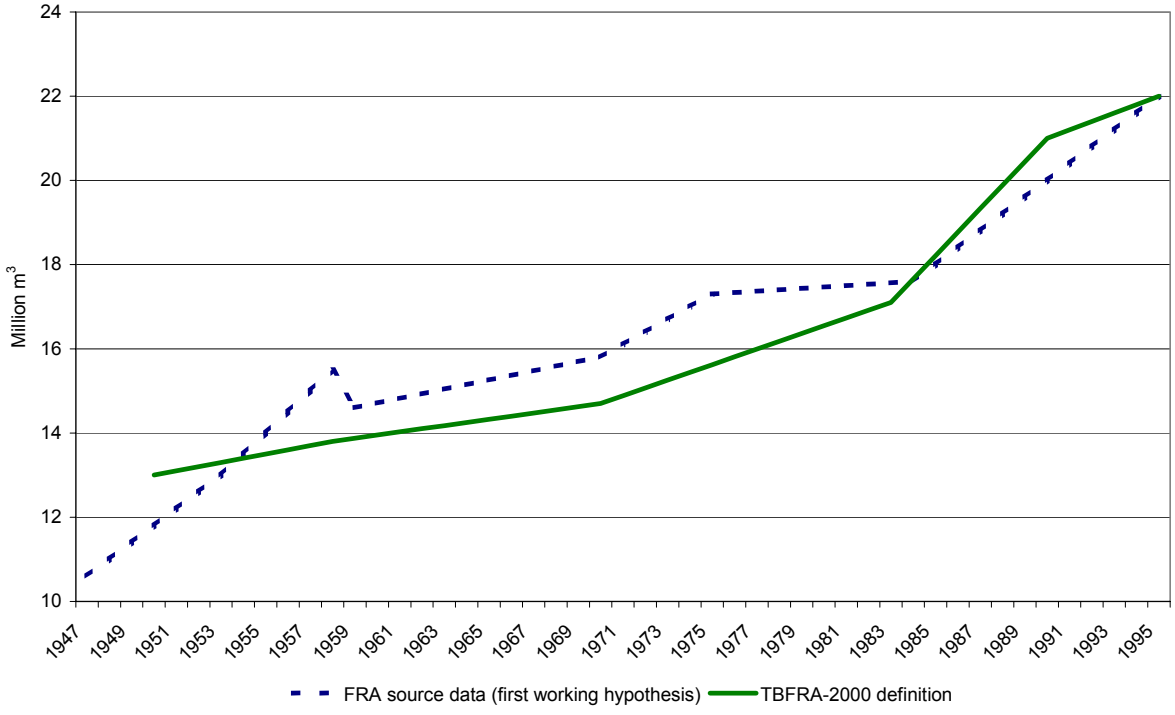
Graph 39

Development of growing stock in Norway



Graph 40

Development of net annual increment in Norway



3.11 Poland

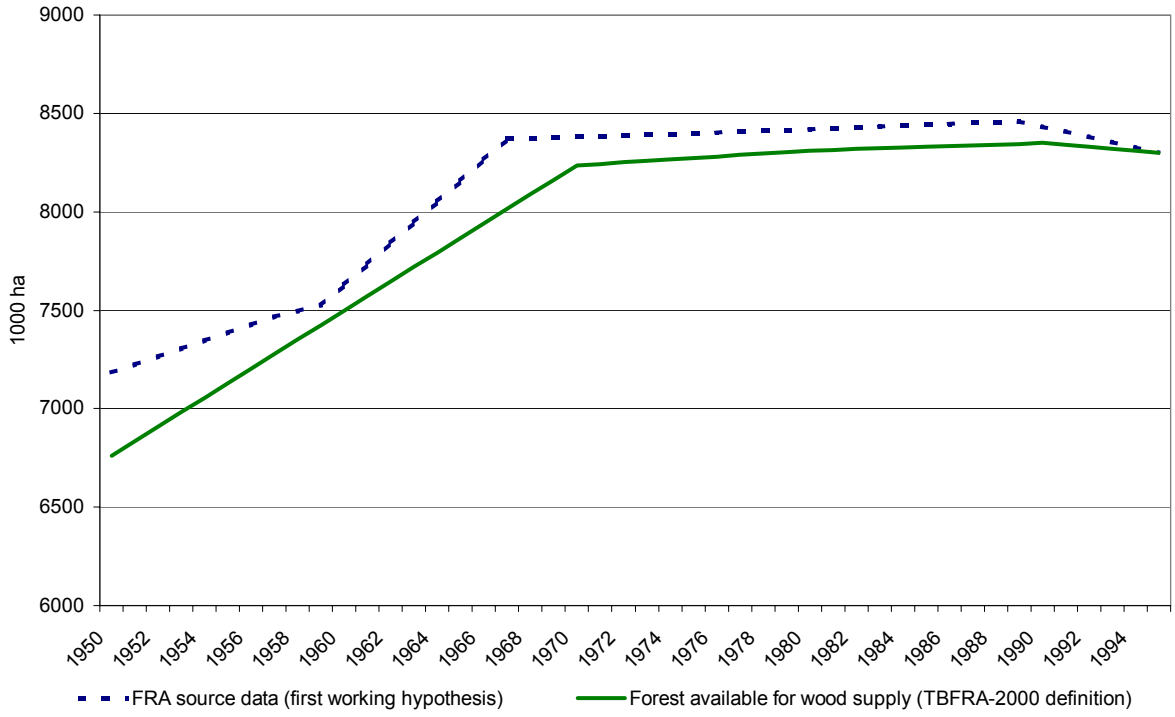
The first reply to the enquiry was received from the correspondent of Poland, who provided a large set of historical Polish national data, which was principally adjusted to the TBFRA-2000 definitional format. He explained that all possible adjustments were done and comments could be found wherever a plausible adjustment was not possible, admitting that reasonable explanations of differences between data (especially for the 1950s) are today, fifty years later, very difficult or even impossible.

The Excel-file provided by the national correspondent included data sheets with a lot of parameters concerning "forest area by species group", "forest area by major use", "land use changes", "internal disturbances", "growing stock & woody biomass", "growing stock by tree genera", "depletion and growth", and "ownership". Out of this multitude of historical data, three main parameters were picked: "forest available for wood supply", "growing stock on forest available for wood supply" and "net annual increment on forest". "Net annual increment" was not available in the original data set, and was therefore calculated as "gross increment" minus "natural losses".

These simple rows of harmonized national historical data going from 1950 up to the reference period in TBFRA-2000 (1992 to 1996) were graphically compared with the compiled FRA data for Poland for "forest available for wood supply", "growing stock on forest available for wood supply" and "net annual increment on forest available for wood supply" (as defined in TBFRA-2000 and “equivalent” terms of other FRA publications according to the first working hypothesis). The figures were interpolated, in order to get a value for each year, which is necessary for a reliable comparison. As a consequence of the fact that the harmonized Polish national data is based on the definitions of TBFRA-2000, the final value for the year 1995 is the same for national and FRA data. In comparison, the two data series for forest area are similar, the national data moves in parallel but slightly below the FRA data, which indicates that the terms “equivalent” with "forest available for wood supply" (TBFRA-2000) are based rather consistently on slightly less restrictive definitions (graph 41).

Graph 41

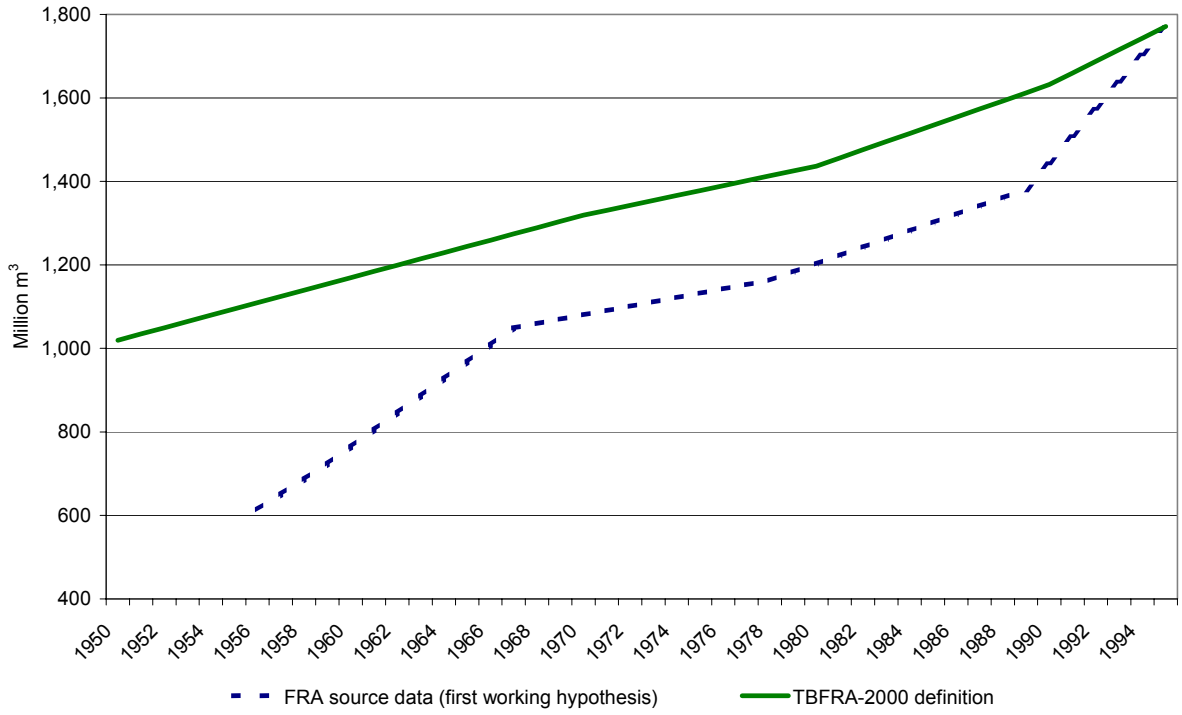
Development of forest area in Poland (I)



The data series for "growing stock" show significant differences (graph 42). Contrary to forest area, the national graph shows considerably higher figures than the FRA graph. The trend of development for the data of both sources is, however, the same. Both data series indicate a consistent growth from the 1950s to today.

Graph 42

Development of growing stock in Poland (I)

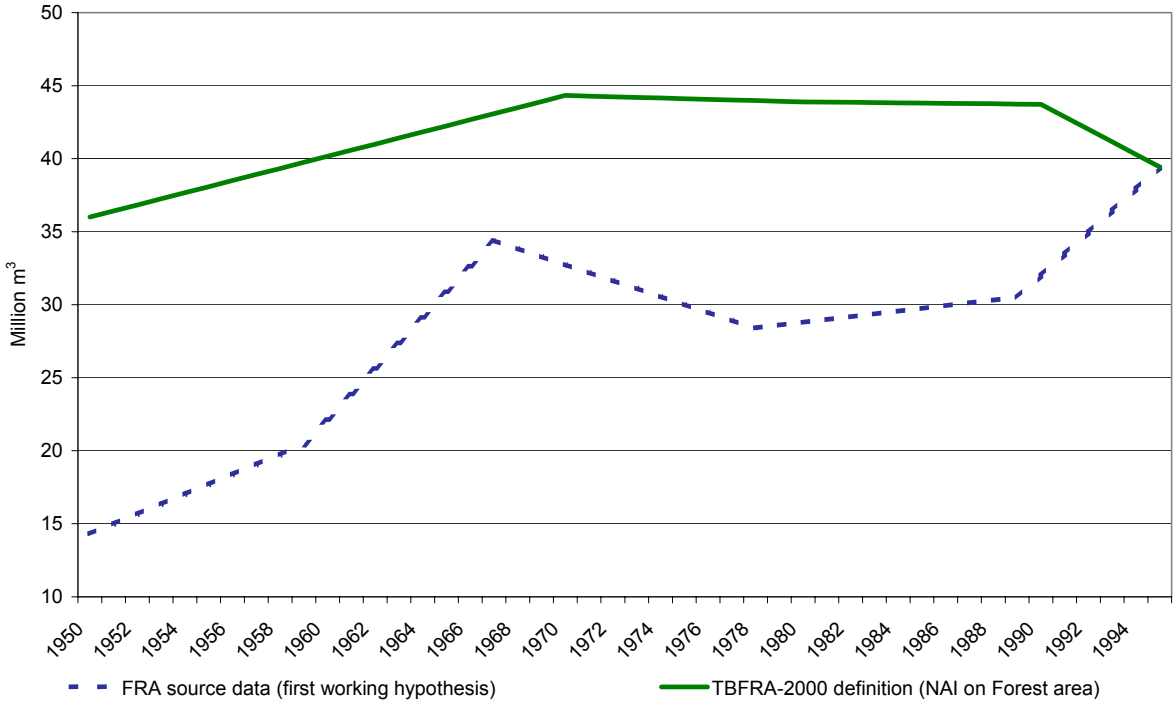


Concerning "net annual increment", there are large differences in both quantity and trend (graph 43). For example, for the year 1950, national data give a value of 36 million m³, versus 14.3 million m³ in *World Forest Resources 1958*. These differences in quantity may partly be caused by the fact that Polish national data for "net annual increment" are referring to the whole forest area; FRA data, however, are referring to the term "forest available for wood supply" of TBFRA-2000 and its "equivalents" of earlier publications (first working hypothesis). Apparently, there was no way to split nationally provided data for increment into "available for wood supply" and "not available for wood supply". Apart from this, these data series reveal a lot of other discrepancies. The FRA figure for the year 1968 is obviously too high, probably due to definitional reasons, because it does not fit in the trend of a constant growth of "net annual increment" throughout the last 50 years. According to FRA data for 1990 to today, "net annual increment" was increasing strongly, whereas it decreased according to national data. This complete contrast should be reviewed and clarified considering that this means two contrasting starting-points for a possible follow-up study about the outlook on the future development of the forest resources and forestry sector.

The country correspondent of Poland was asked to give reasons for the facts mentioned above. Concerning the historical development of forest area, the national correspondent reports that after World War II, a relatively big share of forest area was devastated in Poland. These forests of low density or poor quality are in some historical reports classified as unproductive and consequently not included in the term "forest", whereas in other sources they may have been included. On the other hand, during this period there was a very high rate of afforestation on about 50 thousand hectares per year. Considering this rapid development of forest area, it is clear that a small change of the reference period may have a significant influence on the data. Concerning the quality of data, the national correspondent emphasized the general difficulties confronted by a forest inventory conducted in the late 1940s and early 1950s. Poland had been significantly destroyed during World War II, state borders were changed in comparison to 1939 and there was a lack of human resources, i.e. professional foresters, for carrying out the inventories.

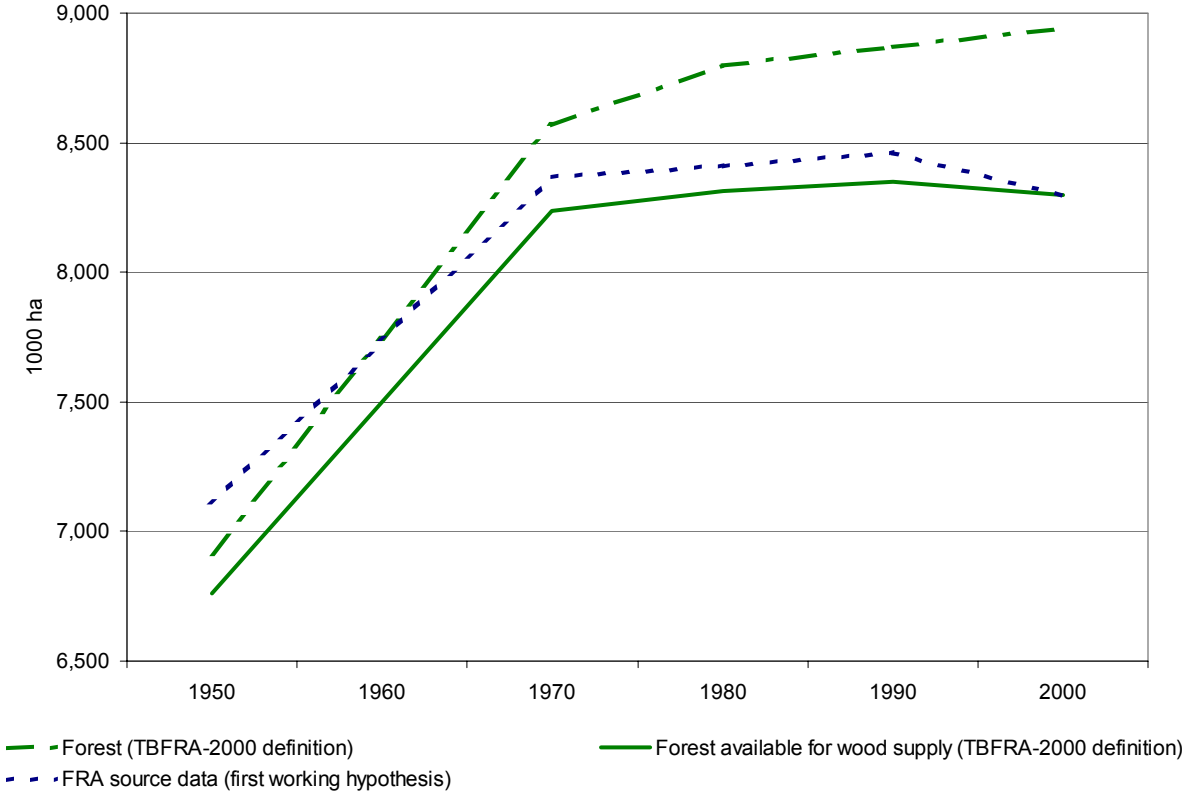
Graph 43

Development of increment in Poland (I)



Graph 44

Development of forest area in Poland (II)

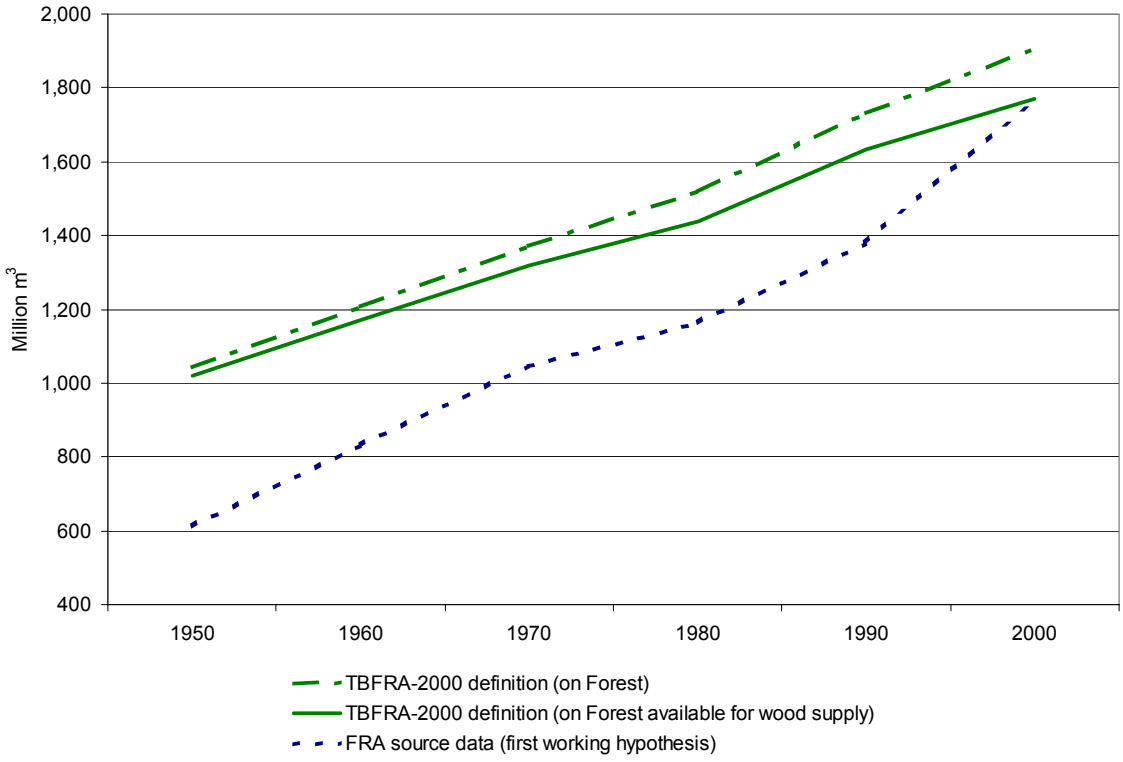


Graph 44 shows a comparison of national data of area adjusted to the same terms and definitions as used in TBFRA-2000 (referring to the terms "forest" and "forest available for wood supply") with FRA source data (referring to the term "forest available for wood supply" of TBFRA-2000 and its “equivalents” of earlier publications (first working hypothesis). The diagram has been simplified in comparison to graph 41, as it better serves the purpose of assessing the main developing trends. Data are assigned to rough periods from 1950 continuing in 10-years intervals to the year 2000, neglecting the exact year of reference (see chapter 2.4). As in the national data set, the value for 1960 had to be calculated by interpolation, because there are no data available for that period, the same method has also been applied to FRA source data. For adjusting historical data to the terms and definitions of TBFRA-2000, auxiliary grounds (streams, forest roads, nurseries, etc.) have been included in "forest", whereas these areas were originally excluded in historical reports. "Forest not available for wood supply" has been assessed according to similar rules as used in TBFRA-2000. As a result, the area of "forest available for wood supply" according to adjusted data is consistently smaller than according to data taken from the various historical FRA publications. This difference is caused by more areas falling into the classification "forest not available for wood supply" in the harmonized data (which is not compensated for by the inclusion of auxiliary land areas).

The national correspondent recommended using the data series referring to the term "forest" for the follow-up policy analysis, as it better illustrates the growth trends concerning forest area in the last five decades. This parameter shows a strong increase until the 1970s, where the trend levels out into a very slow rate of increase.

Graph 45

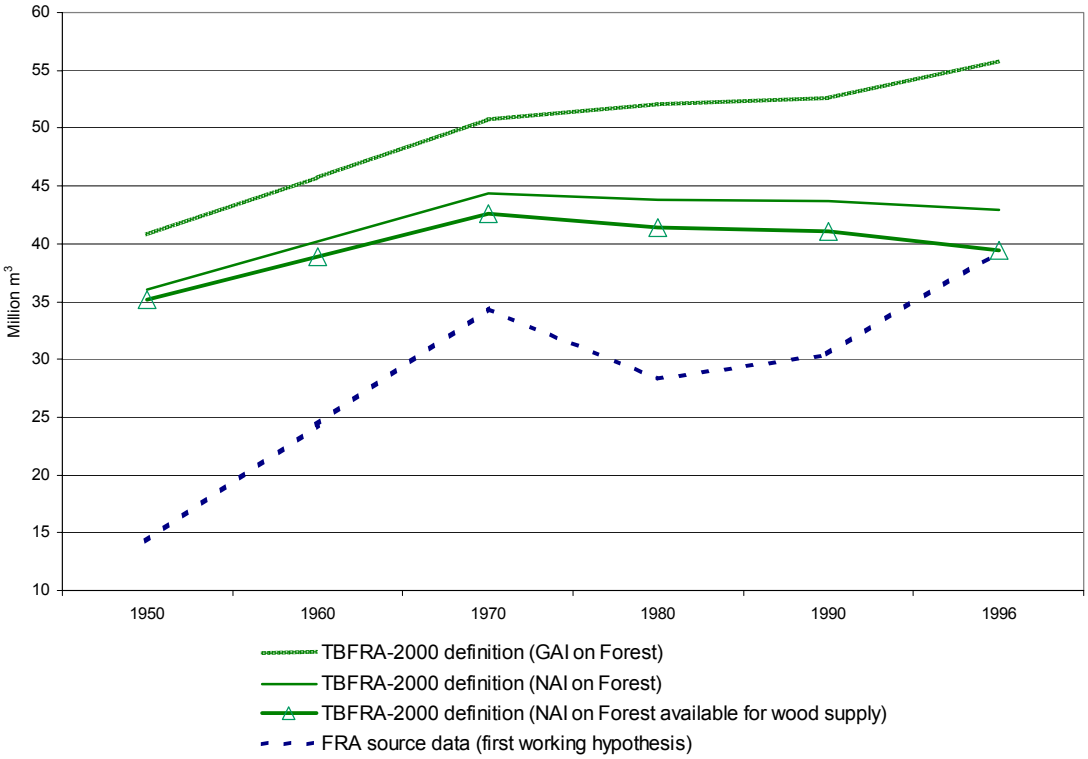
Development of growing stock in Poland (II)



Concerning the parameter "growing stock", historical data was adjusted to terms and definitions used in TBFRA-2000 by adding the volume of trees and branches with a diameter of less than seven centimetres, to the volume of "merchantable" volume ("merchantable" having a diameter of more than 7 cm). The national correspondent considers this as the main reason for the differences between harmonized national data and FRA source data (graph 45).

Considering the graphs based on adjusted national data (referring to "growing stock on forest" and to "growing stock on forest available for wood supply"), a constant linear growth over the last 50 years can be discerned. This clear trend shall be used as the basis for the policy analysis.

Graph 46
Development of increment in Poland (II)



In the case of increment, the national correspondent has adjusted historical data of the last 50 years to the definitions "net annual increment" referring to "forest available for wood supply" used in TBFRA-2000. This was done in order to make the values comparable to the FRA source data series that was only available for "net annual increment" referring to the term "forest available for wood supply" of TBFRA-2000 and its "equivalents" of earlier publications (first working hypothesis). However, exact reasons for the significant differences between FRA source data and harmonized data for this parameter cannot be determined.

Considering the data series based on harmonized national data "net annual increment on forest", "net annual increment on forest available for wood supply" and "gross annual increment on forest" all show similar growth trends for 1950 to 1970 (graph 46). After that, "gross annual increment" shows a slowing increase, "net annual increment on forest" and "net annual increment on forest available for wood supply" shows a slight decrease. This could be explained by the stagnating area of "forest available for wood supply" together with the substantial increase of the volume of "natural losses".

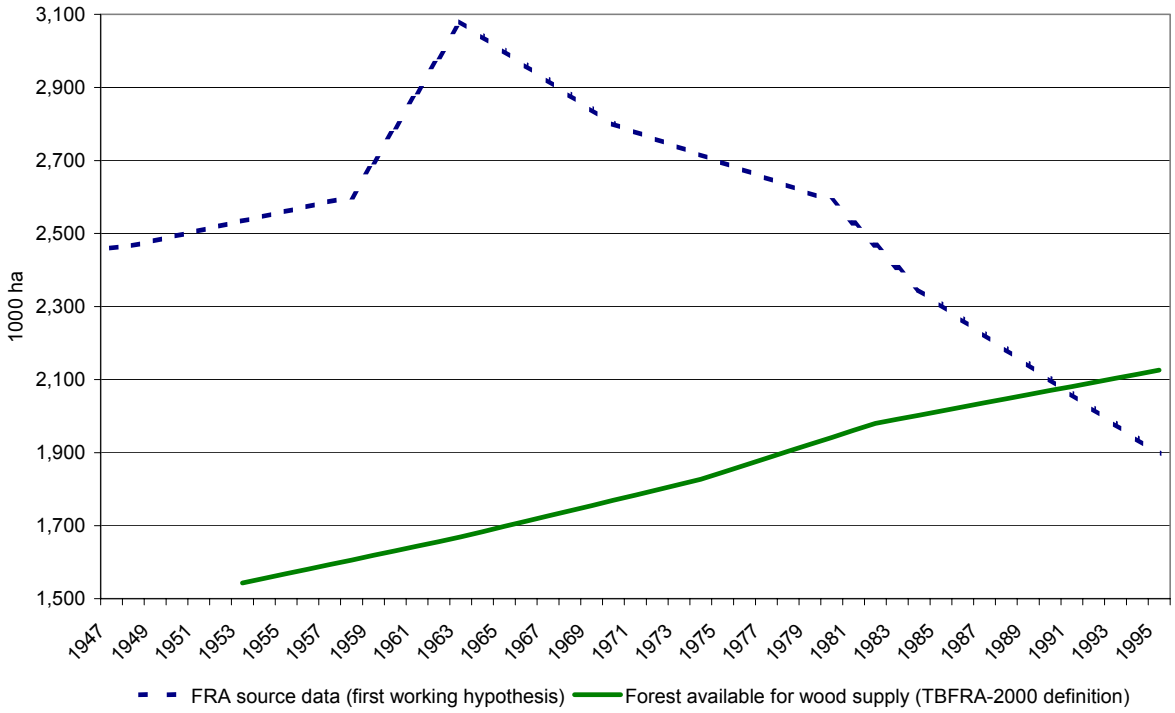
3.12 Portugal

The national correspondent of Portugal provided a harmonized national data set for several parameters covering the period from 1953 to the 1990s. For a comparison with FRA source data ("forest available for wood supply", "growing stock" and "net annual increment" of TBFRA-2000 and their "equivalents" of earlier FRA publications according to the first working hypothesis) data for the following parameters were chosen: "forest available for wood supply" (split into "coniferous", "non-coniferous" and "mixed"); "growing stock on forest available for wood supply (split into "coniferous" and "non-coniferous"); and "net annual increment on forest available for wood supply" (split into "coniferous" and "non-coniferous"). These data are of special interest. The national correspondent reported that the work of harmonization had to rely completely on published information, as it was not possible to use the original data. Because of missing data, and data based on different concepts and definitions, data from old information sources had to be modified in order to get a harmonized time series. This work was done by using interpolation and extrapolation methods and by applying supplementary data, which came from special "one time" inventories and growth models. Data for the 1950s were based on forest statistics. In the 1960s the first National Forest Inventory took place, which

has been revised so far three times during the 1970s, 1980s and 1990s. All data only apply to Continental Portugal. The oversee territories like the Azores and Madeira are not included in the figures. Although there were some forest resources data available for those islands, a partial inclusion of these territories would have made the final data set inconsistent.

Graph 47

Development of forest area in Portugal

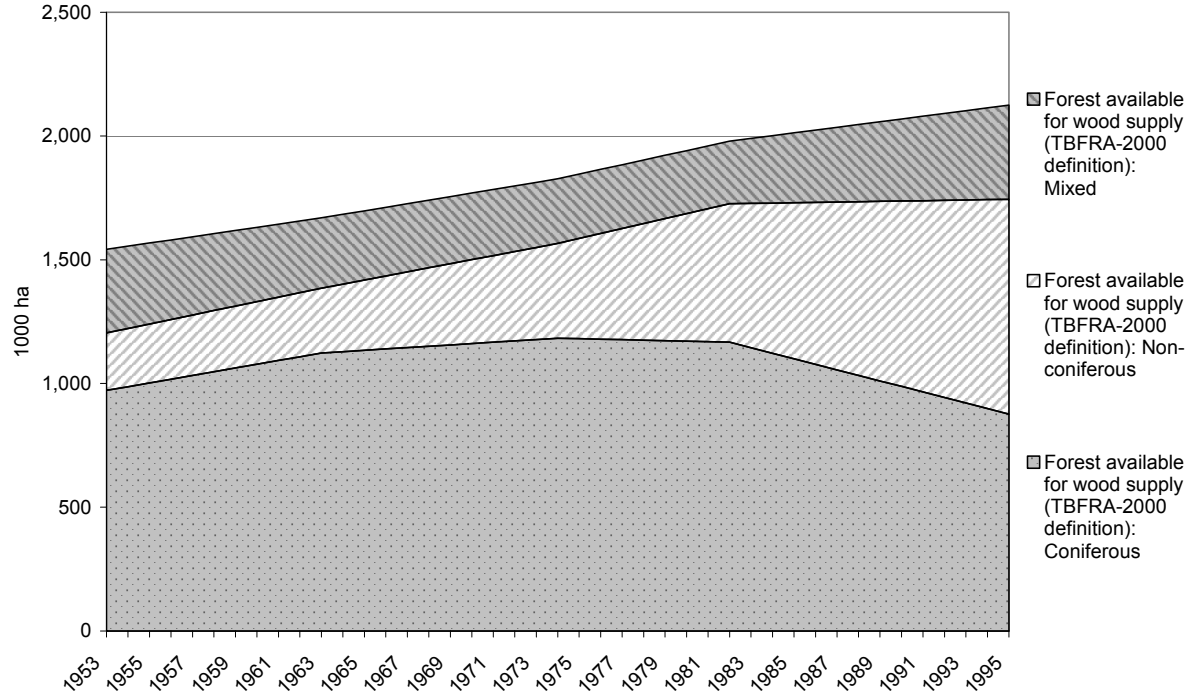


A comparison of FRA source data with national provided data concerning the parameter "forest available for wood supply" shows fundamental discrepancies and proves a very strong overestimation of this parameter in early FRA publications (graph 47). According to FRA source data there was an increase of "forest area" until the 1960s followed by a strong decrease until today. This is in considerable contrast to the linearly growing trend that the harmonized national data depicts. The reported values for this parameter change considerably from one FRA publication to another, which suggest that minor changes in definitions may have had major effects on the inventory results because of the particular properties of Portuguese forest areas.

Regarding the changes of the tree species grouping in "forest available for wood supply" in the last decades, it can be seen from graph 48 that non-coniferous species are (especially since the 1980s) increasing in area, while since the early 1980s, coniferous species are decreasing in area. In the 1950s the ratio of coniferous to non-coniferous species used to be roughly 5:1, whereas this ratio has changed to approximately a 1:1 ratio at present. The preferred tree species in recent afforestation activities are obviously broadleaved species, principally eucalyptus, which seem to continuously replace mature coniferous stands

Graph 48

Forest available for wood supply of Portugal by species groups



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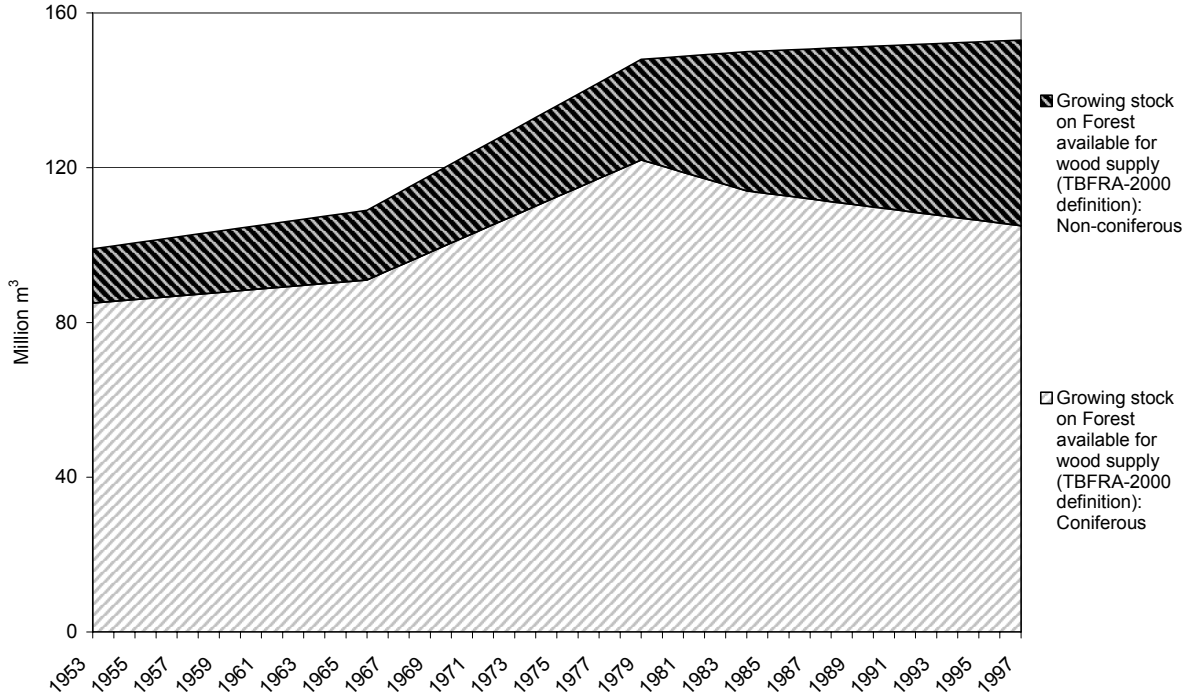
Graph 49

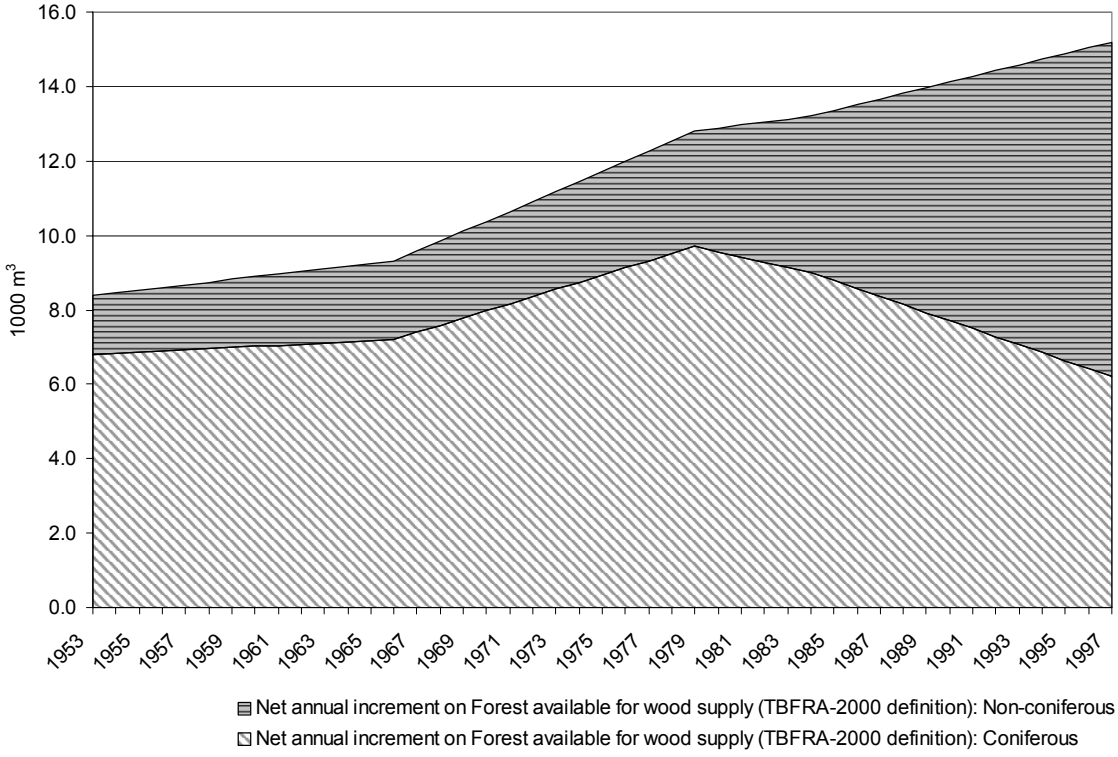
Growing stock on forest available for wood supply in Portugal by species groups



The assumption that non-coniferous plantations have been for the last 20 years replacing old coniferous stands can be substantiated by considering how the shares of these two species groups have developed since the 1950s for "growing stock on forest available for wood supply" (graph 49) and "net annual increment on forest available for wood supply". Currently, coniferous stands still represent two thirds of the total "growing stock" in Portugal, whereas non-coniferous stands currently produce almost two thirds of the "net annual increment" (graph 50). Many of the coniferous forests are over-mature and only able to produce a small increment. Many of the broadleaved forest are still rather young (many some 10-15 years from reaching maturity) and capable of producing a considerable increment. This becomes even more obvious when the ratio of "net annual increment" to "growing stock" of these two species groups is compared for the year 1997. One m^3 of growing stock produces approximately 0.06 m^3 of net annual increment on coniferous forests versus around 0.19 m^3 of net annual increment on non-coniferous forests (a more than three fold higher value). The reasons for the change from coniferous species to non-coniferous species in Portuguese forestry would be an interesting issue to be examined in the follow-up policy analysis.

Graph 50

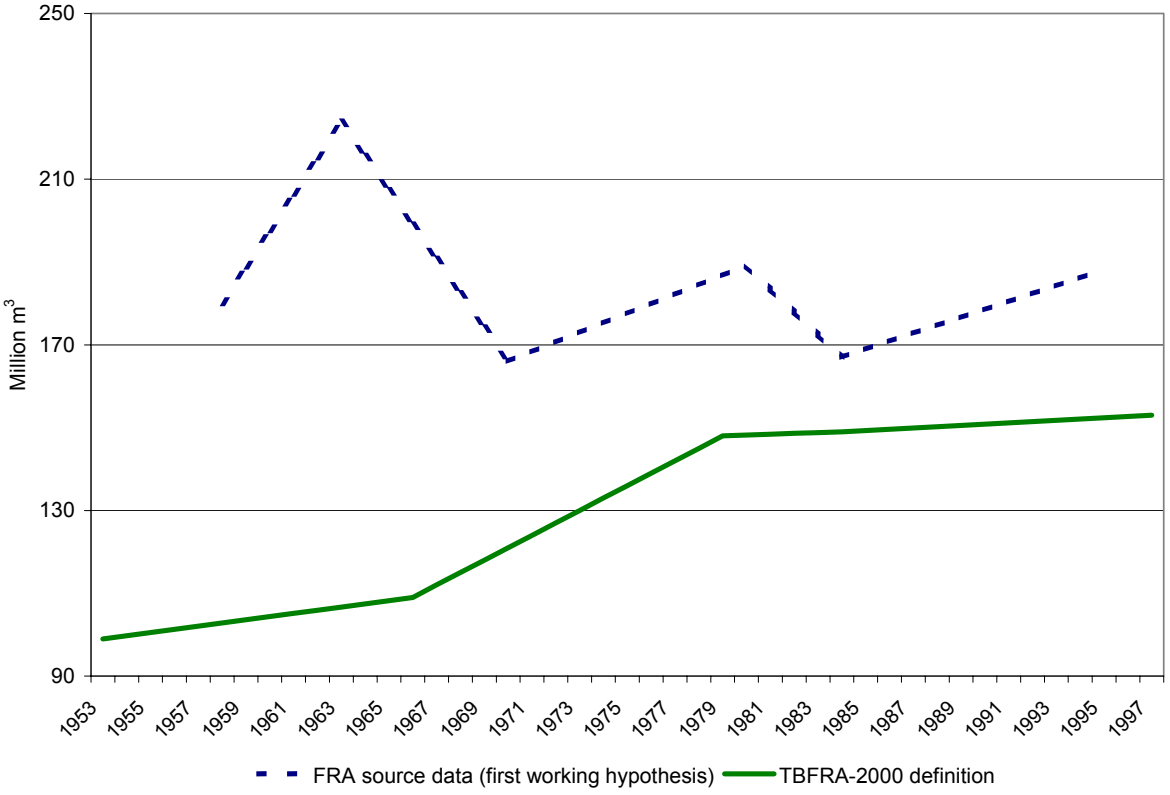
Net annual increment on forest available for wood supply in Portugal by species groups



Similar to the case of “forest available for wood supply”, "growing stock" (in national data) shows consistently lower values than FRA source data (graph 51). The inconsistent data values provided by the different FRA publications make it impossible to assess any plausible trends. The harmonized national data series shows a slight increase of the volume of "growing stock" over the whole period, interrupted by a period of accelerated growth in the late 1960s and 1970s. This development of "growing stock" according to national data is reflected in the evolution of "net annual increment" which shows a consistent growth intensifying between 1966 and 1979 (graph 52). The FRA source data series describes (excepting around 1963) a similar trend but with lower values.

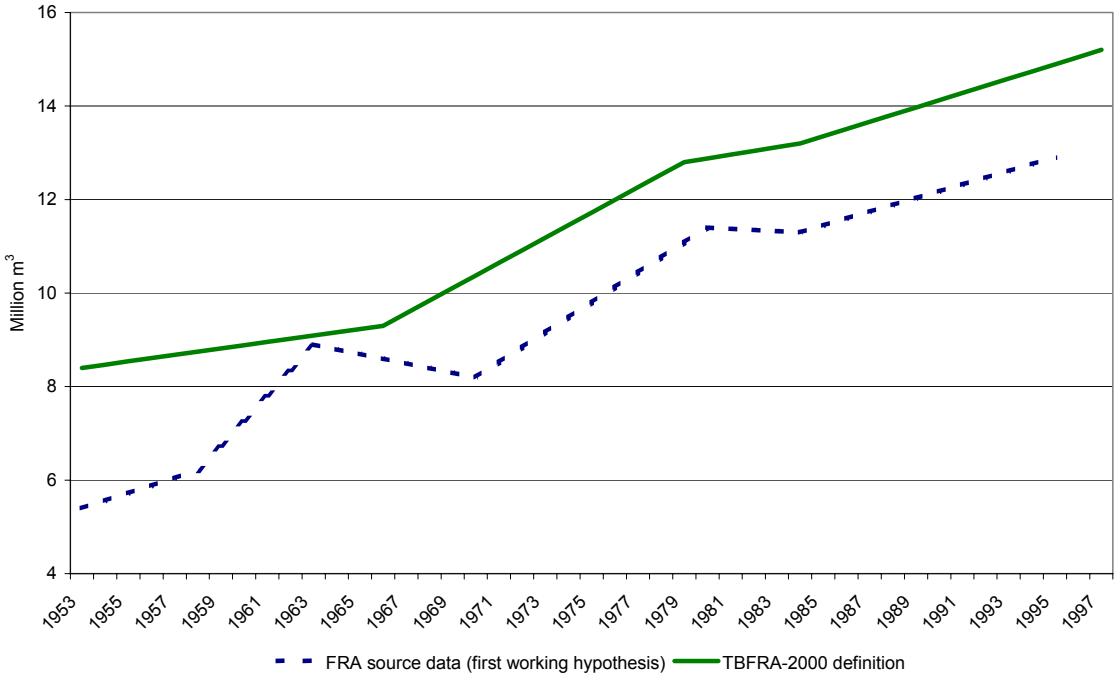
Graph 51

Development of growing stock in Portugal



Graph 52

Development of net annual increment in Portugal



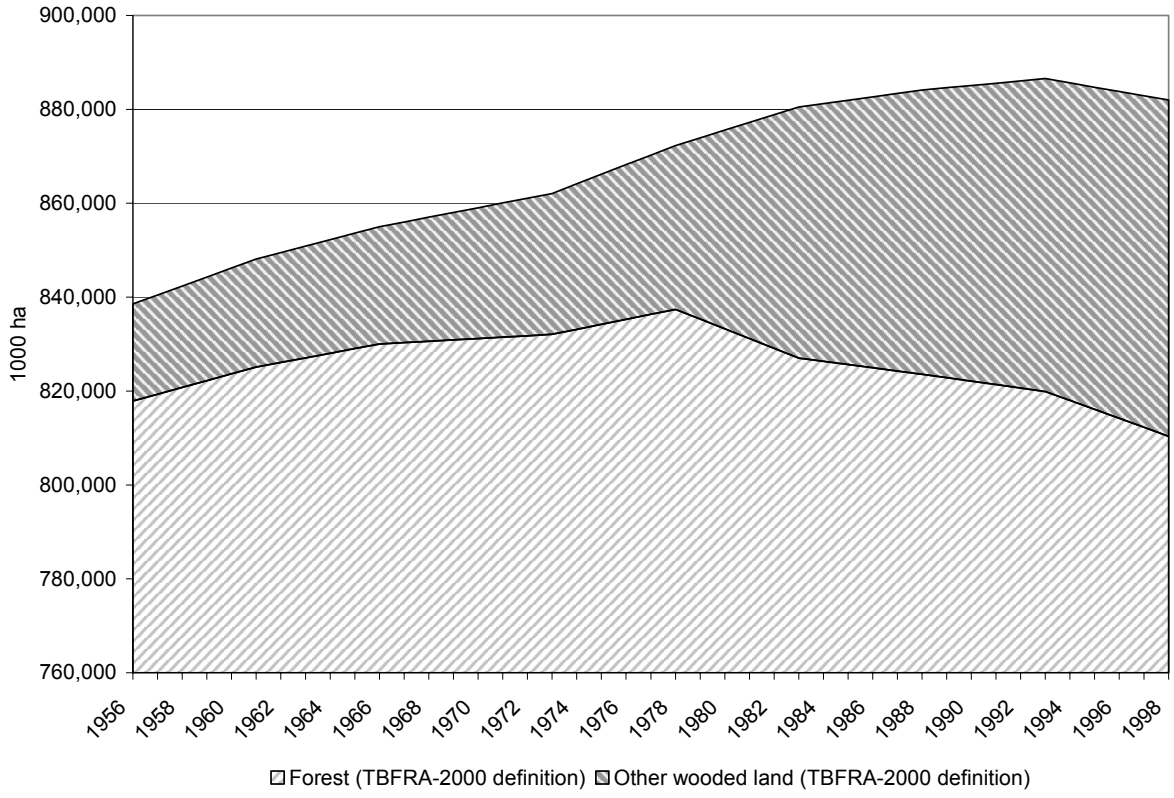
3.13 Russian Federation

The Russian correspondent has provided a set of national data for "forest", "other wooded land", "forest and other wooded land", "growing stock" and "net annual increment" covering the period from 1956 to 1998. The data are harmonized to the extent possible with the definitions as used in TBFRA-2000. It must be considered that not all the forest area had been surveyed before 1956 and that the procedure varied within the period.

Ex-post harmonization of data covering the last five decades is difficult, and the challenge of producing consistent data for the latest FRA publication (TBFRA-2000) should not be underestimated. The UNECE/FAO classification system is substantially different from the Russian national system of categorisation of forestland. The harmonization and recalculation of the figures coming from the Russian State survey has been a very time- and resources-consuming activity. The accuracy of the final outcome could not be verified as Russian forest inventories do not use statistical methods and no permanent sample plots exist (for more information see UNECE*/TIM/SP/18*). All these challenges should be considered regarding the development of forest resources in Russia according to the provided data.

Graph 53

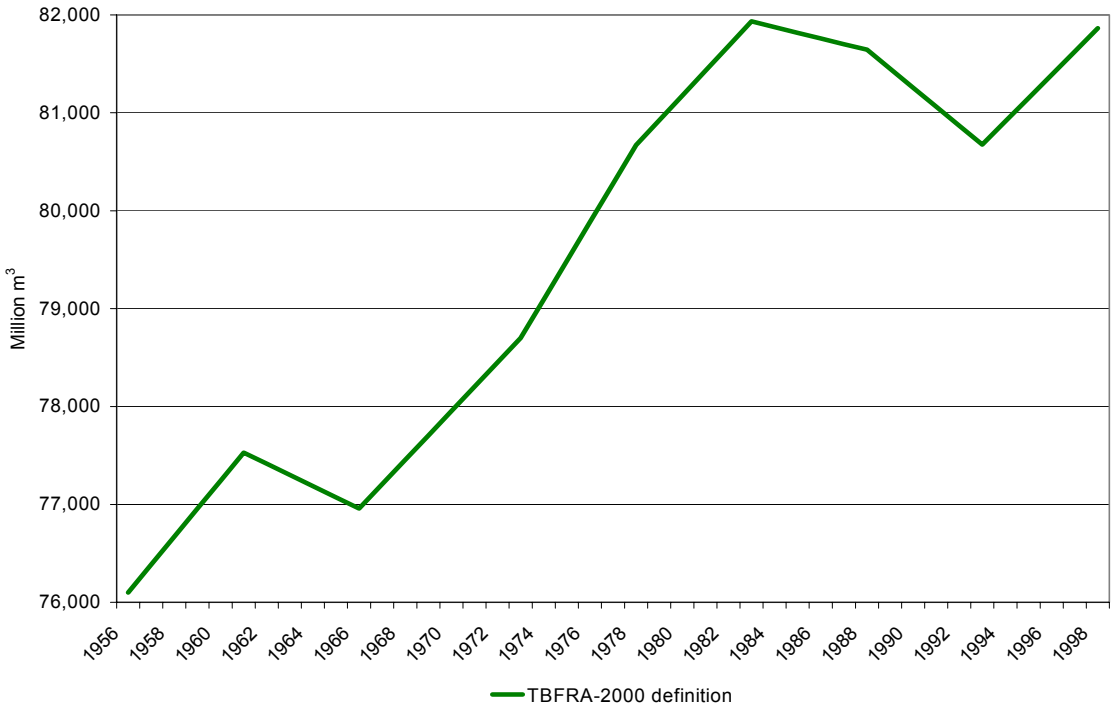
Development of forest area in the Russian Federation



The area of "forest and other wooded land" increased by almost 50 million hectares from the late 1950s to 1993, after which it decreased (graph 53). While the area of "forest" has been decreasing since the late 1970s, the area of "other wooded land" has been increasing during the whole period of 1956 to 1998. The recent decrease of "forest and other wooded land" is caused by a decrease of "forest" area between 1993 and 1998, which outweighs the increase of "other wooded land". The national correspondent reports that the general increase of "forest and other wooded land" until the early 1990s, may be partly explained by agricultural land becoming woodlands. The recent decrease of the value of this parameter has been caused by the transfer of unproductive woodland into gardens, pastures and hunting land for indigenous peoples.

Graph 54

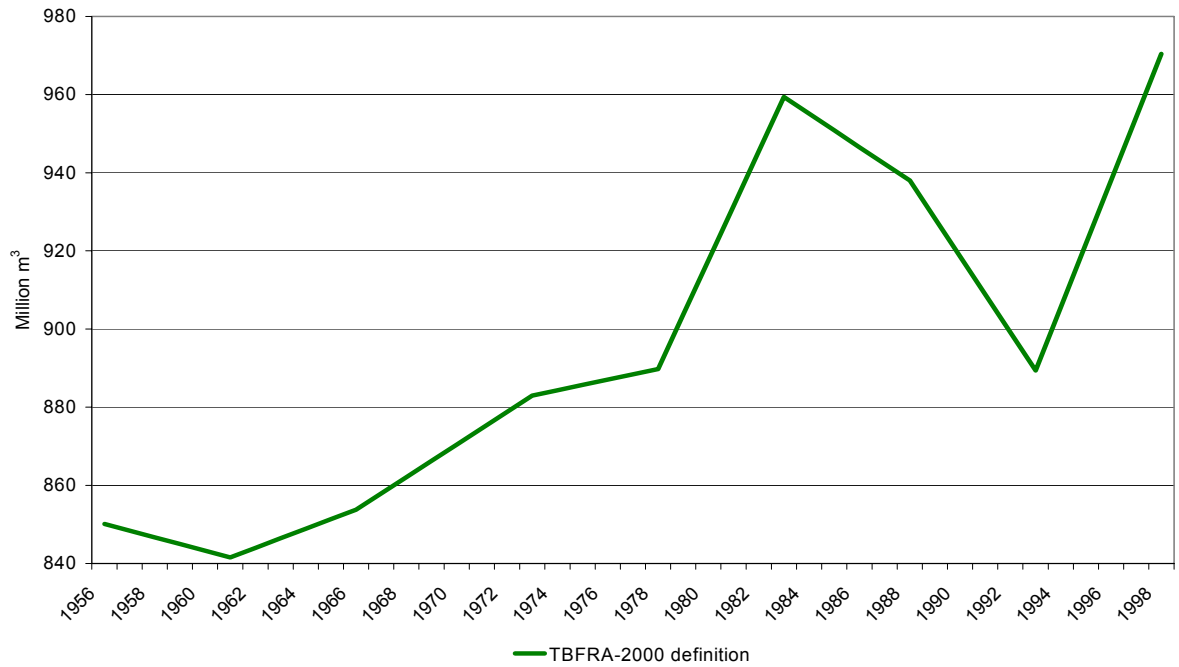
Development of growing stock in the Russian Federation



"Growing stock" and "net annual increment" show similar trends for the late 1960s up to today (a considerable increase from 1966 to 1983 and a remarkable drop down in the year 1993) (graphs 54 and 55). The correspondent of the Russian Federation commented that a part of the strong decrease of both parameters in 1993 is likely due to a calculation error. Concerning "net annual increment", it should be assumed that its volume is understated. Informal calculations put the value of this annual increment for the year 1993 at approximately 940 million m^3 instead of the reported 890 m^3. The reported decrease of the volume of "growing stock" between 1961 and 1966 and the decrease of "net annual increment" between 1956 and 1961 are further striking discontinuities in the development of these two parameters.

Graph 55

Development of net annual increment in the Russian Federation

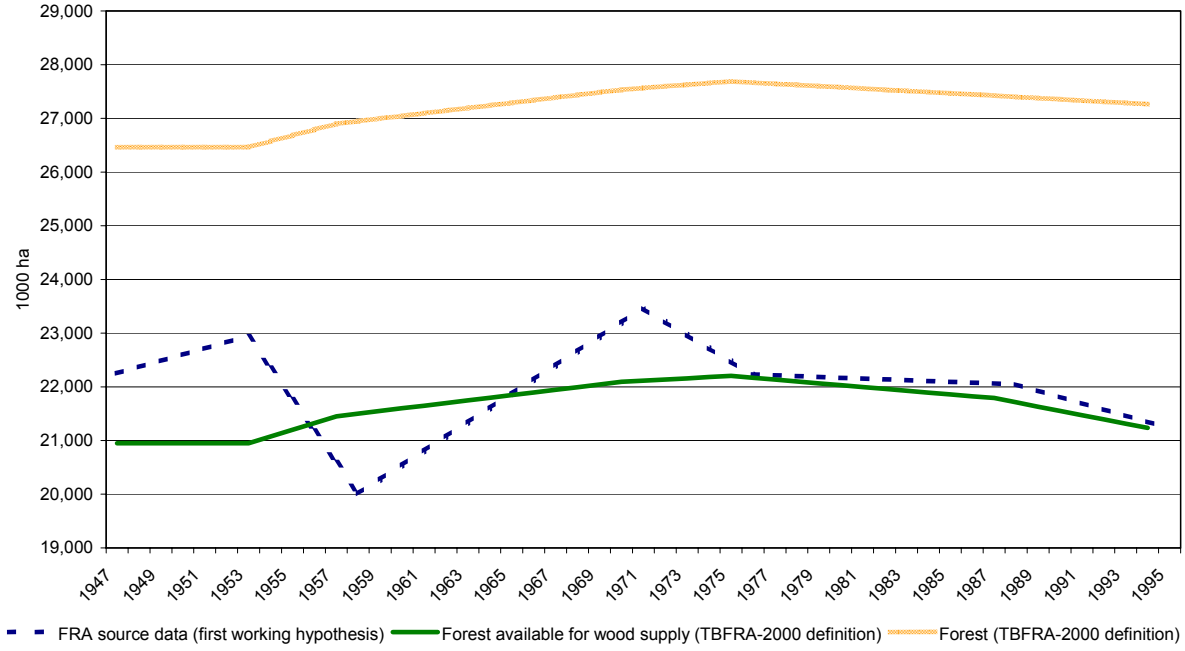


3.14 Sweden

The national correspondent provided a comprehensive set of data harmonized with the definitions used in TBFRA-2000. For a comparison with FRA source data, the historical series for the parameters "forest", "forest available for wood supply", "growing stock" and "net annual increment" are of special interest. According to FRA source data and nationally provided data, the trend and figures for "forest available for wood supply" are comparable from 1976 on. The discontinuities in FRA source data before this date are caused by definitional deviations. The results reported by national data both for "forest" and for "forest available for wood supply" show a slight increase until the 1970s followed by a slight decrease up to today. "Forest available for wood supply" has almost the same value for the years 1947 and 1994. Not surprisingly, this depicted trend is rather identical with the one reported in the Swedish yearbook *NBF, 2000,* (see Chapter 2.5).

Graph 56

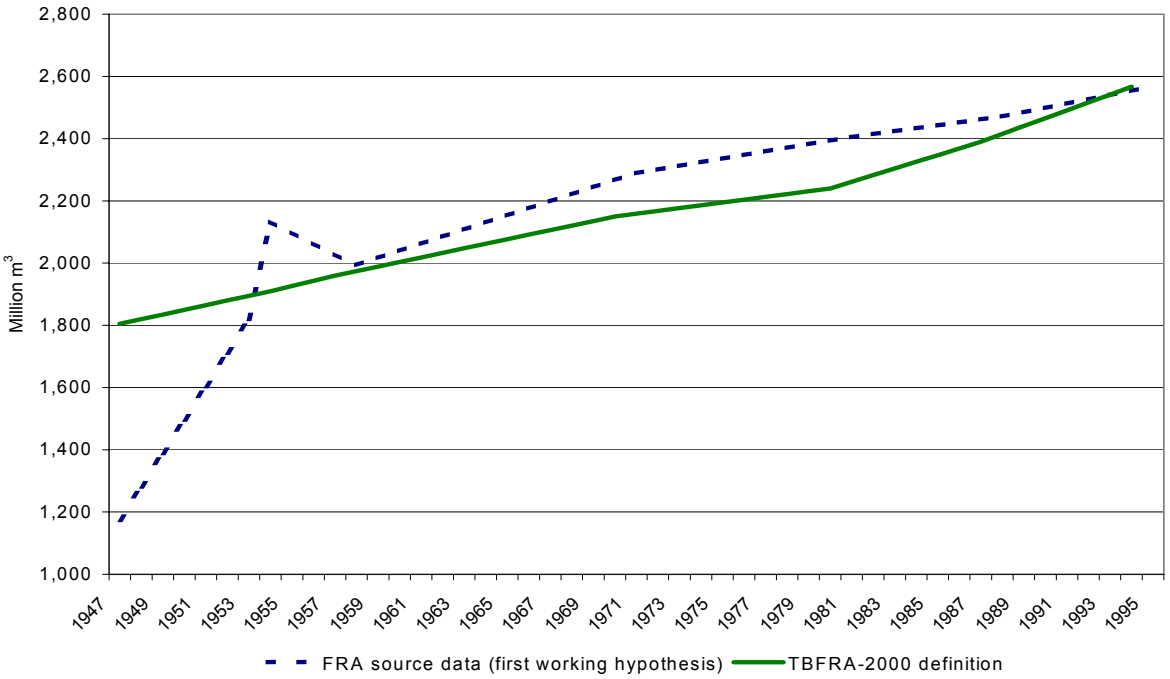
Development of forest area in Sweden



The decreasing forest area in Sweden is caused by expansion of human settlements onto former forest covered areas, which has outweighed the transformation of agricultural land to forestland in the last 20 years (graph 56). According to the national correspondent, it is, however, unlikely that these processes connected with expansion of human settlements explain the reported decrease. It can be assumed that an actual decrease of forest area has been taking place. Still this decrease is supposed to be at a lower pace than is reported in the data basis. Different challenges in the implementation of the inventories may have contributed to the recent underestimation of forest area.

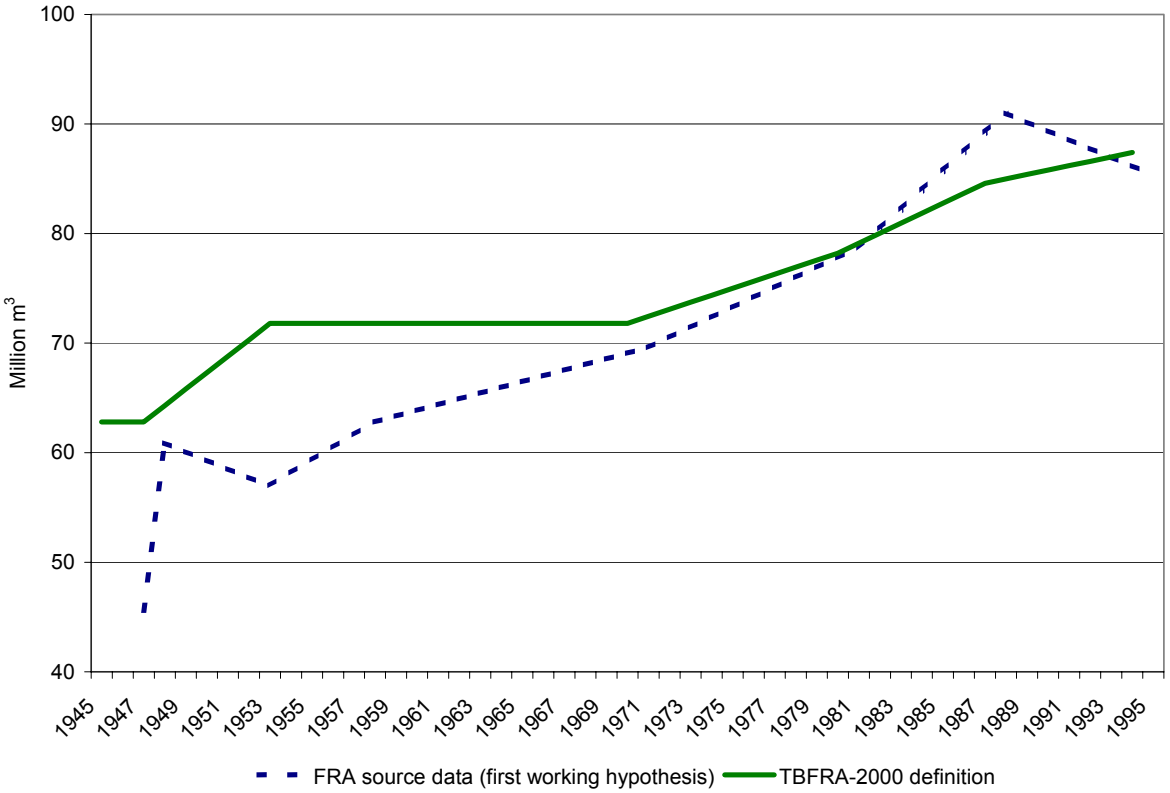
Sweden utilizes a sample based, circular plot inventory. Every plot represents a certain area in the landscape, and it is thus important to which land use class the plot is classified as this may influence the area estimations. Forest areas inside municipal areas are not inventoried to the extent that they once were. This area has been more strictly framed in the late inventories compared with earlier ones, which would imply lower values for forest area. Also, on the border between forest and other land it is sometimes difficult to define if the sample plot is on forestland or on other land. This is extremely difficult in the zones between swamps and forests.

Graph 57
Development of growing stock in Sweden



Concerning "growing stock" national data and FRA source data correspond well for 1958 to today (values of FRA source data are consistently above those of national data) (graph 57). The irregular development of "growing stock" from 1947 to 1958 according to data from the respective FRA publications seems to be caused by definitional changes combined with insufficient measurement methods. According to the long-term consistent national data, the "growing stock" develops rather linearly from around 1,800 million m^3 in 1947 to around 2,600 million m^3 in 1994 (an almost 50% gain). According to the harmonized data series, this same pace of growth can be seen in the development of "net annual increment", showing an increase from roughly 60 million m^3 to 90 million m^3 (graph 58). The data trends develop, however, not linearly but in stages (stable or slight growth alternates with intensified periods). It can be remarked that FRA source data have the same overall trend with some artificially caused discontinuities, which do not reflect the true development of this parameter.

Graph 58
Development of net annual increment in Sweden



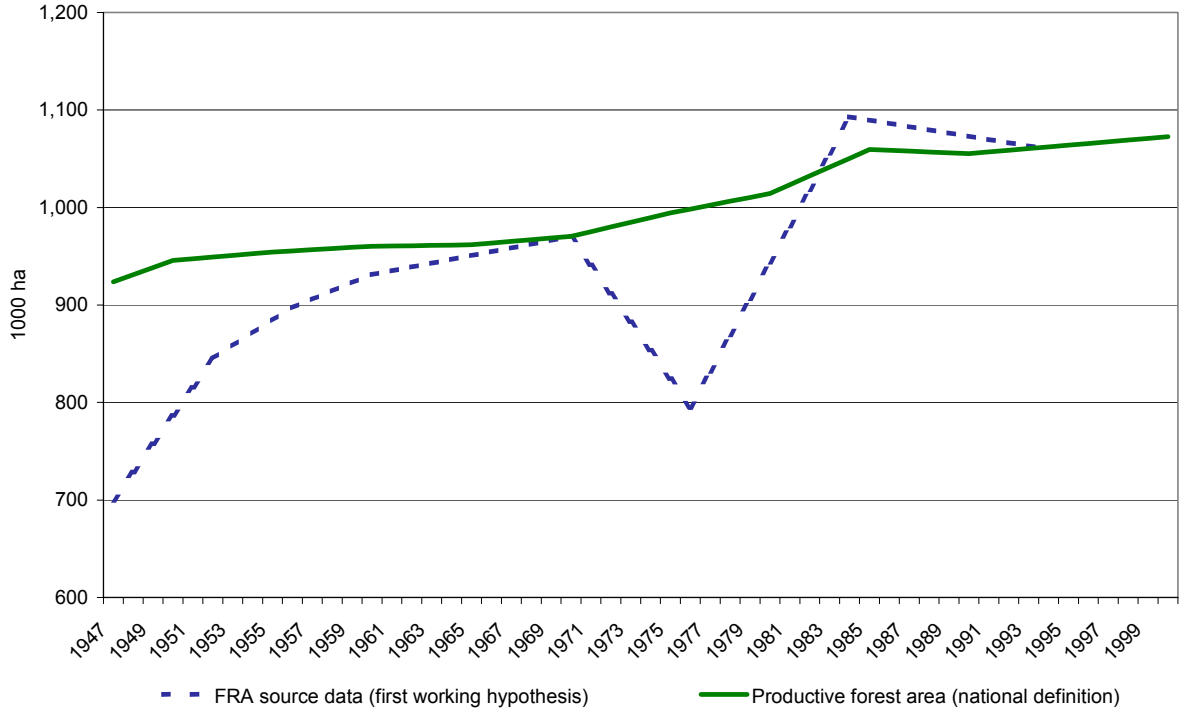
3.15 Switzerland

The national correspondent of Switzerland provided a data series consistent over time for the nationally defined term "productive forest area" covering the period from 1945 to 2000 (graph 59). Data for "growing stock" and "net annual increment" have been harmonized to the data provided to TBFRA-2000, for the period from 1970 up to today. It should be noted that data on "growing stock" and "net annual increment" have been reported to TBFRA-2000 according to the national stem volume definition without an adjustment to the definition used in TBFRA-2000 (the resulting bias is considered negligible; see *UN-ECE/FAO, TBFRA 2000*).

Broad correspondence of the general trends can be seen when comparing the development of forest area according to FRA source data and to national data. The FRA source data value referring to the year 1976 contains an anomaly caused by a definitional deviation, and should be ignored. It can be seen that both FRA source data and national data report a sustained increase of forest area, interrupted by a slight decline in the late 1980s. However, the increase of forest area before 1970 (according to FRA source data), which is rather strong in comparison to the harmonized national data series, looks dubious and is unlikely to reflect reality. The graph based on consistent national data over time shows overall a nearly linear growth of "productive forest area" (which has increased by about 16% during the period).

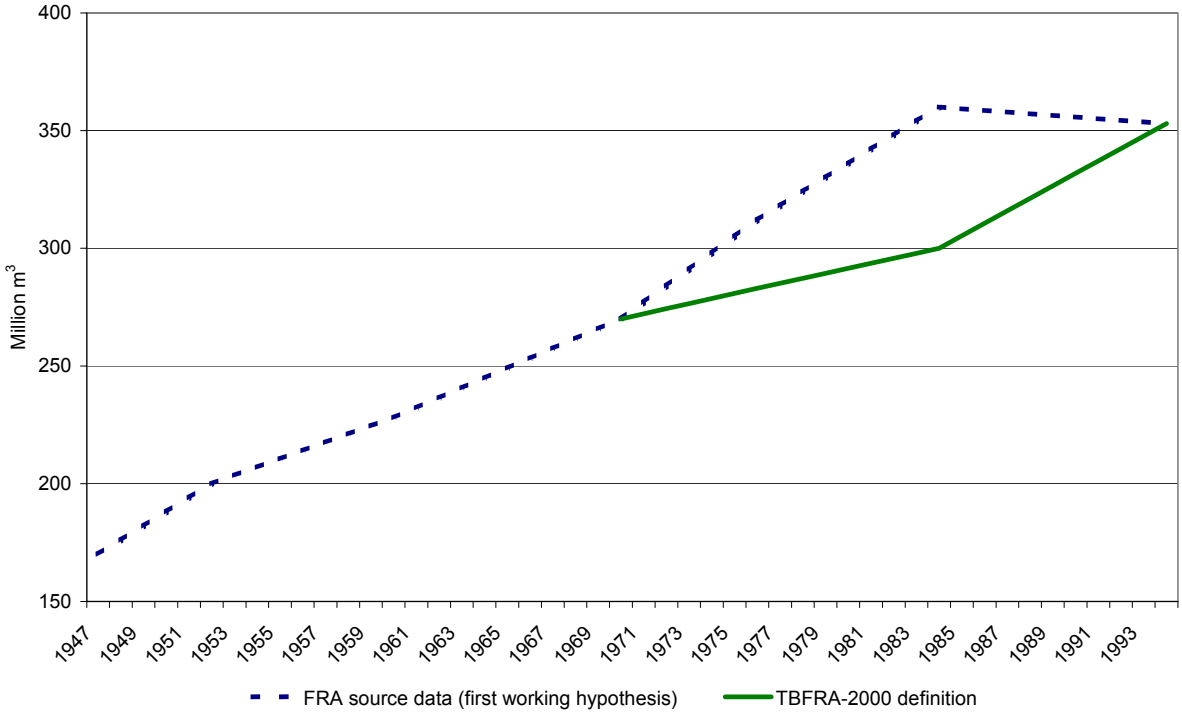
Graph 59

Development of forest area in Switzerland



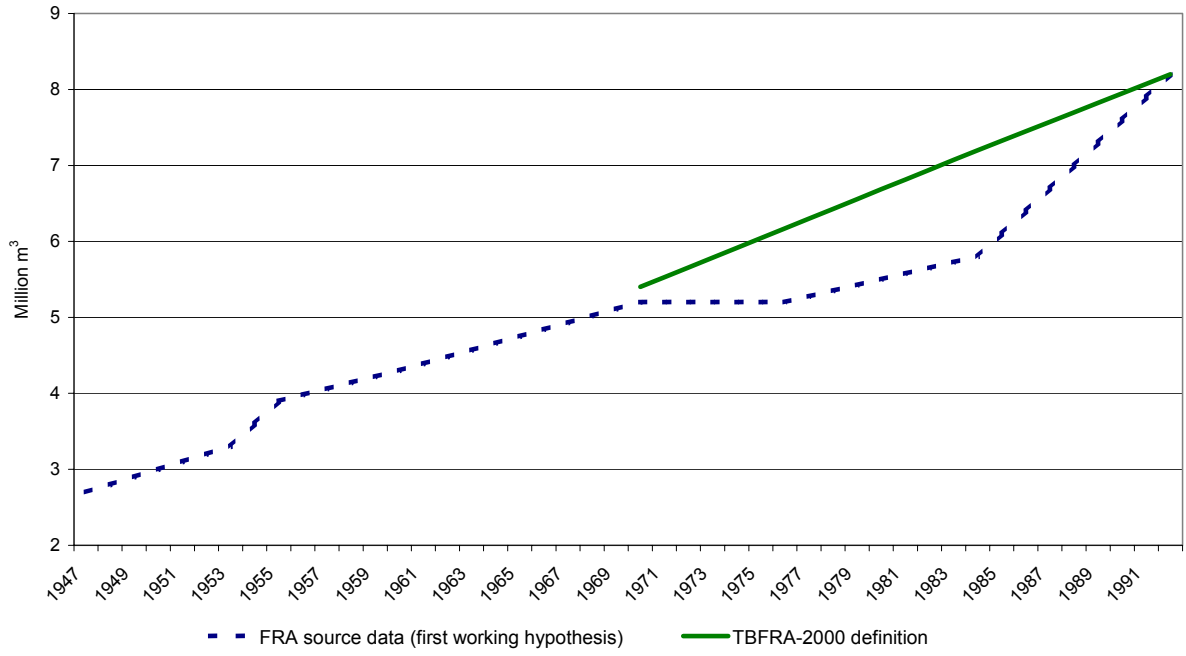
Graph 60

Development of growing stock in Switzerland



FRA source data show for “growing stock” a sustained increase until the mid 1980s followed by a slight decline (graph 60). Data provided by the national correspondent shows moderate growth of the volume of "growing stock" in the 1970s and early 1980s that accelerates in the following years. Even if harmonized data are only available for the last three decades, one may assume an upward growth of this parameter for earlier years as well (albeit with a lower intensity than FRA source data would suggest).

Graph 61
Development of net annual increment in Switzerland



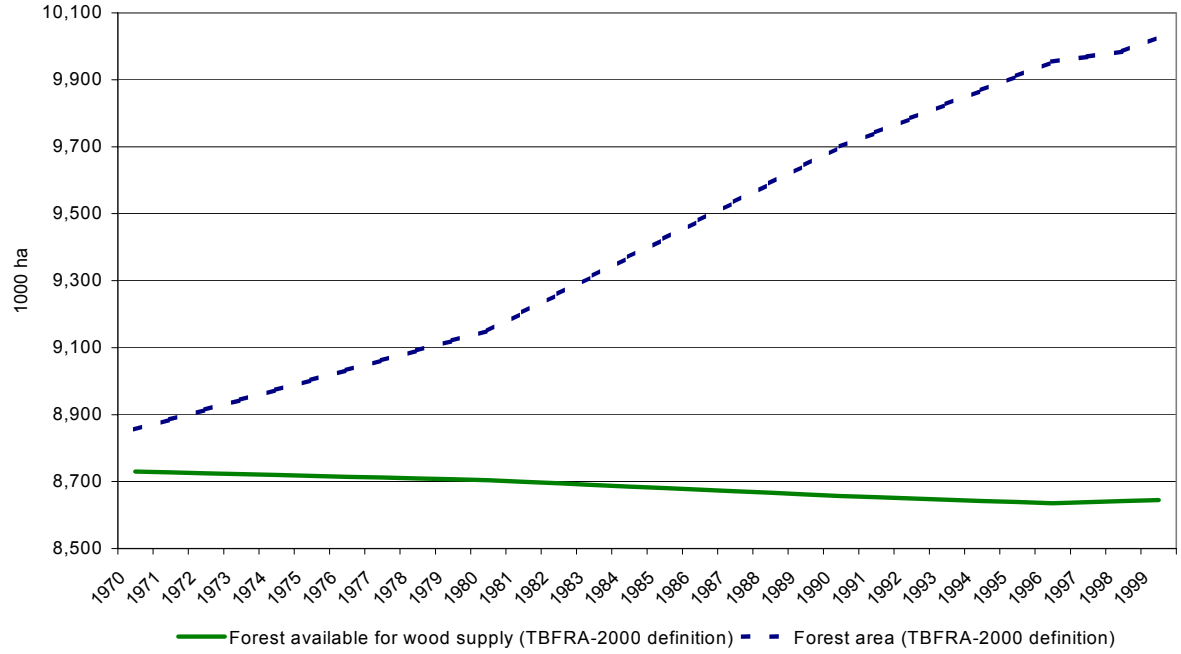
The graph line for "net annual increment" based on FRA source data shows constant growth in the first decades after World War II (graph 61). Afterwards, the increase slows down until the mid 1980s and re-accelerates considerably in recent years. Nationally harmonized data shows a constant increase of "net annual increment" from 1970 up to today. Analogous to "growing stock", the growth trend of "net annual increment" may be assumed as well for the period until 1970.

3.16 Turkey

Turkey provided comprehensive data harmonized to the definitions of TBFRA-2000. Of particular interest for the assessment of historical trends in Turkish forest resources are: "forest area", "forest available for wood supply", "growing stock on forest available for wood supply", "growing stock on forest" and "gross increment on forest available for wood supply". The data set covers 1970 to 1999. It should be noted that the figures with the reference years 1980 and 1990 are estimated values for all parameters and may lack reliability.

Graph 62

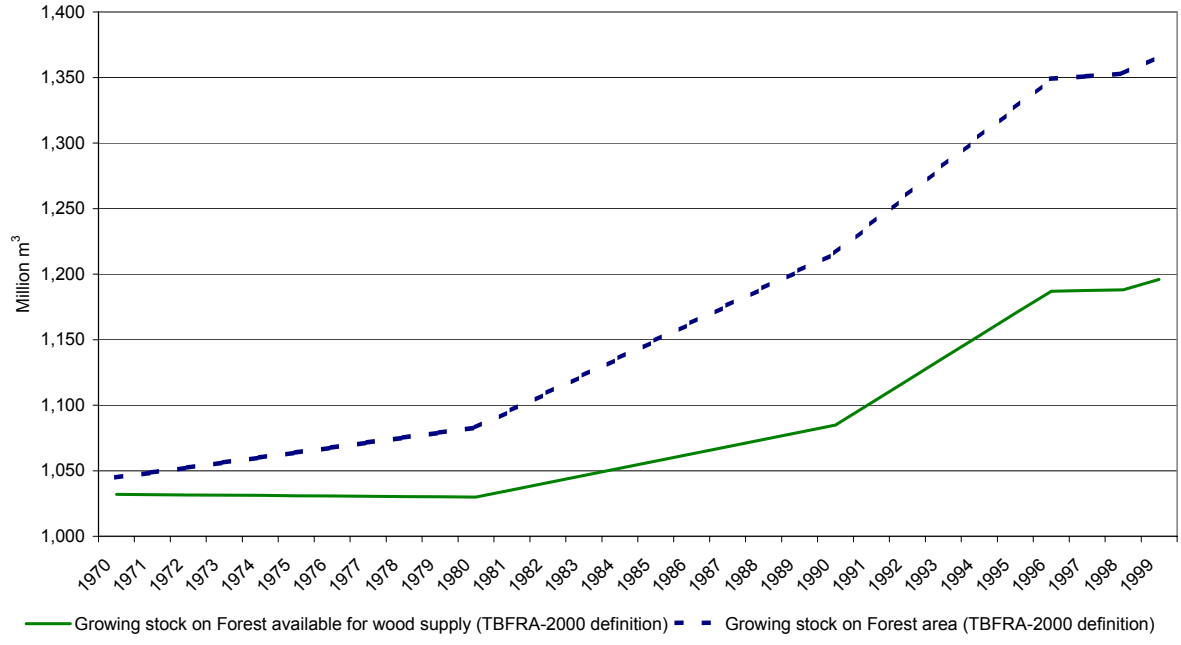
Development of forest area in Turkey



The area of "forest available for wood supply" stays rather stable over the last three decades (graph 62). It decreased by about 85 thousand hectares, which is negligible in view of the 8.6 million hectares of "forest available for wood supply" reported for the year 1999. On the other hand, "forest area" increased quite linearly by about 1 million hectares since 1970. This phenomenon that "forest area" and area of "forest available for wood supply" are not developing in parallel can be seen in the case of several other countries. The increase of total "forest area" is not affecting the development of the parameter "forest available for wood supply", which is decreasing. The area of "forest" not available for wood supply was 126 thousand hectares in 1970, it grew to 1,383 thousand hectares by 1999 (a more than 10 fold increase). The reasons for the growing percentage of forest area not available for exploitation may be an interesting issue to be examined in the follow-up policy analysis.

Graph 63

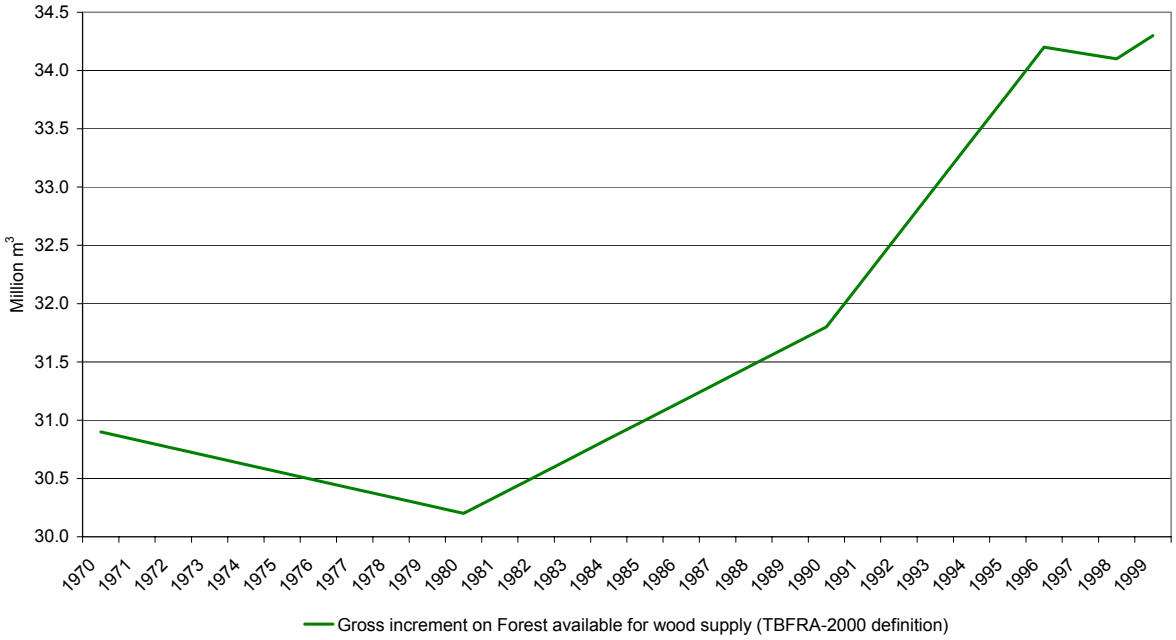
Development of growing stock in Turkey



"Growing stock on forest available for wood supply" shows growth of about 150 million m^3 since 1970, "growing stock on forest" has increased by about 300 million m^3 since 1970 (graph 63). This stronger increase is driven by the increase of total "forest area". Both of these parameters have similar trends; after a rather stable period in the 1970s, an accelerating growth in the 1980s and early 1990s, followed by a levelling out in recent years. "Gross increment on forest available for wood supply" has a similar trend except that between 1970 and 1980 there was a decrease (graph 64).

Graph 64

Development of gross increment in Turkey



3.17 United Kingdom

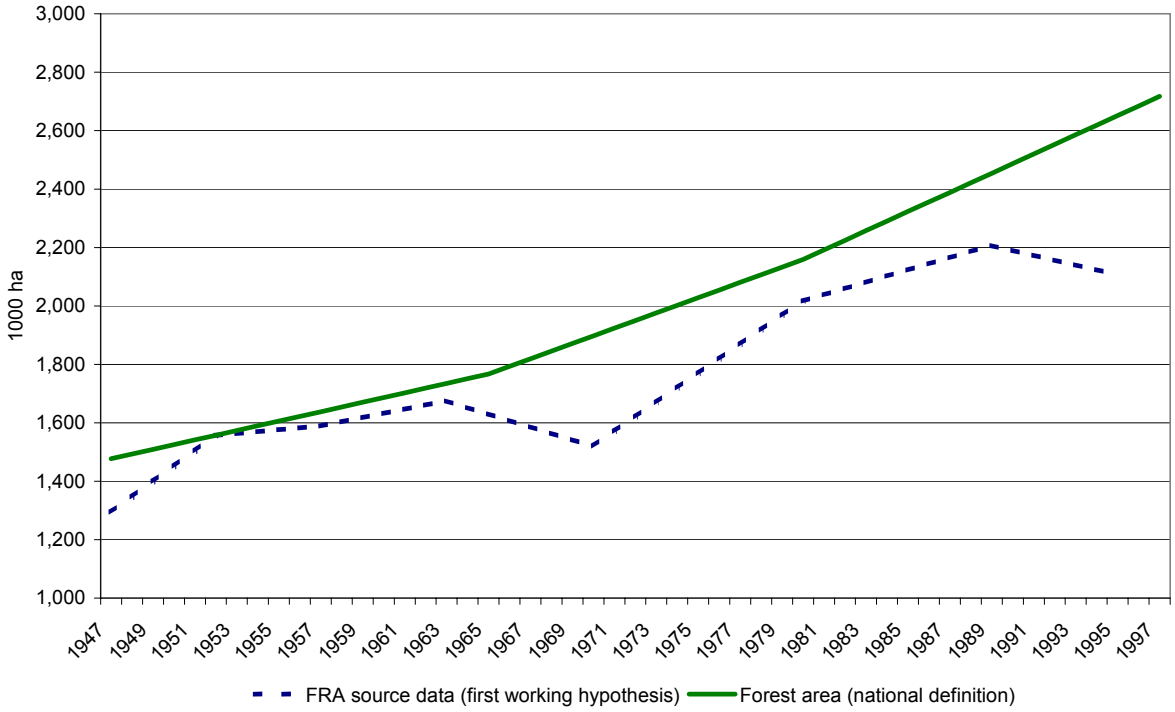
The United Kingdom reply contained harmonized national data for "forest area", "growing stock" and "net annual increment" covering the period from 1947 to today. The data came from three census surveys that took place in 1947, 1965, 1980, and the National Inventory of Woodland and Trees (NIWT) for which the reference year varies by country (England 1998, Wales 1997 and Scotland 1995). As a common reference date for Great Britain has not been assigned yet, the national correspondent suggests 1995 to 1999. Concerning the historical data as a whole, the correspondent reported that initially data only for Great Britain was available, which means that Northern Ireland had not been included. Official statistics for "forest area" in Northern Ireland were added to the United Kingdom totals. "Growing stock" and "net annual increment" were adjusted via extrapolation by applying the ratio of Northern Ireland "forest area" to United Kingdom "forest area". Mistakes caused by this methodology are insignificant considering that the forest area of Northern Ireland represents just 1.7 percent of the total forest area of the United Kingdom.

A comparison of data for the term "forest available for wood supply" of TBFRA-2000 (and its "equivalents" as elaborated in the first working hypothesis) with nationally provided data for "forest area" may be considered questionable and conclusions must be made carefully. Regarding the slightly accelerating increase of "forest area" since 1947 according to national data, it can be assumed that the drop in area of "forest available for wood supply" according to FRA source data in 1970 is not very likely to reflect the real development of the forest resources (graph 65). Except for this discrepancy and the decrease of "forest available for wood supply" in recent years according to FRA source data[2], the major trends of forest area in the United Kingdom are quite similar in both data sets. Referring to the national data series, the pace of growth of "forest area" reaches a considerable 1.2% per year, which leads to a doubling of the value of this parameter within the last 50 years.

[2] TBFRA-2000 data are based on projections from the 1980 census and underestimated the area of "forest available for wood supply" in the late 1990s. Data from NIWT were not available when the TBFRA projections were made in 1997.

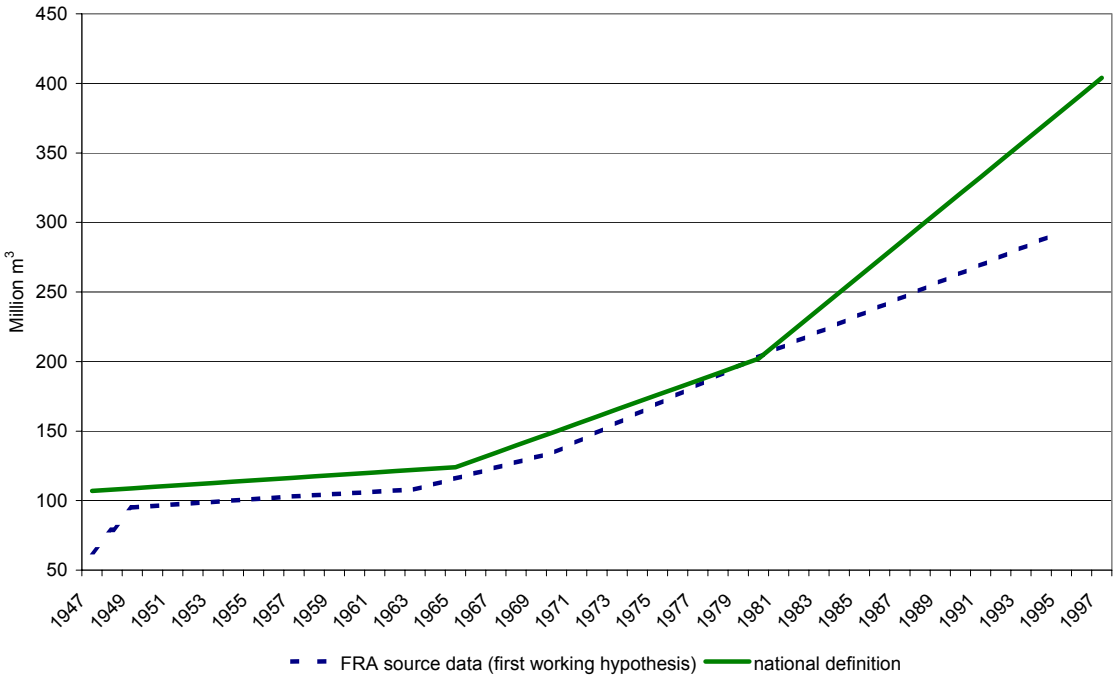
Graph 65

Development of forest area in the United Kingdom



Graph 66

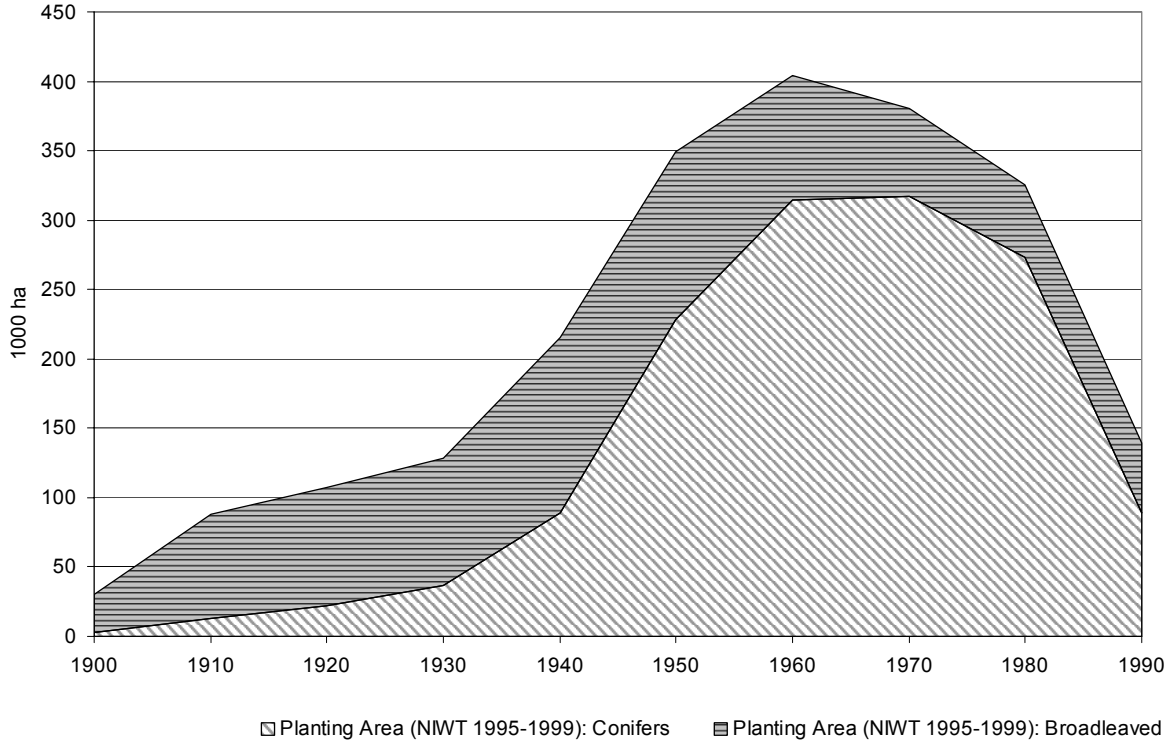
Development of growing stock in the United Kingdom



Concerning "growing stock", both the FRA source data set and the national data set show a progressively increasing trend with approximately the same values until 1980 (graph 66). After this date (according to nationally provided data), the volume of "growing stock" increases exponentially, so that in 1997 the value of this parameter is almost four times higher than it was 1947. According to FRA data, "growing stock" has a linear development. It must be considered that the underestimation of "growing stock" in early forest inventories was common throughout Europe. On the other hand, today's high volume of "growing stock" can be explained by major afforestation efforts after World War II, which resulted in a high percentage of mature stands. This is shown in the diagram of the age profile of woodland in Great Britain (graph 67).

Graph 67

Area of woodland in the United Kingdom by planting year classes and species groups, from NIWT 1995-1999

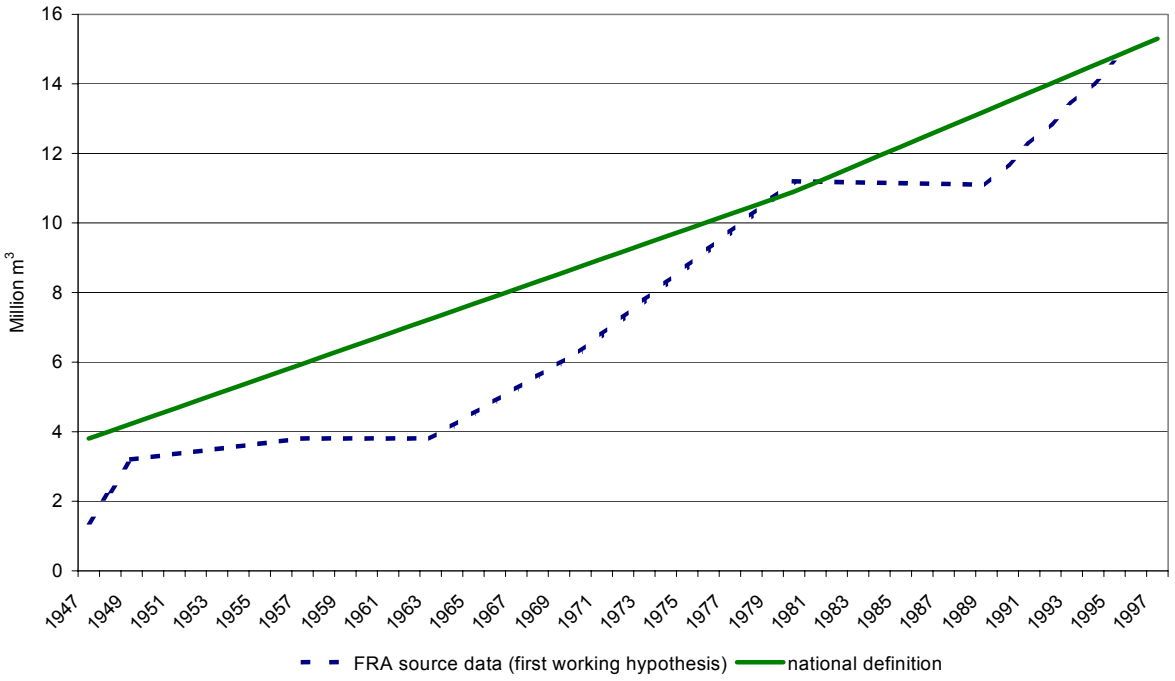


Note: Woodland excludes felled, coppice and open space. Age is determined from records where these are available. Where records were not available or were clearly inaccurate, age-class was assigned by reference to similar crops of known age in the locality.

The strong increase of "growing stock" throughout this period is reflected by the nationally provided data series for "net annual increment", which depicts a linear development from 4 million m^3 in 1947 to more than 15 million m^3 in 1997 (graph 68). The FRA source data describes a similar trend to the harmonized data set except the progression is more in stages.

Graph 68

Development of net annual increment in the United Kingdom



4 Analysis of factors behind changes in forest resources

4.1 Introduction

For the purpose of analysis of the factors behind the trends in European forest resources identified in chapter 3, European countries (including CIS countries) have been grouped in five sub-regions (see Annex 5.1 to 5.3). The grouping in regions has been implemented according to economic and policy factors that have led to subdivisions in EU/EFTA countries, CEEC countries and CIS countries. EU/EFTA countries have been subdivided in three regions employing the criterion of ecological conditions. The same procedure in the case of CEEC and CIS countries had to be skipped due to a lack of harmonized data sets (especially for southern CEEC countries and CIS countries). Although belonging neither to CEEC countries nor to EU/EFTA countries, Turkey has been arbitrarily placed in the group of southern (EU/EFTA) countries. The graphs illustrating the development of forest resources by sub-regions (presented below) are based on harmonized data series provided by the countries.

By broadening the discussion of the driving forces behind European forest resources to a regional level, the study concentrates on those main policy decisions, market and/or exogenous factors, which can be considered to have had a major impact on the region as a whole, neglecting national particularities. The focus of the present study is the European level, aimed at drawing conclusions for country groups by looking past national borders. Consistent forest resources data are still missing for several countries and the countries have, without a doubt, better resources to make a detailed historical analysis of driving forces behind the changes in forest resources restricted to their national territories. Due to resource and time constraints, the analysis below represents a first draft, aimed at encouraging follow-up work on this subject. It should offer general results inducing future deeper analysis.

4.2 Development of forest resource parameters by region

4.2.1 Northern Europe

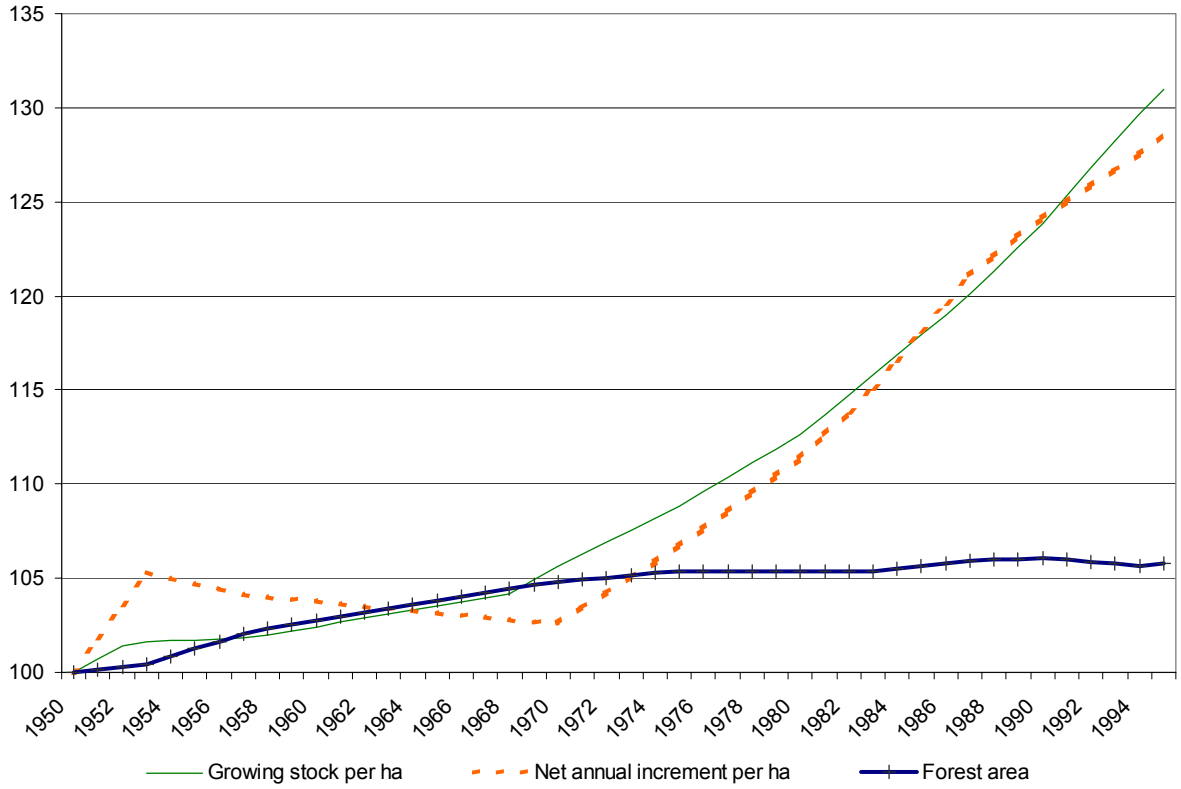
The forest area in the northern European region increased 6% from the 1950s to the 1970s (graph 69). Since then, it has stayed more or less constant. Growing stock (per hectare) showed a strong increase of roughly 31 % during the last 50 years. Net annual increment (per hectare) in general decreased slightly until the 1970s; afterwards it increased by almost 30 %.

The growth process of forest area in northern Europe is mainly caused by a change in land use. Agriculture land, grazing land and peat land have gradually been taken out of use and have either been naturally colonized by forests or actively afforested. After World War II, Finland invested massively in creating forestland by ditching peat land. This was also done in Sweden and Norway on a smaller scale. In the 1960s and 1970s, big efforts were made in afforestation and the conversion of low-productive broadleaved forests into coniferous forests (mainly in coastal districts of western and northern Norway).

In summary, the increasing development of forest area in northern Europe until the early 1970s was driven by changes in land use. It can be seen in the case of Sweden and assumed for the whole sub-region that policy forces made a great contribution to this process. The official policies have been encouraging the conversion of land that is not used for other purposes to forestland by planting. The agricultural policy was also pro-forest orientated until the mid 1970s. Since the 1970s, growth of forest area has slowed, but was still significant for the whole region. During the 1980s and 1990s only small areas of agricultural land have been converted to forestland. Additionally, the building of roads, railroads and electric power lines, and the expansion of cities and other populated or industrialized areas are forces reducing forest area (which can be observed in the whole of Europe).

Graph 69

Development of forest area, growing stock and net annual increment in northern Europe (1950 = 100%)



Note 1: As not all countries could provide data series harmonized to the definition of "forest available for wood supply" as used in TBFRA-2000, data based on different definitions is processed in the graph (see Chapter 3 and Annex 5).

Note 2: For Denmark only harmonized data for "gross annual increment" are available and thus used in the graph.

Summarizing the main factors behind the development of forest area in northern European countries; it can be noted that the policy driven effect of land use change towards forestry land use, which increases the forest area, has been progressively offset by forces which reduce available forest area (strongly linked to the expansion of human settlements in former forest lands).

Analogous to forest area, growing stock and net annual increment show an increasing development in northern Europe. This is not surprising as the development of growing stock and increment is strongly linked to that of forest area (so the reasons identified above can also be applied to growing stock and net annual increment). There are other factors that determine the development of growing stock (per hectare) and net annual increment (per hectare). The slight decrease in net annual increment (per hectare) in the 1950s and 1960s in the northern European region can be explained by the fact that in the 1950s clear cutting became a major harvest prescription, whereas before selective cuttings was used. At this time, there were large areas of selectively cut forests with low production (so called "green lies") and fairly small areas of younger fast growing forests. In the 1950s these old "green lies" (characterized by low volume and increment), were starting to be transformed into fast growing semi-natural forests by first clear-cutting the areas and reforesting them. Big areas of young forest stands (about 250 to 300 thousand hectares per year in Sweden) were created. As these stands had a low increment the first 20 years, and as much of the old forests also produced poorly, the increment stabilized for quite a long period. It was not until the mid 1970s, when the large planted areas of forest came into their fast growing phase (at the same time that the harvest and clear-cut were reduced) that the increment increased at a fast pace. Admittedly, there are other factors such as changes in tree species composition, effecting the development of increment. In the case of Norway, for example, it could be shown that afforestation efforts were accompanied by efforts to replace low-productive broadleaved forests with more efficient coniferous ones.

Regarding the development of the volume of growing stock, it should be taken into consideration that it is strongly linked to the volume of net increment and to the volume of removals, which is mainly driven by market factors. As removals have been structurally lower than net annual increment in almost all of Europe in the last decades, growing stock will logically increase. Given the weakened increase of increment in the last years and assuming the same market conditions in the future, the intensity of increase of growing stock can be expected to get lower in the next years.

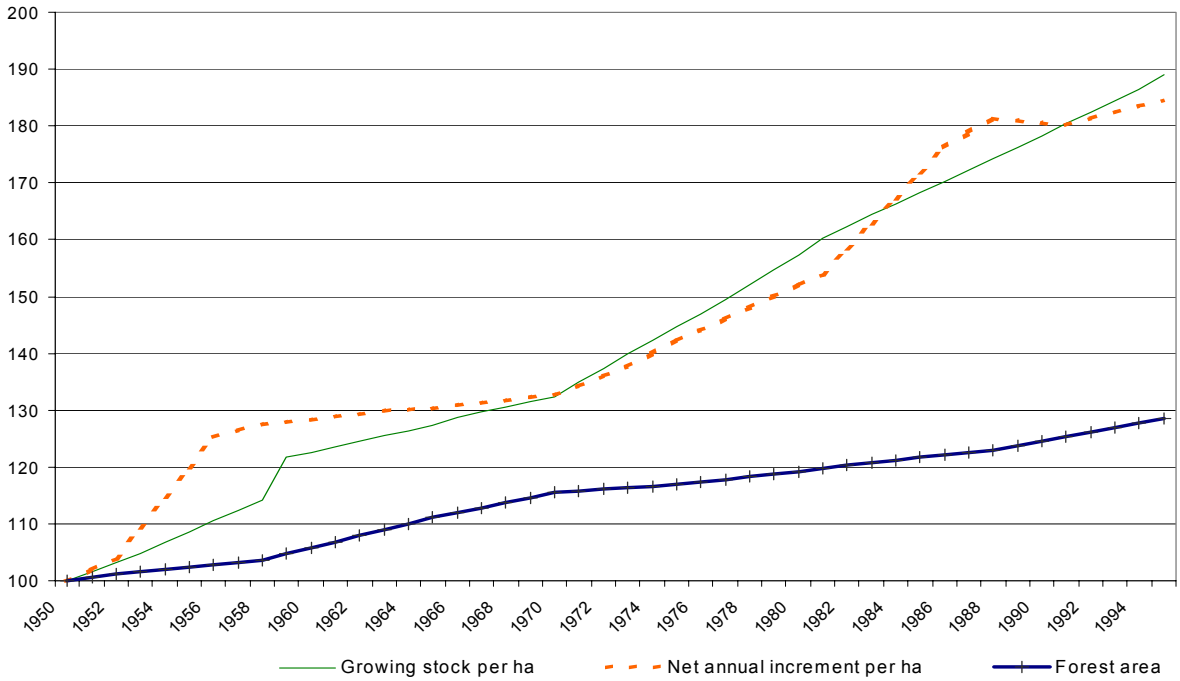
4.2.2 Western Europe

Forest area in the western European region shows an increase from 1950 up to today of roughly 30% (graph 70). Growing stock (per hectare) and net annual increment (per hectare) increased significantly in the period and almost doubled. The increase of net annual increment (per hectare) has, however, been levelling out in recent years.

Graph 70

Development of forest area, growing stock (per ha) and net annual increment (per ha) in western Europe

(1950 = 100%)



Note: As not all countries could provide data series harmonized to the definition of "forest available for wood supply" as used in TBFRA-2000, data based on different definitions are processed in the graph (see Chapter 3 and Annex 5).

Large-scale afforestation programmes drove the growth trend of forest area in western European countries after World War II along with natural colonization of abandoned agricultural lands. This land use change from agricultural lands to forestlands (due to an intensification of agricultural production) was partly offset by progressive deforestation in urbanized areas and the extension of human settlements and infrastructure in regions with forest cover.

In the United Kingdom, large areas of coniferous forest were planted by the Forestry Commission from the end of World War II to the early 1970s and – to a lesser extent – by the private sector up to the late 1980s. Thus, the growth in forest area can largely be attributed to policy decisions, implemented by the Forestry Commission, with a smaller role for private sector incentives through a favourable tax system up to 1988.

The explication for the growth of forest area in France can be found in a drop in agricultural activities. This process was accompanied by a broad programme of afforestation (starting in 1947 and concerning mainly coniferous forests), which was subsidized by the state. The policy's objective was to reduce the dependence of France on imported softwood. This programme of afforestation has been decelerating progressively, so that it has only a minor impact today. The afforestation of agricultural lands, which was tried

recently, did not have a great success. Still, forest area continues to grow rather significantly mainly in the foothills, and in the south of France on former agricultural land.

For Belgium, the ongoing increase of forestland in recent years was caused by new afforestation in rural areas that outweighed the area of deforestation in urbanized areas (mainly in the north of Belgium). Taking these two processes into consideration, one may assume an increasing polarization of forest covered rural areas and deforested urban areas, implying for the urban population a loss of recreation zones in their close surroundings.

The major afforestation programmes starting in the 1950s, (mentioned above), have had a decisive impact on increasing growing stock and increment in western Europe. The increase of the volume of growing stock can be explained by the fact that removals have been lower than annual increment. In the United Kingdom from 1980 to 1997, increment averaged around 15 million m^3 a year and harvest around 5 million m^3 a year which means an increase of growing stock of approximately 10 million m^3 a year. Today harvesting activities have reached a volume of 10 million m^3 a year and are forecast to increase to more than 15 million m^3 per year in the next 15 to 20 years, which would imply a deceleration or halt to a further increase of growing stock (assuming the increment stays at the current level). In addition to increasing removals, the current policy of the Forestry Commission to grant incentives to plant more broadleaves will also reduce the increment compared with planting equivalent areas of conifers.

The reason for the low level of removals in French forests is the underdeveloped forest industry, which is handicapped by difficult market conditions and which has strong competition from Scandinavia and Canada. There has also been a strong drop in utilization of firewood in the 20th century. In the future, an increase of harvest may be expected because large areas of plantations will reach maturity and, hypothetically, because of a possible recovery of fire wood consumption in the name of strengthening the use of renewable energy sources. This would decelerate the increase of the volume of growing stock in the forests of France. Also the improvement of forest quality has contributed to the increase of growing stock and increment in western European forests. This can be seen in the case of Belgium, where from 1970 to 2000 a large part of coppice and coppice with standards has been converted into high forest. This intensification of forestland use may be assumed for the whole region and is reflected by the data showing an increase of growing stock and increment per hectare.

4.2.3 Southern Europe

For the southern sub-region, the data analysis shows a growth of about 17 % of the forest cover, quite steep for the period between 1950 and 1970, less intensive but still solid between 1970 and 2000 (graph 71). At the same time growing stock (per hectare) as well as increment (per hectare) were growing faster (in particular over the last decade). It should be noted that only Turkey, Portugal, and Italy represent the region. The graph shows a certain delay between the growth of forest area, and that of growing stock and increment.

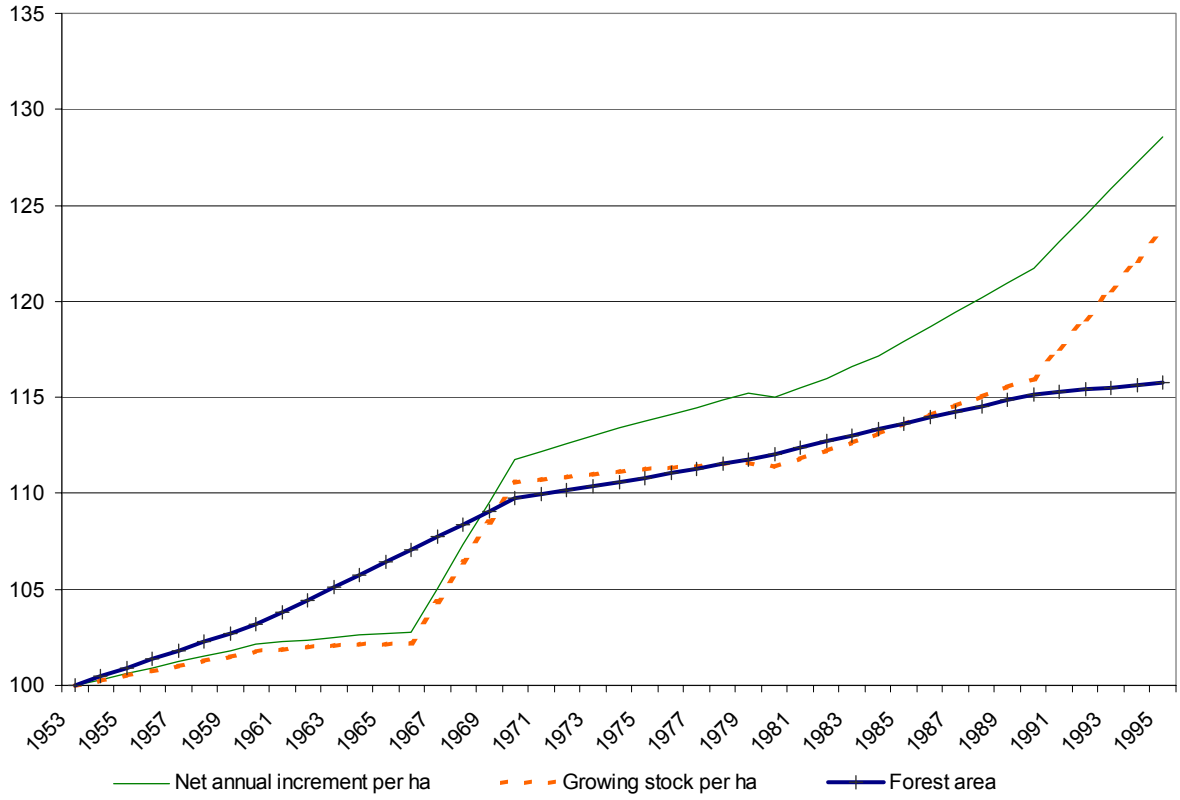
While the forest cover of the countries in this region is now near the average level in Europe (UN-ECE/FAO, TBFRA-2000), the growth rates indicate a rather low level of forest share in the beginning of the analysed period (around 1950). The Mediterranean forests were devastated due to human activities such as: harvesting fuel wood and charcoal, intensive grazing, and agriculture (which has historically utilized the best soils for its development). Rural areas and forestry were removed from the economic, social and ecological potentials.

Following the Civil War in Spain (1941-1971) the dictatorship considered afforestation as an element for the modernization of the forest (although native wood of great quality were rejected in favour of fast growing tree species adapted for the pulp industry). Through 1951 the trend was the attainment of economic and political independence. Between 1951 and 1959 a liberalization process began. Opportunities for timber marketing were recognized and afforestation became even more intensive. Afforestation programmes were often based on coniferous species and reached significant levels up to the 1980s. Currently, the progressive abandonment of agricultural lands (in particular in mountain areas) is allowing an increase of coniferous forests.

Graph 71

Development of forest area, growing stock (per ha) and net annual increment (per ha) in southern Europe

(1953 = 100%)



Note 1: As not all countries could provide data series harmonized to the definition of "forest available for wood supply" as used in TBFRA-2000, data based on different definitions are processed in the graph (see Chapter 3 and Annex 5).

Note 2: For Turkey, only harmonized data for "gross annual increment" are available and thus used in the graph.

In some countries, most of the forestland is privately owned (Portugal, Italy, Spain), whereas in others (Turkey), the forestland is predominantly in public ownership. Forestry in the southern sub-region is often mentioned in the context of illegal clear cuttings, burning, and follow up changes in land use for commercial and tourist oriented enterprises. All this points to a decline in the economic attractiveness of forestry over recent decades. The issue is under policy discussion and is receiving public attention. It has local importance, whereas the empirical analysis provides a different picture; showing that total forest resources have increased quite steadily and significantly.

The southern sub-region is characterized by marginally productive stands. After World War II, large parts of the Italian forests were heavily exploited and in bad condition.

During the 1950s new forest policies were adopted, eliminating large-scale clear cuttings, increasing forest biomass and establishing forests, which correspond to the natural ecosystems. The changes in silvicultural methods reduced harvest levels and timber marketing. Today, the conditions of the forest in the southern sub-region are better ecologically, but high costs of forest utilization and increasing timber imports have taken place.

Until now, the main management approach was "cutting by opportunity". Forests are used as a "savings bank"; that is cut to satisfy owner needs with less attention to the silviculture of the forest. Due to a lack of infrastructures, forest tradition and culture, optimal results have not been achieved yet, so that even when assuming maintenance of the current forest area, the production could be increased, especially in a qualitative way. This sub-region calls for more attention during future quantitative and qualitative analysis.

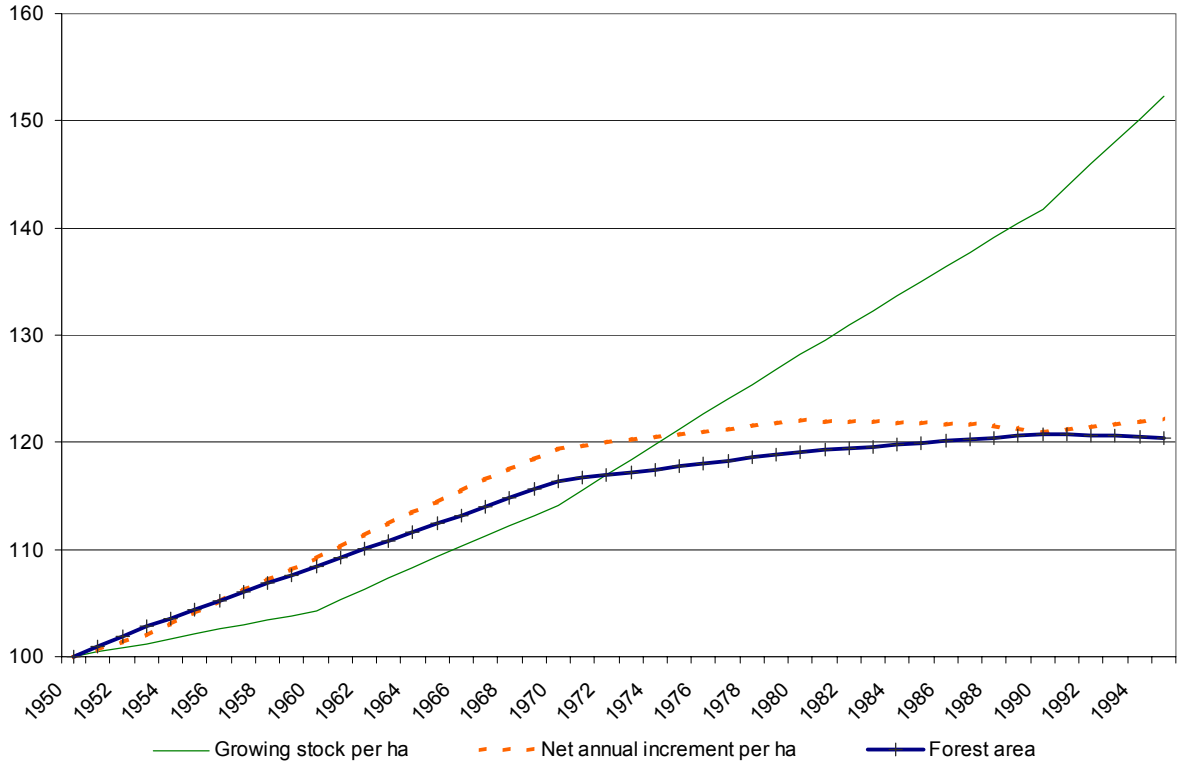
4.2.4 Central and eastern Europe

Forest area, growing stock (per hectare) and net annual increment (per hectare) of the central and eastern European region increased considerably up to 1970 (graph 72). From the 1970s to today, the growth of forest area and net annual increment (per hectare) has levelled out, whereas growing stock (per hectare) has continued to increase.

Graph 72

Development of forest area, growing stock and net annual increment in central and eastern Europe

(1950 = 100%)



Note: As not all countries could provide data series harmonized to the definition of "forest available for wood supply" as used in TBFRA-2000, data based on different definitions are processed in the graph (see Chapter 3 and Annex 5).

The increase of forest area in central and eastern Europe from 1950 to 1970 can be explained by a high rate of afforestation after World War II, which was driven by two factors:

1. The region of central and eastern European countries had been significantly destroyed by the war. Therefore, a huge amount of timber was urgently demanded in the late 1940s and in the 1950s as construction material, but the resources were very limited. It can be seen in the case of Poland (and may be applied to the whole region) that the forest area was badly plundered. There was an enormous area of forests that had been clear-cut during the war and were not regenerated. These conditions reminded people of the significance of wood resources and might also have convinced the authorities to pursue large-scale regeneration and afforestation programmes during the 1940s to the 1960s.
2. World War II caused a considerable decrease of the population. Moreover, big migrations after the end of the war and rapid industrial development lowered the ratio of rural populations. These conditions fostered the change of agricultural lands into forests.

In the course of a gradual fulfilling of wood demand and with the change of people's awareness, forest is considered to serve other needs more and more, in addition to its function of wood supply. The recreational, climatic and protective functions of the forests have been gaining importance. At present, afforestation is driven more by social and ecological purposes than by productive ones. It should be emphasized that the lobbying efforts of foresters for an increase of forests and for multi-functional forestry has had a major impact in almost all of Europe in recent years.

The increasing development of growing stock (per hectare) and net annual increment (per hectare) is largely driven by a shift in the age structure of forests. In central and eastern Europe, major parts of the forest area (planted in the late 1940s to the 1960s) are currently reaching maturity. As can be seen in the Czech Republic, an overly mature forest means a rapid increase of increment and growing stock but can bring about a drop in felling possibilities in the next decades.

The rather stable values for net annual increment (per hectare) since the 1970s, may be explained for the whole region (as in the case of Poland), by natural losses, which have increased since the mid 1970s and culminated in the mid 1980s. The reasons of this phenomenon are complex, but air pollution, water pollution, and man-made disturbance to the hydrology of the forest have all led to tree mortality. In addition to those primary factors, increased homogeneity and even-age management may represent favourable conditions for pathogens like insects and fungi. The destruction of growing volume is supplemented by natural factors like wind, snow and fire. Certainly these explanations are rather general, and there are a lot of forest stands, where specific conditions have had an impact on mass natural losses. After the political and economical break down in the early 1990s many of these negative trends have been turned around. It is still too early for final conclusions, but positive change in forest health has been reported in recent years.

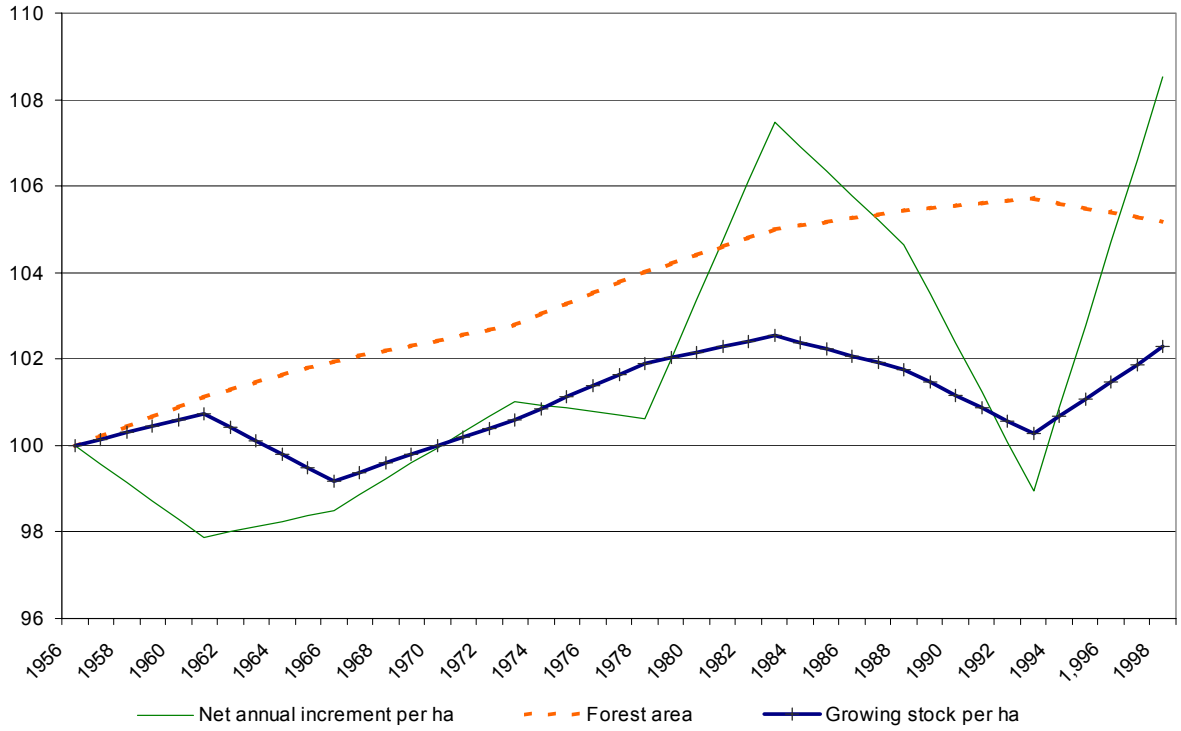
4.2.5 CIS (Commonwealth of Independent States)

The CIS sub-region is represented only by the Russian Federation, where the forest area remains completely in state ownership. The data analysis, supported by national correspondents, shows a growth of nearly 6 %, which corresponds to over 40 million ha forest cover. The growth developed quite steady through the collapse of the planned economy and the crisis in the beginning of the 1990s, where the forest cover declined slightly (graph 73). Growing stock (per hectare) as well as net annual increment (per hectare) show a high volatility due to data quality problems, but indicate a slight growth trend. Thus the further analysis was focussed on qualitative aspects gathered from Russian national correspondents.

Graph 73

Development of forest area, growing stock and net annual increment in the CIS

(1956 = 100%)



Note: Russian data are harmonized, to the extent possible, to the definition of "forest and other wooded land" as used in TBFRA-2000.

In far eastern and northern regions, the forest area in Russia is characterized by a significant share of untouched forests, which were and are up to now not used for forest management. The major share of forests is concentrated in the Asian part of Russia – 78% of forest area and 73 % of the growing stock. Under the centrally planned economy of the former USSR, forest resources were managed in the interest of the state, often at the expense of market relationships and environmental constraints. Silvicultural and other forest management were controlled and assessed primarily through 'quantitative' indicators (hectares, m^3). One of the main logging practices was highly concentrated clear-cutting. The insufficiency of financial resources allocated for forest renewal and protection resulted in the deterioration of the environmental condition of forests in areas of intensive felling operations, with local environmental crises in some areas (in the north-west, Volga Region, Lake Baikal, etc.). The centrally planned economy turned out to be incapable of ensuring efficient development of the forest sector in terms of either economic or environmental objectives.

Nevertheless the forest area increased significantly. According to the overall plans for economic reforms in the former USSR, the infrastructure was improved significantly during the 1960s and 1970s, which led to a shift of virgin forest into forest available for wood supply. Further, in the framework of the Khrushchev agricultural reforms, the forest area grew during the 1950s and 1960s in the context of huge afforestation programmes carried out with the goal of protecting areas and soils under danger of erosion, and supporting agricultural production. After this period, a reduction of the agricultural area has taken place and the population of rural areas has decreased sharply. Low quality trees and shrubs have colonized former agriculture land and have thus contributed to an increase of forest area. Up to the beginning of the 1990s an increase of forest area is reported for all 11 sub-regions of Russia.

However in recent years, many city dwellers have received small fields (smallholdings) from forest land in long-term rent and personal property agreements. After the collapse of the planned economy, the infrastructure was devastated, particularly in the more remote regions. Therefore forest area available for wood supply has decreased through to the end of the 1990s.

In the period under analysis the annual average increment accounted to more than 800 million m^3, while the volume of felling did not exceed 310 million m^3, so the total growing stock increased. The volume of wood cut per one hectare of stocked area accounts for 0.22 m^3 on the average for the Russian Federation, in the west-Siberian region 0.11 m^3, in the east-Siberian region 0.15 m^3 and in the far-eastern region only 0.05 m^3. For comparison, in the countries with developed forest industries this index exceeds 2.5 m^3/ha.

Currently, mature and over-mature stands account for 54 % of the total growing stock. Coniferous species prevail (larch, spruce, pine, cedar) with a share of 78% of the growing stock (primarily mature and over-mature stands). The development of growing stock was inconsistent between the various regions of Russia, increasing slightly in the western parts but decreasing mainly in Siberian regions. The main reasons for decreasing growing stock in these regions were intensive fellings in the 1980s as well as fires and insects. The greatest increase of growing stock was in the central region because of the reduction in harvest volumes and more reproduction. The growing stock of mature and over-mature stands (mainly conifers) was reduced by 9 billion m^3. On the other hand, growing stock of broadleaves increased by 1.7 billion m^3. This is attributable to the forest industry's orientation toward the processing and consumption of softwoods.

With the current system of forest lease agreements lasting up to five years (longer for agreements made at the time of privatization), forest users are not provided with incentives to make long-term investments in forest development, such as forest roads. Very low stumpage prices are not sufficient for the State (the owner of the forest land) to cover even those forest management and operation costs that are annually funded by the State budget (including the costs of reforestation, silviculture, fire and pest management). In 2000, the total amount of budget proceeds from stumpage and lease charges made up merely 60 % of the budget allocations for forest management.

4.3 Development of forest resources in European regions by parameters

4.3.1. Forest area

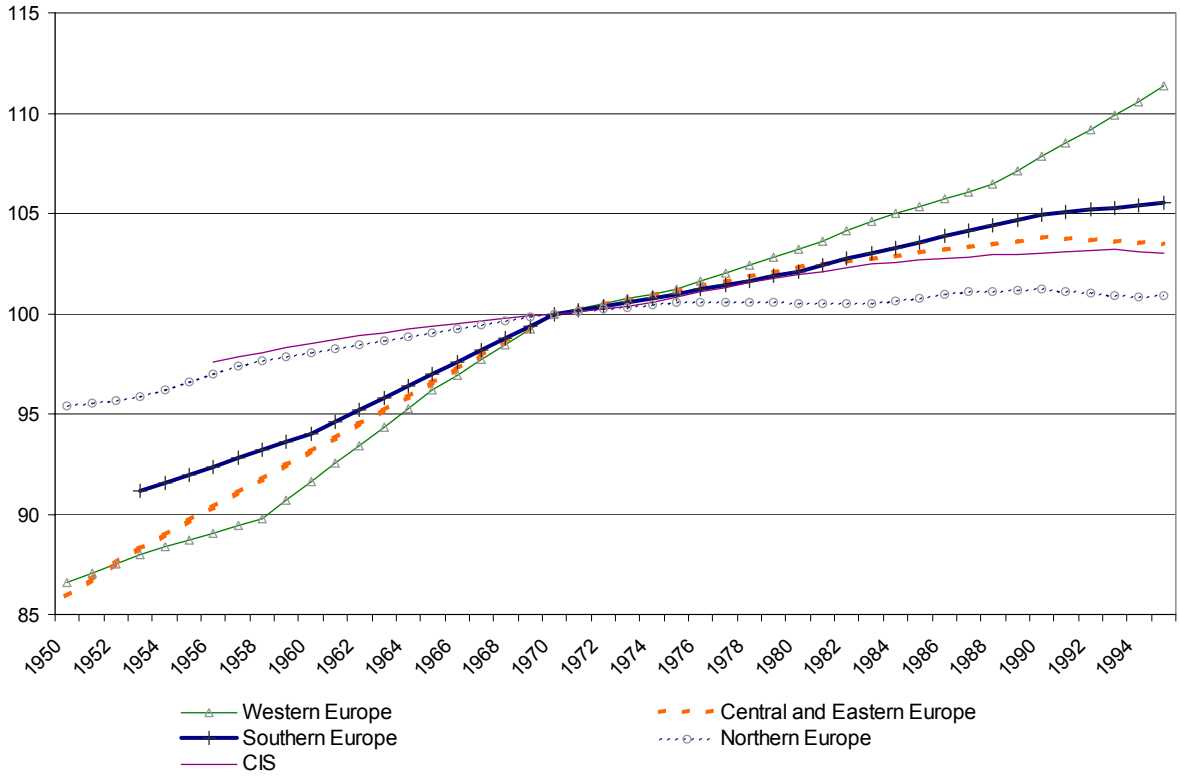
Europe is characterised by a general increase of forest area. During the last 50 years the forest area in western Europe has increased by almost 30 %. The growth was significantly lower in central and eastern as well as in southern Europe, with about 20% and 16% respectively (graph 74). In CIS and northern Europe, the

overall increase of forest area was rather low at roughly 5% over the analysed period. It should be noted that in absolute terms the increase of the forest cover is remarkable. The increase of forest area in Russia amounts to more than 40 million hectare over the analysed period. The growth of forest area has slowed down notably since the beginning of 1970s in all sub-regions, with the exception of the western Europe.

Graph 74

Development of forest area in Europe by regions

(1970 = 100%)



Note: As not all countries could provide data series harmonized to the definition of "forest available for wood supply" as used in TBFRA-2000, data based on different definitions are processed in the graph (see Chapter 3 and Annex 5).

The ratio of forest area per capita is high in the CIS and northern Europe, where it corresponds to 2-3 ha per capita and 5+ ha per capita respectively, while the average forest cover in western Europe is only 0.3 ha per capita (UN-ECE/FAO, TBFRA-2000). There are two major sources for an increase of forest area available for wood supply: (a) afforestation and (b) shifts from forests, which were not previously available for wood supply, e.g. because of degrading infrastructure. In the first decades after World War II major afforestation efforts were made (in particular) in western as well as central and eastern Europe to compensate for earlier clear cuttings and to achieve timber self-sufficiency. The progressive population drift from rural to urban areas were major contributors to land use changes towards forestry. Additionally, the growth of forest area was reinforced by natural colonization of abandoned agricultural lands.

Various general factors appeared over recent decades that caused a slowing down of forest area growth: Timber self-sufficiency is no longer on the political agenda due to the globalization processes. Loss of forest in urbanized areas and the extension of human settlements and infrastructure into rural regions contributed to a lower growth of forest cover. At the same time, forest cover development (over the more recent decades) is likely to be driven by the demand for social and environmental benefits from forestry, as well as fostering a shift from agricultural land use towards forestry (attempting to reduce the burden of agricultural subsidies on the European Union). Afforestation measures are supported by special financial programmes of the European Commission in EU countries (CAP). Further, concentration of the pulp and panels industries has escalated over the last decades causing an increasing demand in easily accessible wood resources. This demand was

partly satisfied via short- and medium-term plantations of high growth stands; different from traditional forestry in terms of rotation period and silvicultural measures, but still covered by the definitions of forest area available for wood supply. Both issues are of less importance for countries in regions with huge forest resources, as CIS and northern Europe and thus the increase of forest area was lower there. In any case, the scope for expansion is limited when the forest cover is already high.

Over recent years forest available for wood supply decreased (particularly in the CIS), partly because of infrastructure degradation in the CIS during the transition and a corresponding shift from forest available for wood supply to forest not available for wood supply. The analysis indicated that the increasing demand for protected forest areas, which certainly led to a shift from forest area available for supply to forest not available for wood supply (particularly in western, central and eastern Europe), offset the above-mentioned increasing factors but did not lead to a considerable decrease of forest area for wood supply.

It may be assumed that the increase of forest area will continue to level out in the future as ecological and environmental needs are likely to cause a change from intensive to extensive agriculture which can already be observed on a small scale. Moreover, in all of Europe, social and ecological functions of the forest will continue to gain importance in comparison to its function of wood supply. This may lead to an improvement of the forest's quality in terms of increased biodiversity, recreational value, and to a better protection of existing forests. It will not necessarily lead to a quantitative increase of the forest cover.

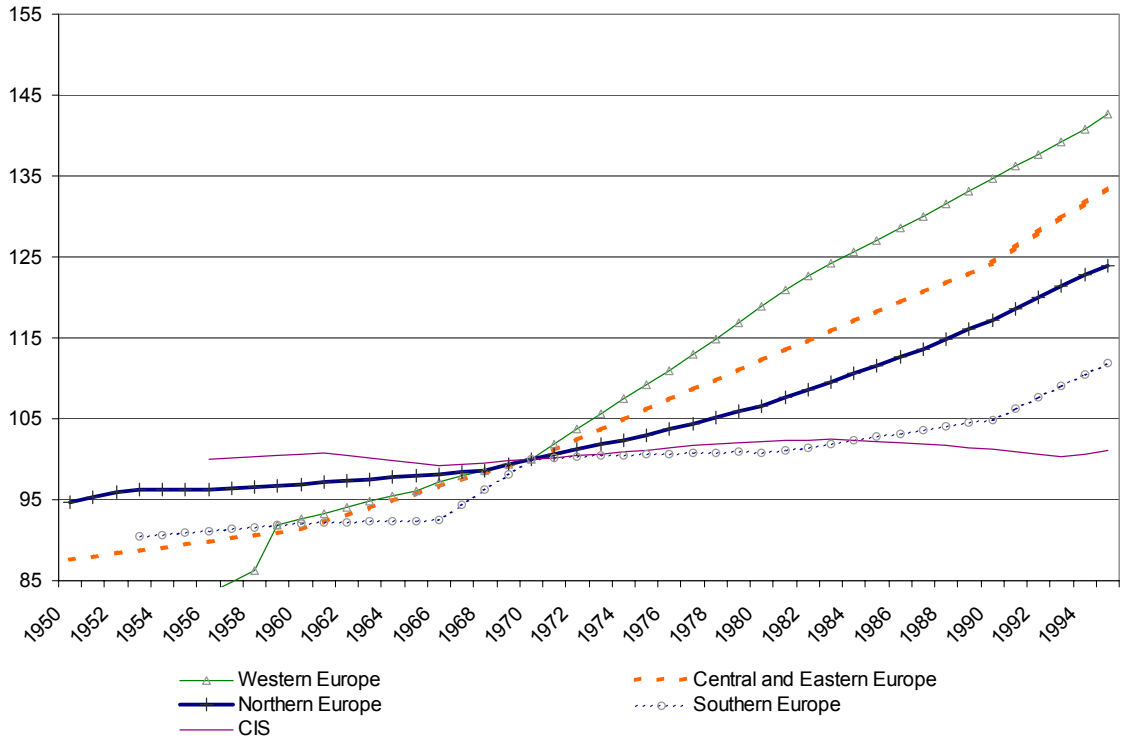
4.3.2 Growing stock

Over the analysed period, the growing stock has expanded much more than the forest area. Growing stock (per hectare) almost doubled in western Europe. It has increased significantly in central, eastern and northern Europe and risen even in southern Europe by more than 20 %, while in the CIS the growing stock is generally still at the starting level (graph 75). The considerable increase of growing stock in the past can be explained by the fact that fellings and natural mortality combined have been structurally lower than annual increment throughout Europe (except CIS).

Graph 75

Development of growing stock (per ha) in Europe by regions

(1970 = 100%)



The differences in the development of growing stock per hectare between the various sub-regions could be explained comparing average growing stock per hectare: western and central Europe are characterized by very high stocks (currently more than 250 m^3/ha in Switzerland, Austria, Slovenia, Germany, Slovakia, Czech Republic), while the average for Europe is 140 m^3/ha and the average growing stock in the CIS is 120 m^3/ha (UN-ECE/FAO, TBFRA-2000). The increment of forest stands, as well as various losses (planned fellings, natural mortality, calamities by storms, insects, fungi and fire) influences the growing stock per hectare. However, the average growth of forests in large-scale regions depends heavily on the age class structure.

During and especially after World War II large areas of mature and pre-mature stands were cut down in western Europe as well as in central and eastern Europe, so that the average growing stock per hectare was relatively low, while middle age stands characterized by high increment, were over-represented. This factor was obviously more significant than the afforestation shown above, which in the beginning decreased the average growing stock per hectare.

The introduction of clear cuttings as a major silvicultural method during the 1960s in northern and (to a lesser degree) in western Europe improved the quality of existing forests for wood production and also contributed to the big ratio of young stands. In general the volume of fellings was developing constantly in all sub-regions, increasing temporarily based on storm damages (e.g. 1990 and 2000) and declining drastically as a result of the crisis during the transition process in CIS and central and eastern European countries in the 1990s (FAO/ECE Timber Statistics). The growing importance of sustainable energy use in Europe may cause a substantial shift back to fuelwood consumption in the future. Thus, the volume of removals could increase significantly, leading to a more efficient balance between increment and actual harvesting of wood, with possible consequences for the development of growing stock.

The fertilizing effects of pollutant emissions may support the growth of forest stands, at least in the short term, which could also be linked to the acceleration of growing stock, which is particularly significant in western, central and eastern Europe. It should be noted, that this factor and its influence is still under scientific debate. The study shows that growing stock has a high inertia. The age-class structure in the starting period influences the trends crucially.

4.3.3 Net annual increment

The analysis of increment (per hectare) shows an interesting grouping. Western Europe has an increased increment of roughly 80 % over the period under analysis, whereas the increment in the other analysed sub-regions show only a 20-30 % increase (excepting the CIS with almost no increase) (graph 76).

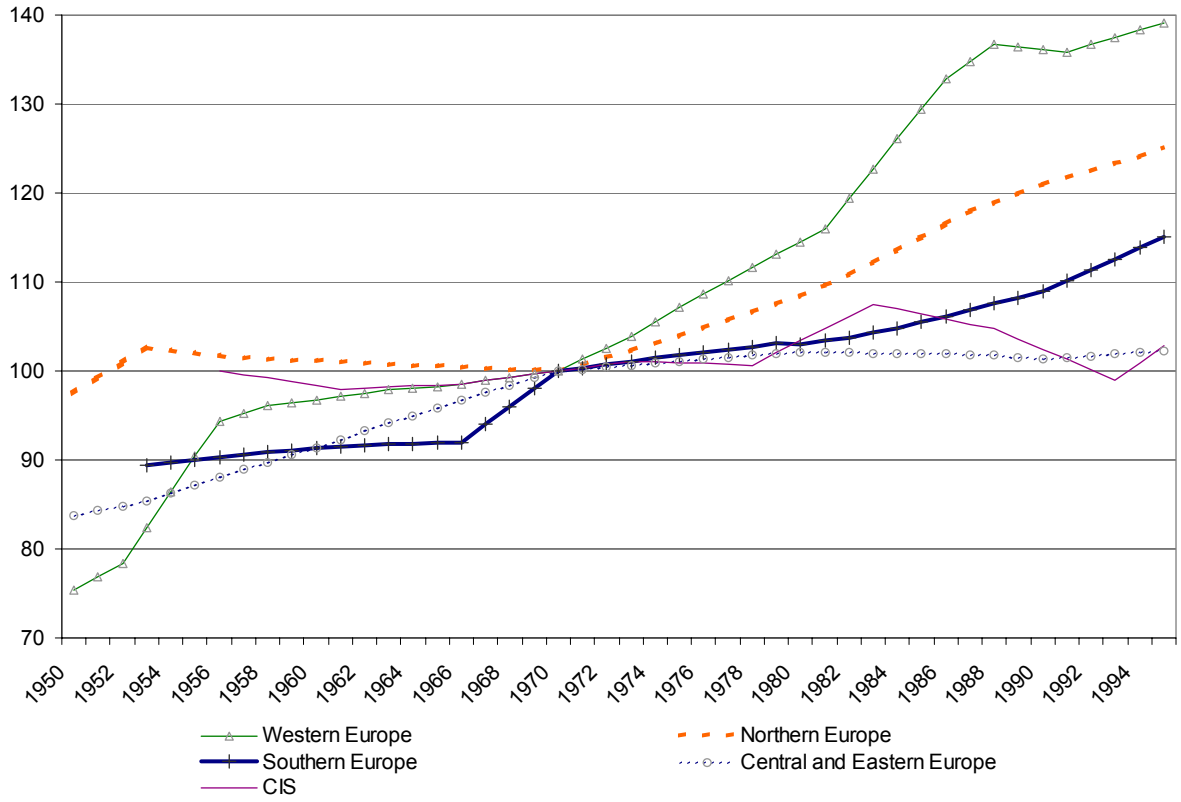
The graph indicates a recent decline in the growth of net annual increment (per hectare). It should be noted that all sub-regions are characterized by volatility that indicates problems in data consistency and makes further analysis difficult.

As for growing stock per hectare, the differences in development of net annual increment per hectare can be explained comparing the absolute levels between the various sub-regions. Western Europe has very high increment, which is, with about 7-8 m^3/ha, nearly double the average increment for Europe (4.8 m^3/ha), while the average increment in CIS amounts to only a bit more than 1 m^3/ha (UN-ECE/FAO, 2000). It is likely that the trend of decelerating increase of net annual increment will continue and might even turn into a declining trend in the future. However, several elements of uncertainty still remain: factors like storms, climate change, or pollutant emissions may effect the future development of this forest resources parameter.

The results show that forest resources have expanded in terms of forest area, growing stock and net annual increment over the last half century. The analysis indicated that less wood has been harvested than grown and that there is a physical potential to increase wood supply from European forests. It should be noted that this analysis does not consider the extent to which this physical potential may be matched by an economic or ecological potential.

Graph 76

Development of net annual increment (per ha) in Europe by regions



(1970 = 100%)

Note: For Denmark and Turkey only harmonized data for "gross annual increment" are available and thus used in the graph.

5 Suggestions for further development of the study

The harmonization of long-term historical data series of main forest resources parameters represents the main part of the present study. The final outcome of this exercise is a harmonized time series for 18 European countries. The issue of comparability of data between different countries has not been treated, as for the purpose of the follow-up analysis the attention was directed to the assessment of major trends. Even if all harmonization work will always have to remain an approximation, the final objective is to get data sets for all European countries adjusted (at least for main parameters) to the definitions of TBFRA-2000, which means the creation of a complete European forest resources database with comparable data series over-time and within countries.

The follow-up analysis of driving forces behind the assessed changes in European forest resources by country groups could only be elaborated to the stage of a first draft due to constraints in time and resources. This rich and exciting subject, however, is worth being analysed in detail. By using the data outcome of the present study and by harmonizing historical forest resources data for further countries, a reliable statistical basis is available, which is indispensable for analytical work.

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ECE/TIM/SP/18. Forest and forest products country profile Russian Federation.

Russian Forest Sector Outlook Study, unpublished draft, 2002

7 Annexes

Annex 1: Request for assistance in assessing historical trends and changes in forest resources

Background

1. The UNECE Timber Section is carrying out a project to assess the historical development of the forest resources in Europe from the end of the Second World War to the present time. It is being undertaken within the framework of two work areas, namely the European Forest Sector Outlook Studies (EFSOS) and the Temperate and Boreal Forest Resource Assessment (TBFRA) programmes. It is envisaged that the project will consist of two main components: (1) a review of historical data; (2) an assessment of the factors behind changes in countries' forest resources over the half-century.

2. At present the work is concentrating on the first component, the review of historical data. Statistics are being extracted for each country from the series of forest resource assessment publications of FAO and UNECE/FAO, which contain information provided by national experts in response to questionnaires. Ideally, the data should be consistent over time, i.e. they should be based on the same terms and definitions, and national experts should have used consistent methodologies to convert data based on national terms and definitions to those based on the internationally agreed terms and definitions. Unfortunately, this has not been the case. For example, what was termed *'forest available for wood supply*' in TBFRA-2000 was reported under various other terms in earlier assessments, including *'forests in use'*, '*productive forest*', *'operable forest*', *'exploitable forest*' and so on. Even the definition of '*forest*' has changed.

3. Apparent changes in forest resource data over time may therefore be a combination of 'real' changes, e.g. changes in area as a result of deforestation or afforestation, and 'definitional' changes of the type described in the previous paragraph, or changes in national classification systems over the time. An important objective of the present project is to remove the latter from the database, so that the true long-term trends can be determined. Only when this has been achieved can the factors behind changes in the resource over time be reliably assessed.

Request for assistance

4. A table is attached setting out the data for a few selected parameters for six periods around the years 1950, 1960, 1970, 1980, 1990 and 2000, taken from the relevant FAO or UNECE publications (*Annex I*). For each statistic the relevant term as used at the time is shown and is placed on the same line as what is believed to be the nearest corresponding term in TBFRA-2000. For instance, the following are shown on the same line:

Year	Term
2000	Forest available for wood supply
1990	Exploitable forest
1980	Exploitable closed forest
1970	Exploitable forest
1960	Forests in use
1950	Forests in use

We have also attached for your reference an EXCEL-file with spreadsheets containing the source data provided by countries to corresponding UNECE/FAO Forest Resources Assessment cycles, including some graphs illustrating the historical development of the main parameters and including a compilation of terms and definitions used in the different FRA publications.

5. You are invited to very kindly:

(1) Review the data for your country in the table and revise and complete those for 1990 and earlier periods so that they are comparable to those for the latest period (2000), i.e. are based on the same terms and definitions as used in TBFRA-2000.

(2) If possible, provide a set of historical data based on national terms and definitions. It is important that these should be consistent throughout the period covered. It does not matter if the periods or years are different from those in the attached table, but please indicate the concrete reference year.

(3) Return the results to UNECE Timber Branch by 10 March 2002.

Annex 2: Terms and definitions used in FRA publications

1. Forest area

Temperate and Boreal Forest Resources Assessment, 2000

Trees outside the forest:
Trees on land other than forest or other wooded land. Includes: Trees on land that meets the definitions of forest and of other wooded land except that *the* area is less than 0.5 ha and the width is less than 20 m; scattered trees in permanent meadows and pastures; permanent tree crops such as fruit tree orchards and coconut palm plantations; trees in parks and gardens, around buildings, in hedgerows and in lines along streets, roads, railways, rivers, streams and canals; trees in shelterbelts and windbreaks of less than 20 m in width and 0.5 ha in area.

Other wooded land:
Land either with a tree crown cover (or equivalent stocking level) of 5-10 percent of trees able to reach a height of 5 m at maturity in situ; or a crown cover (or equivalent stocking level) of more than 10 percent of trees not able to reach a height of 5 m at maturity in situ (e.g. dwarf or stunted trees) and shrub or bush cover. Excludes: Areas having the tree, shrub or bush cover specified above but of less than 0.5 ha and width of 20 m, which are classed under "other land"; Land predominantly used for agricultural practices.

Forest and other wooded land (FOWL 00):
[term without own definition]

Forest (F 00):
Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity in situ. May consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground; or of open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5m are included under forest, as are areas normally forming part of the forest area which are temporarily un-stocked as a result of human intervention or natural causes but which are expected to revert to forest. Includes: Forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks and other small open areas within the forest; forest in national parks, nature reserves and other protected areas such as those of special environmental, scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and a width of more than 20 m. Rubberwood plantations and cork oak stands are included. Excludes: Land predominantly used for agricultural practices.

Forest available for wood supply (FAWS 00):
Forest where any legal, economic, or specific environmental restrictions do not have a significant impact on the supply of wood. Includes: areas where, although there are no such restrictions, harvesting is not taking place, for example areas included in long-term utilization plans or intentions.

Forest not available for wood supply:
Forest where legal, economic or specific environmental restrictions prevent any significant supply of wood. Includes: (a) Forest with legal restrictions or restrictions resulting from other political decisions, which totally exclude or severely limit wood supply, inter alia for reasons of environmental or biodiversity conservation, e.g. protection forest, national parks, nature reserves and other protected areas, such as those of special environmental, scientific, historical, cultural or spiritual interest; (b) Forest where physical productivity or wood quality is too low or harvesting and transport costs are too high to warrant wood harvesting, apart from occasional cuttings for auto-consumption.

Even-aged (high forest):
High forest in which the predominant proportion of the trees falls into the same age class, generally resulting in a single storey forest.
~ High forest: Forest normally composed of trees of seedling origin, but may also include trees from vegetative reproduction, e.g. poplars. Includes: stands in process of transformation into high forest.

Even-aged high forest available for wood supply:
[term without own definition]

Forest Resources of the Temperate Zones, 1990

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

Other wooded land:
Land that has some forestry characteristics but is not forest as defined above. It includes: open woodland and scrub, shrub and brushland, whether or not used for pasture or range. It excludes land occupied by "Trees outside the forest".
~ open woodland: Land with tree crown cover (stand density) of about 5-20% of the area.
~ scrub, shrub and brushland: Land with scrub, shrub or stunted trees where the main woody elements are shrubs (usually more than 50 cm and less than 7m in height), covering more than about 20% of the area, not primarily used for agricultural or other non-forestry purposes, such as grazing of domestic animals. "Trees outside the forest" are excluded.
~Trees outside the forest: Includes trees on: - Arable land (trees in hedgerows and on boundaries) - Land under permanent crops (tree crops such as rubber, coconut, fruit tree orchards, shelter trees and boundary trees) - Permanent meadows and pastures (trees in hedgerows and on boundaries, scattered trees, small woodlots less than 0.5ha) - Other land (trees in city parks, streets, gardens, around buildings, trees in hedgerows and in lines along roads, canals, railways, rivers and streams, small woodlots less than 0.5ha)

Forest and other wooded land (FOWL 90):
Land under natural or planted stands of trees, whether productive or not. Includes land from which forest has been cleared but that will be reforested in the foreseeable future. It includes areas occupied by roads, small cleared tracts and other small open areas within the forest that constitute an integral part of the forest.

Forest (F 90):
Land with tree crown cover (stand density) of more than about 20% of the area. Continuous forest with trees usually growing to more than about 7m in height and able to produce wood. This includes both closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground and open forest formations with a continuous grass layer in which tree synusia cover at least 10% of the ground. Included are (a) All plantations, including one-rotation plantations, primarily used for forestry purposes; (b) Small areas normally forming part of the forest area which are un-stocked as a result of human intervention or natural causes but which are expected to revert to forest; (c) Young natural stands and all plantations established for forestry purposes which have not yet reached a crown density of more than 20%; (d) Forest roads, cleared tracts, firebreaks and other small open areas, as well as forest nurseries that constitute an integral part of the forest; (e) Forests in national parks, nature reserves and other protected areas such as those of special scientific, historical or cultural interest; (f) Areas of windbreak and shelterbelt trees larger than 0.5 ha in extent Excluded are: (a) "Trees outside the forest as defined below; (b) Areas not meeting the conditions of forests as described above, even if administered by a Forest Authority
~Trees outside the forest: Includes trees on: - Arable land (trees in hedgerows and on boundaries) - Land under permanent crops (tree crops such as rubber, coconut, fruit tree orchards, shelter trees and boundary trees) - Permanent meadows and pastures (trees in hedgerows and on boundaries, scattered trees, small woodlots less than 0.5ha) - Other land (trees in city parks, streets, gardens, around buildings, trees in hedgerows and in lines along roads, canals, railways, rivers and streams, small woodlots less than 0.5ha)

Exploitable (EF 90):
Forest and other wooded land on which there are no legal, economic or technical restrictions on wood production. It includes areas where, although there are no such restrictions, harvesting is not currently taking place, for example, areas included in long term utilization plans or intentions.

Un-exploitable:
Forest and other wooded land on which there are legal, economic or technical restrictions on wood production. It includes (a) forest and other wooded land with severe legal restrictions on wood productions, e.g. national parks, nature reserves and other protected areas such as those of special scientific, historical or cultural interest; (b) forest and other wooded land where physical productivity is too low or harvesting and transportation costs to the nearest market are too high to warrant wood harvesting, apart from occasional possible cuttings for auto-consumption.

Forest Resources of the UNECE Region, 1980

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

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

Forest and other wooded land (FOWL 80):
[term without own definition]

Exploitable (operable) closed forest (ECF 80):
Closed forest in which commercial cuttings have occurred or could occur periodically. This implies at least one commercial cutting during a rotation period.
~ Commercial cuttings: Cutting of logs, pulpwood, pitprops, poles, posts, fuelwood for commercial purposes. The cutting of logs for the production of sawnwood for domestic consumption is considered as commercial cutting. However, the cutting, on a casual basis, of poles and fuelwood for domestic consumption is not considered as commercial cutting.

Un-exploitable (inoperable) closed forest:
Closed forest in which commercial cutting is prohibited or severely restricted by law (e.g. protection forests); or in which physical productivity is too law or transportation costs to the nearest market are too high to warrant periodical commercial cuttings.
~ Commercial cuttings: Cutting of logs, pulpwood, pitprops, poles, posts, fuelwood for commercial purposes. The cutting of logs for the production of sawnwood for domestic consumption is considered as commercial cutting. However, the cutting, on a casual basis, of poles and fuelwood for domestic consumption is not considered as commercial cutting.

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

Stocked exploitable closed forest:
[term without own definition]

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

Forest Resources of the European Region, 1970:

Other wooded land:
Other wooded land is defined as a land with trees whose crowns cover from 5% to 20% of the area or with shrubs or stunted trees covering more than 20%; such land has some forestry characteristics and should not be primarily used for non-forestry purposes such as grazing.

Forest and other wooded land (FOWL 70):
Forest and other wooded land combines the two previous categories and indicates the total area of land under forestry conditions and not used primarily for any other purpose.

Closed forest area (CF 70):
Closed forest area refers to the total area of land with a "forest cover", i.e. with trees whose crowns cover more than 20% of the area, and which are not used primarily for purposes other than forestry. This area includes all plantations, all forests whether reserved or not, forest roads and streams and other small open areas, as well as forest nurseries, which cannot be readily excluded, and areas of windbreak and shelter trees managed as forests; it also includes young plantations which have not yet reached a crown density of more than 20% and temporarily un-stocked areas in which trees have been temporarily removed by cutting or burning; isolated groups of trees which cover an area smaller than 0.5 ha are excluded.

Operable closed forest (OCF 70):
Operable closed forest is defined as closed forest where the current or potential productivity and accessibility would allow forest operations under actual or foreseeable conditions. It includes forest areas that could be opened up for exploitation by the provision of access roads or in which operations may become feasible under improved economic conditions.

Inoperable closed forest:
The area classified as inoperable closed forest includes closed forest where operations are considered unfeasible under current conditions of productivity or accessibility, due to adverse site, unfavourable terrain conditions or location which makes the area economically inaccessible. In addition it includes among inoperable forests those areas where cutting is prohibited or seriously restricted by legal regulations, e.g. for protection or recreation purposes. It should be noted that the definition itself allows for some flexibility in the areas under consideration in relation to changes in techniques and in economic conditions of forest operations.

World Forest Inventory, 1963

Forest (stocked forest land) (F 63):
Forest land bearing a tree or bamboo cover, whether productive or not.

Forest in use (for industrial or commercial purposes) (FIU 63):
All forest from which industrial wood, fuelwood and/or other products are extracted, including afforested and reforested areas, and forest that are now being used intermittently (40-year intervals or less). Excludes forest yielding only fuelwood in very small quantities or where cutting of fuelwood and some industrial wood, or extraction of other forest products, is merely casual or occasional. Although nearly all forest land is capable of producing some fuelwood and even, sometimes, a minor amount of poles and timber, the utilization of forest for this small-scale cutting does not place it in the category of "forest in use for industrial and commercial purposes".

Unproductive forest:
Forest where ecologically adverse conditions limit physical productivity to such an extent that all economic exploitation is impossible, e.g. tundra, maquis, chaparal, etc. Several other types or sub-types of unproductive forest may be recognized, e.g. forest may be unproductive because of low economic productivity, where forest growth is too low to warrant industrial exploitation: other forest may produce a sufficient timber crop to warrant an industrial exploitation but transport costs to the nearest market may be prohibitive. In addition, several combinations of these factors may cause the forest to be unproductive.

Forest land:
All lands bearing vegetative associations dominated by trees of any size, exploited or not, capable of producing wood or other forest products, of exerting an influence on the climate or on the water regime, or providing shelter for livestock and wild life. Includes: (i) Lands from which forest has been clear-cut or burned, but which

will be reforested in the foreseeable future; (ii) Public and private forests of any size; (iii) Forest of slow growth and of dwarfed or stunted forms - e.g., subalpine; (iv) Bamboo stands; (v) All lands affected by shifting cultivation, other than those now being prepared or used for agricultural crops, which will become stocked with forest in the foreseeable future; (vi) Savannah types with density averaging at least 0.05; (vii) Wattle plantations; (viii) One-rotation plantations for production of timber; (ix) Nurseries of forest trees; (x) Forest roads and other small open areas that constitute an integral part of the forest. Excludes: (i) Areas occupied by orchards of fruit or nut trees, and plantations for non-forest crops such as rubber and cinchona; (ii) Areas occupied by individual trees or lines or groups of trees - for example, along roadways, canals and streams, or in city parks, private gardens and pastures - too small to be managed as forest; (iii) Areas of windbreak and shelterbelt trees that are in small groups or narrow strips, too small to be managed as forest; (iv) Lands primarily managed for permanent agriculture; (v) All lands under shifting cultivation being prepared or used for agricultural crops and such lands which will not return to forest in the foreseeable future.

World Forest Inventory, 1958

Forests (F 58):
All lands bearing vegetative associations dominated by trees of any size, exploited or not, capable of producing wood or other forest products, of exerting an influence on the climate or on the water regime, or providing shelter for livestock and wild life. Includes: (i) Lands from which forest has been clear-cut or burned, but which will be reforested in the foreseeable future; (ii) Public and private forests of any size; (iii) Forest of slow growth and of dwarfed or stunted forms - e.g., subalpine; (iv) Bamboo stands; (v) All land which is not part of a recognized fallow rotation of the shifting cultivator, and which will return to forest when he abandons the land; also lands under shifting cultivation on which forest production is maintained concurrently - e.g. Acacia senegal in Sudan;(vi) Savannah types with density averaging at least 0.05; (vii) Wattle plantations; (viii) Tree nurseries; (ix) Forest roads. Excludes: (i) Areas occupied by orchards of fruit or nut trees, and plantations for non-forest crops such as rubber and cinchona; (ii) Areas occupied by individual trees or lines or groups of trees - for example, along roadways, canals and streams, or in city parks, private gardens and pastures - too small to be managed as forest; (iii) Areas of windbreak and shelterbelt trees that are in small groups or narrow strips, too small to be managed as forest; (iv) Lands primarily managed for permanent agriculture; (v) All land which is part of a recognized fallow rotation of the shifting cultivator, or which will not return to forest even so it bear a light timber crop before being cut, burned over and re-cultivated.

Forests in use (FIU 58):
All forest from which industrial wood, fuelwood and/or other products are extracted, including afforested and reforested areas, and forest that are now being used intermittently (40-year intervals or less). Excludes forest yielding only fuelwood in very small quantities or where cutting of fuelwood and some industrial wood, or extraction of other forest products, is merely casual or occasional.

Unproductive forest:
Forest lands which, although accessible, are considered in capable of producing usable crops of wood or other forest products. Includes all accessible areas for which existing knowledge of forest type, density or site conditions rules out any reasonable prospect of exploitation and regardless of whether or not cutting is restricted or prohibited.

Productive forests:
All forest land which is now producing or is capable of producing usable crops of wood or other forest products such as resin, latex, tanbark, cork, bamboo, etc.

Accessible forests:
All forests which are within reach of exploitation by existing waterways, roads, railways, or other means of transportation, or to which movable cableways can be constructed.

Inaccessible forests:
All forests, whether or not potentially exploitable, which are not yet within reach of exploitation because of the lack of transportation systems.

Unexploited forests:
All forests, which are not now being, utilized for extraction of industrial wood, fuelwood or other forest products.

Permanent forests:
Permanent forests intended to remain in forestry use

World Forest Resources, 1953

Forests (F 53):
All lands bearing vegetative associations dominated by trees of any size, exploited or not, capable of producing wood or of exerting an influence on the local climate or on the water regime. Included are: Lands from which forests have been recently clear cut or burned but which will be reforested in the near future; public and private forests of any size; tree nurseries; forest roads; mangrove forests, forests of low growth and of dwarfed or stunted forms. Excluded are: Brush lands, groups of trees outside the forest, trees along roads, etc., and on agricultural lands and parks.

Forests in use (FIU 53):
Forests yielding industrial wood and/or fuelwood.

Unproductive forest:
Forests incapable of yielding products other than fuel because of adverse site conditions. Forests of slow growth and of dwarfed or stunted forms are included.

Productive forests:
Forests physically capable of producing crops of usable wood.

Accessible forests:
Forests which are now within reach of economic management or exploitation as sources of forest products, including immature forests and managed forests where fellings are prohibited.

Inaccessible forests:
Forests which are not yet managed or exploited, owing to inaccessibility.

Forests in use with predominantly economic character:
Forests yielding usable wood and where the protective function is of less importance than the economic function.

Unexploited but accessible forests:
Accessible forests in which there is no cut. Forests in which the cut is prohibited, national parks and other recreational forests, if they are accessible, are included.

Forest Inventory, 1947

Forested lands (FL 47):
Lands bearing vegetative associations dominated by trees of any size, capable of producing timber or other forest products or of exerting an influence on the climate or on the water regime. Also, lands from which forests have been recently clear-cut or burned but which will be reforested in the near future.

Accessible productive forests (APF 47):
Accessible forests are those that are now within reach of economic exploitation as sources of forest products, including immature forests. This category includes all productive forest lands owned by corporations or individuals, all publicly owned forests covered by working plans, and other public forests not covered by working plans but considered to be accessible for exploitation now.

Other forests:
Forests incapable of yielding products other than fuel because of adverse site conditions. This category includes forests of slow growth and of dwarfed or stunted form.

Productive forests:
Forested lands physically capable of producing crops of usable wood.
Inaccessible forests
Forest lands of productive quality that are not yet economically accessible.

2. Increment

Temperate and Boreal Forest Resources Assessment, 2000

Gross annual increment:
Average annual volume of increment over the reference period of all trees, measured to a minimum diameter breast height (dbh) of 0 centimetres (cm). Includes: The increment on trees that has been felled or dies during the reference period.

Net annual increment:
Average annual volume over the given reference period of gross increment less that of natural losses on all trees to a minimum diameter of 0 cm (dbh).

Forest Resources of the Temperate Zones, 1990

Gross increment:
Average volume of increment over given period of all trees (all diameters, down to a stated minimum diameter. Also included is the recruitment (ingrowth) of small trees when they reach the minimum diameter.

Net increment:
Gross increment less natural losses over given period

Natural losses:
Losses to growing stock over given period due to mortality from causes other than cutting by man, e.g. disease, insects, fire, windfall, flooding etc.

Forest Resources of the UNECE Region, 1980

Gross increment:
Average volume of increment over given period of all trees (all diameters, down to a stated minimum diameter. Also included is the recruitment (ingrowth) of small trees when they reach the minimum diameter.

Net increment:
Average gross increment less natural losses over given period

Natural losses:
Losses over given period to growing stock due to mortality from disease, insects, fire, windfall, flooding and other causes, including competition and over-maturity.

Forest Resources of the European Region, 1970
[not provided]

World Forest Inventory, 1963

Gross increment:
Average volume of annual increment of all trees.

Net growth:
Average annual net growth equals gross increment less losses.

Losses:
Average volume rendered unusable annually by forest fires, shifting cultivation, insect pests, tree diseases, natural thinning, wind, snow, avalanches, other climatic factors, etc.

World Forest Inventory, 1958

Gross increment:
Average volume of annual increment of all trees.

Net growth:
Average annual net growth equals gross increment less losses.

Losses:
Average volume rendered unusable annually by forest fires, shifting cultivation, insect pests, tree diseases, natural thinning, wind, snow, avalanches, other climatic factors, etc.

World Forest Resources, 1953

Gross increment:
Average volume of annual increment of all trees in the forests in use.

Net growth:
Average annual net growth equals gross increment less natural losses.

Natural losses:
Average volume of roundwood rendered unusable annually by forest fires, insect pests, tree diseases, snow, windstorms, avalanches, etc., during a recent period.

Forest Inventory, 1947

Total annual growth (gross increment):
The total volume of wood produced by all trees in the forest computed as an annual average for a 10-year period.

Net average annual growth:
The net volume remaining after subtracting natural losses, as defined above, from total annual growth.

Losses from natural causes:
Average volume of roundwood rendered unusable annually during the past 10 years by forest fire; by insect pests and tree diseases; and by climatic factors such as windstorms, ice, etc.

3. Growing stock

Temperate and Boreal Forest Resources Assessment, 2000

Growing stock:
The living tree component of the standing volume.
~ Standing volume: Volume of standing trees, living or dead, above-stump measured over-bark to top (0 cm). Includes all trees with diameter over 0 cm (dbh) Includes: Tops of stems, large branches; dead trees lying on the ground that can still be used for fibre or fuel. Excludes: Small branches, twigs and foliage.

Forest Resources of the Temperate Zones,1990

Growing stock:
The living part of the standing volume.
~Standing volume: Above-ground volume of standing trees, all species, living or dead, all diameters down to a minimum diameter. Includes dead trees laying on the ground that can still be used for fibre or as fuel.

Forest Resources of the UNECE Region, 1980

Growing stock:
The living part of the standing volume.
~Standing volume: Volume of standing trees, all species, living or dead, all diameters down to a stated minimum diameter. Species that do not have an upright trunk (brush, etc.) are not considered trees. It includes dead trees lying on the ground that can still be used for fibre or as fuel.

Forest Resources of the European Region, 1970
[not provided]

World Forest Inventory, 1963

Growing stock:
Volume of standing timber (industrial wood and fuelwood, excluding bamboo).

World Forest Inventory, 1958

Growing stock:
Volume of standing timber (industrial wood and fuelwood, excluding bamboo).

World Forest Resources, 1953

Growing stock:
Estimated total volume of standing timber (industrial wood and fuelwood), growing in the forests in use.

Forest Inventory, 1947

Total volume:
The total volume of wood, without bark, contained in all trees 10cm or more in diameter measured over bark at a point 1.3 meters above ground level. Volume is expressed in cubic meters of roundwood, represented in the table by the symbol m^3 (r).

Annex 3: Overview of terms used in FRA publications (first working hypothesis)

Forest Inventory, 1947	World Forest Resources, 1953	World Forest Inventory, 1958	World Forest Inventory, 1963	Forest Resources of the European Region, 1970	Forest Resources of the ECE Region, 1980	Forest Resources of the Temperate Zones,1990	Temperate and Boreal Forest Resources Assessment, 2000
					Trees outside the forest	Trees outside the forest	Trees outside the forest
				Other wooded land	Other wooded land	Other wooded land	Other wooded land
				Forest and other wooded land (FOWL 70)	Forest and other wooded land (FOWL 80)	Forest and other wooded land (FOWL 90)	Forest and other wooded land (FOWL 00)
Forested lands (FL 47)	Forests (F 53)	Forests (F 58)	Forest (stocked forest land) (F 63)	Closed forest area (CF 70)		Forest (F 90)	Forest (F 00)
Accessible productive forests (APF 47)	Forests in use (FIU 53)	Forests in use (FIU 58)	Forest in use (for industrial or commercial purposes) (FIU 63)	Operable closed forest (OCF 70)	Exploitable (operable) closed forest (ECF 80)	Exploitable (EF 90)	Forest available for wood supply (FAWS 00)
Other forests	Unproductive forest	Unproductive forest	Unproductive forest	Inoperable closed forest	Unexploitable (inoperable) closed forest	Unexploitable	Forest not available for wood supply
Productive forests	Productive forests	Productive forests	Forest land		Stocked closed forest		Even-aged (high forest)
Inaccessible forests	Accessible forests	Accessible forests			Stocked exploitable closed forest		Even-aged high forest available for wood supply
	Inaccessible forests	Inaccessible forests			Closed forest		
	Forests in use with predominantly economic character	Unexploited forests					
	Unexploited but accessible forests	Permanent forests					
Total annual growth (gross increment)	Gross increment	Gross increment	Gross increment	not provided	Gross increment	Gross increment	Gross annual increment
Net average annual growth	Net growth	Net growth	Net growth	not provided	Net increment	Net increment	Net annual increment
Losses from natural causes	Natural losses	Losses	Losses	not provided	Natural losses	Natural losses	not provided

Annex 4: Long-term trends in forest resources (example: Austria)

Source	Forest Inventory, 1947		World Forest Resources, 1953		World Forest Inventory, 1958		World Forest Inventory, 1963		European Timber Trends and Prospects to the year 2000 and beyond Volume II		Forest Resources of the ECE Region, 1980		Forest Resources of the Temperate Zones,1990		Temperate and Boreal Forest Resources Assessment, 2000	
6	**FOREST AREA**		**FOREST AREA**		**FOREST AREA**		**FOREST AREA**		**FOREST AREA**		**FOREST AREA**		**FOREST AREA**		**FOREST AREA**	
reference period for the inventory		1947		1951		1952-56		1952-62		1961-70		1971-80		1986-90		1992-96
reference year for the inventory		1947		1951		1955		1960		1967		1977		1989		1995
1000 ha									Forest & other wooded land (FAWL)	3,691	Forest & other wooded land (FAWL)	3,754	Forest & other wooded land (FAWL)	3,877	Forest & other wooded land (FAWL)	3,924
1000 ha	Forested land	3,139	Forests	3,156	Forests	3,352	Forests	3,166	Closed forest	3,700			Forest	3,877	Forest	3,840
1000 ha	Accessible Productive Forests (APF 47)	2,500	Forests in use (FIU 53)	3,139	Forests in use (FIU 58)	3,177	Forests in use (FIU 63)	2,991	Exploitable closed forest (ECF 70)	3,230	Exploitable closed forest (ECF 80)	3,165	Exploitable forest (EF 90)	3,330	Forest available for wood supply (FAWS 00)	3,352
1000 ha	APF, coniferous	1,600	FIU, coniferous	2,476	FIU, coniferous	2,472	FIU, coniferous	2,512					EF Coniferous	2,530	FAWS Predominantly coniferous	2,125
1000 ha	APF, non-coniferous	300	FIU,non-coniferous	473	FIU, non-coniferous	484	FIU,non-coniferous	479					EF non-coniferous	800	FAWS Predominantly non-coniferous	470
1000 ha	APF, mixed woods	600	FIU, mixed woods		FIU, mixed woods	0	FIU, mixed woods								FAWS Mixed	757
1000 ha	Productive forests, publicly owned	700	Accessible forests, publicly owned	763	Accessible forests, publicly owned	872							Forest publicly owned	703	Forest in public ownership	672
1000 ha	Productive forests. privately owned	2,070	Accessible forests, privately owned	1,930	Accessible forests. privately owned	2,480							Forest privately owned	3,174	Forest in private ownership	3,168
1000 ha	Productive forests, owned by institutions	30	Accessible forests, owned by institutions	446												
	GROWING STOCK (GS)		**GROWING STOCK (GS)**		**GROWING STOCK (GS)**		**GROWING STOCK (GS)**		**GROWING STOCK (GS)**		**GROWING STOCK (GS)**		**GROWING STOCK (GS)**		**GROWING STOCK (GS)**	
reference period for the inventory		1947		1947		1952-56		1952-62		1961-70		1971-80		1986-90		1992-96
reference year for the inventory		1947		1947		1955		1960		1967		1977		1989		1995
mill. m3 o.b.													Total GS of forest & tree resource	998	Total GS	1,107
mill. m3 o.b.													GS on forest	998	GS on forest	1,097
mill. m3 o.b.	Total volume in APF	348	GS in FIU	348	GS in FIU	479	GS in FIU	479	GS on ECF	752	GS on ECF	797	GS on exploitable forest land (EFL)	953	GS on FAWS	1,037
mill. m3 o.b.	Total volume in APF, coniferous	310	GS in FIU, coniferous	310	GS in FIU, coniferous	432	GS in FIU, coniferous	432	GS on ECF, coniferous	642	GS on ECF, coniferous	674	GS on EFL, coniferous	788	GS on FAWS, coniferous	849
mill. m3 o.b.	Total volume in APF, non-coniferous	38	GS in FIU, non-coniferous	38	GS in FIU, non-coniferous	47	GS in FIU, non-coniferous	47	GS on ECF, non-coniferous	110	GS on ECF, non-coniferous	123	GS on EFL, non-coniferous	165	GS on FAWS, non-coniferous	188
	NET ANNUAL INCREMENT (NAI)		**NET ANNUAL INCREMENT (NAI)**		**NET ANNUAL INCREMENT (NAI)**		**NET ANNUAL INCREMENT (NAI)**		**NET ANNUAL INCREMENT (NAI)**		**NET ANNUAL INCREMENT (NAI)**		**NET ANNUAL INCREMENT (NAI)**		**NET ANNUAL INCREMENT (NAI)**	
reference period for the inventory		1947		1947		1952-57		1952-62		1961-70		1971-80		1986-90		1992-96
reference year for the inventory		1947		1947		1956		1960		1967		1977		1989		1995
mill. m3 o.b.													Total NAI of forest & tree resource	24.0	Total	28.1
mill. m3 o.b.													NAI on forest land	24.0	NAI on forest	27.8
mill. m3 o.b.	Net average annual growth (NAAG) in APF	8.2	Net growth (NG) in FIU	8.2	Net growth (NG) in FIU	8.2	NAI in FIU	9.7	NAI on ECF	18.5	NAI on ECF	19.6	NAI on exploitable forest land (EFL)	22.0	NAI on FAWS	27.3
mill. m3 o.b.	NAAG in APF, coniferous	7.0	NG in FIU, coniferous	7.0	NG in FIU, coniferous	7.1	NAI in FIU, coniferous	8.5	NAI on ECF, coniferous	15.7	NAI on ECF, coniferous	16.7	NAI on EFL, coniferous	16.5	NAI on FAWS, coniferous	21.9
mill. m3 o.b.	NAAG in APF, non-coniferous	1.2	NG in FIU, non-coniferous	1.2	NG in FIU, non-coniferous	1.1	NAI in FIU, non-coniferous	1.2	NAI of ECF, non-coniferous	2.8	NAI on ECF, non-coniferous	2.9	NAI, non-coniferous	5.5	NAI on FAWS, non-coniferous	5.4

Annex 5.1 Historical trends in forest resources

Forest area (1000 ha)

	Source	Category	value	year	value	year	value	year	value	year	value	year	value	year	value	year	value	year	value	year
Northern European countries																				
Denmark	NC	FA	371	1951	405	1965	406	1976	417	1990	473	2000								
Finland	NC	FSL	21,900	1952	22,400	1968	23,000	1998												
Norway	NC	FAWS	5,300	1950	5,600	1958	5,850	1970	6,013	1983	6,592	1990	6,609	1995						
Sweden	NC	FAWS	20,950	1947	20,950	1953	21,452	1957	22,092	1970	22,204	1975	21,790	1987	21,236	1994				
Western European countries																				
Austria	NC	FAWS	3,259	1966	3,168	1976	3,339	1983	3,331	1988	3,352	1994								
Belgium	NC	FAWS	601	1950	616	1959	617	1970	636	1982	648	1991	660	2000						
France	NC	FAWS	10,954	1947	11,307	1953	11,500	1958	13,090	1970	13,340	1981	13,602	1988	14,470	1997				
Germany	FRA	HYP	7,548	1947	9,558	1952	9,996	1958	9,616	1963	9,428	1968	9,800	1970	10,142	1987	9,852	1988		
Ireland	FRA	HYP	89	1947	124	1951	145	1958	171	1962	268	1970	347	1980	394	1989	580	1996		
Luxembourg	FRA	HYP	78	1947	81	1952	83	1954	81	1962	100	1970	80	1983	82	1989	86	1996		
Netherlands	NC	FAWS	245	1960	260	1966	272	1970	308	1980	311	1990	314	1995						
Switzerland	NC	PFA	909	1945	946	1950	960	1960	970	1970	1,014	1980	1,055	1990	1,073	2000				
United Kingdom	NC	FA	1,477	1947	1,767	1965	2,159	1980	2,717	1997										
Southern European countries																				
Greece	FRA	HYP	500	1947	2,000	1953	1,976	1958	1,992	1963	2,289	1964	2,300	1970	1,793	1983	3,094	1992		
Italy	NC	FA	5,900	1940	5,625	1950	5,826	1960	6,162	1970	6,363	1980	6,760	1990	6,847	1998				
Portugal	NC	FAWS	1,543	1953	1,669	1963	1,827	1974	1,980	1982	2,126	1995								
Spain	FRA	HYP	12,500	1953	15,800	1958	14,935	1963	5,931	1971	6,506	1980	10,479	1990						
Turkey	NC	FAWS	8,730	1970	8,704	1980	8,657	1990	8,635	1996	8,642	1998	8,645	1999						
Central and Eastern European countries																				
Albania	FRA	HYP	1,000	1950	930	1981	910	1990	902	1995										
Bulgaria	FRA	HYP	2,976	1947	3,259	1958	3,200	1970	3,300	1980	3,222	1990	3,124	1995						
Czech Republic	NC	FAWS	2,416	1950	2503	1960	2,410	1970	2505	1980	2,552	1990	2486	2000						
Hungary	NC	FAWS	1,162	1950	1,302	1960	1,477	1970	1,602	1980	1,685	1990	1,702	1996	1,753	2000				
Poland	NC	FAWS	6,762	1950	8,236	1970	8,311	1980	8,349	1990	8,300	1996								
Romania	FRA	HYP	6,326	1949	5,768	1958	5,008	1962	5,900	1970	5,860	1981	5,413	1990	6,680	1995				
Slovakia	NC	FA	1,771	1953	1,776	1960	1,918	1970	1,952	1980	1,976	1988	2,016	1996						
former Yugoslavia	FRA	HYP	7,521	1953	6,833	1961	7,000	1970	8,500	1979	7,768	1988	7,154	1996						
CIS countries																				
Russian Federation	NC	FOWL	838,546	1956	848,110	1961	855,000	1966	862,078	1973	872,300	1978	880,503	1983	884,094	1988	886,538	1993	881,974	1998

Abreviations:

NC Data provided by national correspondent
FRA FRA source data

FA Forest area
FSL Forest and scrub land
FOWL Forest and other wooded land
FAWS Forest available for wood supply
PFA Productive forest area
HYP First working hypothesis (see Chapter 2.2 and Annex 3)

Annex 5.2 Historical trends in forest resources

Growing Stock (Million m^3)

	Source	value	year	value	year	value	year	value	year	value	year	value	year	value	year	value	year	value	year
Northern European countries																			
Denmark	NC	53	1951	55	1965	60	1976	65	1990	74	2000								
Finland	NC	1,538	1952	1,492	1968	2,002	1998												
Norway	NC	400	1950	432	1958	492	1970	541	1983	616	1990	671	1995						
Sweden	NC	1,805	1947	1,895	1953	1,910	1954	1,960	1957	2,150	1970	2,240	1980	2,390	1987	2,567	1994		
Western European countries																			
Austria	NC	780	1966	827	1976	934	1983	972	1988	988	1994								
Belgium	NC	56	1950	68	1959	84	1970	122	1982	132	1991	141	2000						
France	NC	953	1947	1,096	1953	1,225	1958	1,331	1959	1,598	1970	2,110	1981	2,345	1988	2,836	1997		
Germany	FRA	819	1947	889	1952	1,141	1958	1,502	1968	1,372	1970	2,820	1987	2,674	1988				
Ireland	FRA	3	1947	5	1951	7	1958	10	1962	15	1970	32	1980	30	1989	43	1996		
Luxembourg	FRA	10	1947	10	1952	10	1957	11	1962	13	1970	13	1983	20	1989	20	1993		
Netherlands	NC	16	1960	25	1966	36	1970	42	1980	49	1990	52	1994						
Switzerland	NC	270	1970	283	1976	300	1984	353	1994										
United Kingdom	NC	107	1947	124	1965	202	1980	404	1997										
Southern European countries																			
Greece	FRA	44	1947	129	1953	102	1958	148	1963	150	1970	149	1981	133	1983	140	1992		
Italy	FRA	329	1947	329	1957	296	1962	286	1970	557	1980	743	1985	877	1995				
Portugal	NC	99	1953	109	1966	148	1979	149	1984	153	1997								
Spain	FRA	97	1953	150	1958	210	1963	427	1970	453	1980	487	1990						
Turkey	NC	1,032	1970	1,030	1980	1,085	1990	1,187	1996	1,188	1998	1,196	1999						
Central and Eastern European countries																			
Albania	FRA	93	1949	80	1981	73	1990	74	1995										
Bulgaria	FRA	152	1947	210	1950	243	1956	264	1970	298	1980	405	1990	401	1995				
Czech Republic	NC	384	1950	415	1960	530	1970	639	1980	683	1990	752	2000						
Hungary	NC	150	1950	180	1960	214	1970	244	1980	274	1990	295	1996	305	2000				
Poland	NC	1,020	1950	1,319	1970	1,437	1980	1,632	1990	1,771	1996								
Romania	FRA	938	1962	1,268	1970	1,268	1981	1,202	1990										
Slovakia	NC	246	1953	259	1960	315	1970	414	1980	464	1988	511	1996						
former Yugoslavia	FRA	718	1953	880	1958	984	1961	913	1970	1,056	1979	1,043	1996						
CIS countries																			
Russian Federation	NC	76,100	1956	77,530	1961	76,959	1966	78,699	1973	80,671	1978	81,934	1983	81,644	1988	80,676	1993	81,864	1998

Abreviations:
NC Data provided by national correspondent
FRA FRA source data: first working hypothesis (see Annex 3)

Annex 5.3 Historical trends in forest resources

Net Annual Increment (Million m^3)

	Source	Category	value	year	value	year	value	year	value	year	value	year	value	year	value	year	value	year	value	year
Northern European countries																				
Denmark	NC	GAI	4.3	1951	4.4	1965	4.4	1976	4.5	1990	4.9	2000								
Finland	NC	AVI	55.2	1952	57.2	1968	79.4	1998												
Norway	NC	NAI	13.0	1950	13.8	1958	14.7	1970	17.1	1983	21.0	1990	22.0	1995						
Sweden	NC	NAI	62.8	1945	62.8	1947	71.8	1953	71.8	1957	71.8	1970	78.2	1980	84.6	1987	87.4	1994		
Western European countries																				
Austria	NC	NAI	22.9	1963	24.3	1973	31.4	1986	27.3	1991										
Belgium	FRA(NC)	HYP	1.2	1947	2.3	1951	2.2	1956	2.4	1962	2.6	1970	4.5	1980	5.3	2000				
France	NC	NAI	33.2	1947	37.6	1952	46.7	1956	53.9	1970	62.6	1981	83.3	1988	92.3	1997				
Germany	FRA	HYP	27.0	1947	30.8	1951	37.0	1957	53.5	1968	47.2	1970	89.0	1995						
Ireland	FRA	HYP	0.1	1947	0.3	1951	0.5	1957	0.7	1962	1.8	1970	2.6	1980	3.3	1989	3.5	1996		
Luxembourg	FRA	HYP	0.2	1947	0.2	1953	0.2	1956	0.2	1962	0.4	1970	0.3	1983	0.7	1993				
Netherlands	NC	NAI	0.9	1960	1.4	1966	1.9	1970	2.3	1980	2.2	1990	2.2	1994						
Switzerland	NC	NAI	5.4	1970	8.2	1992														
United Kingdom	NC	NAI	3.8	1947	10.9	1980	15.3	1997												
Southern European countries																				
Greece	FRA	HYP	0.9	1947	3.8	1952	3.6	1956	4.1	1963	3.3	1964	4.0	1970	3.6	1983	3.5	1992		
Italy	FRA	HYP	11.3	1947	14.8	1951	11.4	1956	11.8	1962	14.0	1970	11.9	1980	18.7	1995				
Portugal	NC	NAI	8.4	1953	9.3	1966	12.8	1979	13.2	1984	15.2	1997								
Spain	FRA	HYP	2.6	1953	4.0	1958	5.3	1963	25.5	1970	27.8	1980	28.6	1990						
Turkey	NC	GAI	30.9	1970	30.2	1980	31.8	1990	34.2	1996	34.1	1998	34.3	1999						
Central and Eastern European countries																				
Albania	FRA	HYP	3.9	1950	3.0	1981	1.0	1990	0.9	1995										
Bulgaria	FRA	HYP	6.1	1947	6.5	1970	7.6	1980	10.2	1995										
Czech Republic	NC	NAI	10.5	1950	16.9	1970	19.4	1980	18.6	1990	23.1	2000								
Hungary	NC	NAI	5.1	1950	6.5	1960	8.6	1970	9.3	1980	9.7	1990	9.9	1996	10.1	2000				
Poland	NC	NAI	35.2	1950	42.6	1970	41.4	1980	41.1	1990	39.4	1996								
Romania	FRA	HYP	13.2	1956	14.7	1962	26.9	1970	26.9	1981	31.6	1990								
Slovakia	NC	NAI	6.6	1953	8.5	1960	11.3	1970	12.9	1980	14.1	1988	13.9	1996						
former Yugoslavia	FRA	HYP	14.7	1952	19.8	1957	20.8	1961	22.4	1970	27.7	1979	27.7	1988	19.3	1995				
CIS countries																				
Russian Federation	NC	NAI	850.1	1956	841.6	1961	853.8	1966	882.9	1973	889.8	1978	959.4	1983	938.0	1988	889.4	1993	970.4	1998

Abreviations:

NC	Data provided by national correspondent	NAI	Net annual increment
FRA	FRA source data	GAI	Gross annual increment
FRA(NC)	FRA source data with modified figure for latest inventory	AVI	Annual volume increment
		HYP	First working hypothesis (see Annex 3)

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The Timber Committee is a principal subsidiary body of the UNECE (United Nations Economic Commission for Europe) based in Geneva. It constitutes a forum for cooperation and consultation between member countries on forestry, forest industry and forest product matters. All countries of Europe; the former USSR; United States, of America, Canada and Israel are members of the UNECE and participate in its work.

The UNECE Timber Committee shall, within the context of sustainable development, provide member countries with the information and services needed for policy- and decision-making regarding their forest and forest industry sector ("the sector"), including the trade and use of forest products and, when appropriate, formulate recommendations addressed to member Governments and interested organizations. To this end, it shall:

3. With the active participation of member countries, undertake short-, medium- and long-term analyses of developments in, and having an impact on, the sector, including those offering possibilities for the facilitation of international trade and for enhancing the protection of the environment;
4. In support of these analyses, collect, store and disseminate statistics relating to the sector, and carry out activities to improve their quality and comparability;
5. Provide the framework for cooperation e.g. by organizing seminars, workshops and ad hoc meetings and setting up time-limited ad hoc groups, for the exchange of economic, environmental and technical information between governments and other institutions of member countries that is needed for the development and implementation of policies leading to the sustainable development of the sector and to the protection of the environment in their respective countries;
6. Carry out tasks identified by the UNECE or the Timber Committee as being of priority, including the facilitation of subregional cooperation and activities in support of the economies in transition of central and eastern Europe and of the countries of the region that are developing from an economic point of view;
7. It should also keep under review its structure and priorities and cooperate with other international and intergovernmental organizations active in the sector, and in particular with the FAO (Food and Agriculture Organization of the United Nations) and its European Forestry Commission and with the ILO (International Labour Organisation), in order to ensure complementarities and to avoid duplication, thereby optimising the use of resources.
8.

More information about the Committee's work may be obtained by writing to:

Timber Section
Trade Development and Timber Division
UN Economic Commission for Europe
Palais des Nations
CH - 1211 Geneva 10, Switzerland
Fax: + 41 22 917 0041
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The Development of European Forest Resources, 1950 to 2000

This study deals with the challenge of adjusting inconsistencies in the historical data series over time for the main forest resources parameters based on the UNECE/FAO Forest Resources Assessments (FRA) source data. It describes the methods used to improve the quality of long-term series based on national inventory data and assesses trends for a number of European countries. It attempts to identify driving forces behind major long-term changes in key forest resource parameters.

European Forest Sector Outlook Study (EFSOS)

The European Forest Sector Outlook Studies (EFSOS) are the continuation of the European Timber Trends Studies dating back to the 1950s. These studies forecast development in the forest and forest products sector over the following twenty years. The current programme consists of two primary studies on the outlook for forest resources and on forest products. A large number of ancillary studies are also in progress or planned. The geographical scope has been broadened to include all European UNECE member states, which collectively have over 70% of the world's temperate and boreal forest. Products covered include all major wood end-products. The results of EFSOS are intended for government policy makers as well as analysts and researchers.

UNECE Timber Committee and FAO European Forestry Commission

Further information about forests and forest products, as well as information about the UNECE Timber Committee and the FAO European Forestry Commission is available on the website www.unece.org/trade/timber. Information about the UNECE may be found at www.unece.org and information about FAO may be found at www.fao.org.

UNECE/FAO Timber Branch
UN Economic Commission for Europe
Palais des Nations
CH-1211 Geneva 10, Switzerland
Fax: +41 22 917 0041
E-mail: info.timber@unece.org