

The European Framework for Integrated Environmental and Economic Accounting for Forests — IEEAF

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Preface

The European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF) is one of the outputs of Eurostat's Environmental Accounting work. It contributes to various EU-wide and international activities in the context of national and environmental accounts, including the implementation of the European System of Accounts (ESA 1995), the implementation of the new Economic Accounts for Forestry (EAF Rev. 1) and the ongoing revision of the System of Integrated Environmental and Economic Accounting (SEEA).

The results of a first set of IEEAF pilot applications have been published as 'The European Framework for Integrated Environmental and Economic Accounting for Forests: Results of pilot applications' (European Commission 1999a, Eurostat catalogue number CA-22-99-329-EN-C). A second set of pilot applications has been completed and results will be published in 2000.

Both the pilot exercises and the development of the IEEAF benefited from substantial financial support provided by the European Commission's Directorates General Environment and Regional Policy, in the context of the Communication from the Commission to the Council and the European Parliament on *Directions for the EU on Environmental Indicators and Green National Accounting - The Integration of Environmental and Economic Information Systems* (COM(94) 670).

The development of the IEEAF was only possible due to the essential contributions made by the members of the Eurostat Task Force on Forest Accounting created in 1995. The Task Force met in August 1995, May 1996, April 1998, March 1999, May 1999 and September 1999 to discuss and further refine the IEEAF.

Special thanks are therefore to the members of the Eurostat Task Force on Forest Accounting:

- L. Ritter, C. Grobecker and L. Frankford (German Federal Statistical Office),
- V. Bergen, H. Schroeder and S. Gutow (University of Göttingen - Germany),
- C. Thoroë and P. Elsasser (Federal Research Centre for Forestry and Forest Products - Germany),
- D. Desaulty (IFEN – French Environment Institute),
- J.-L. Peyron and A. Tessier (ENGREF – France),
- F. Battelini and F. Falcitelli (Italian Statistical Office),
- I. Gschwandtl and J. Hangler (Austrian Ministry of Agriculture and Forestry),
- B. Nikodem and W. Sekot (under contract with the Austrian Central Statistical Office),
- L. Kolttola and J. Muukkonen (Statistics Finland),
- M. Eriksson and M. Wolf (Statistics Sweden),
- K. Skanberg (National Institute of Economic Research - Sweden).

Beyond their contributions as members of the Task Force the Professors C. Thoroë (Germany), V. Bergen (Germany), J.-L. Peyron (France) and W. Sekot (Austria) and their staff provided essential inputs through their evaluations and numerical analyses of the different valuation methods for forest land and timber.

Contributions to the work of the Task Force on Forest Accounting and to this publication also came from M. Aarne, E. Mikkola, H.-G. Andresen, U. Eidmann and M. Ernens of Eurostat F1 (Economic and structural statistics for agriculture and forestry) and M. Pau Vall and R. Montgomery of Eurostat F3 (Environment statistics). This manual was prepared by G. Gié of Planistat Europe and A. Steurer of Eurostat B1.

The work on forest accounting is continuing at Eurostat together with the Task Force on Forest Accounting. Work is focusing on further methodological development of the IEEAF, on the physical description and monetary valuation of non-market environmental and protection services provided by forests and on collecting data more regularly from more Member States.

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Head of Unit
National accounts methodology,
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1. Introduction

- 1.01 As demonstrated by the latest Environmental assessment report of the European Environment Agency "Environment in the European Union at the turn of the century" (EEA 1999), forests are at the crossroads of many environmental and economic problems including climate change, loss of biodiversity, soil erosion, water stress and stability of mountain areas.
- 1.02 The *fifth Community environmental action programme* ('Towards sustainability: a European Community programme of policy and action in relation to the environment and sustainable development' 93/C 138/01) expressed a growing concern about European forests, threatened by forests fires and acidification. The Programme formulated the objective of "an optimisation of forest so that it may fulfil all its functions", in particular through the development of forestry output, employment and reforestation, including on agricultural land. The Programme also reaffirms the engagement of the European Union to fight against the greenhouse effect and to support the international efforts for the protection of tropical forests.
- 1.03 The *Review of the fifth Community environmental action programme* (Decision 2179/98/EC) underlined the need to better co-ordinate actions and policies affecting forests, with a view to facilitating their management, including afforestation, protection from forest fires, conservation and sustainable management.
- 1.04 The *Ministerial Conference on the protection of forests in Europe* (Helsinki, 16-17 June 1993) adopted resolutions which define, *inter alia*:
- general guidelines for the sustainable management of forests in Europe,
 - general guidelines for the conservation of the biodiversity of European forests,
 - strategies for a process of long-term adaptation of forests in Europe to climate change,
 - a set of indicators.
- 1.05 The *Communication from the Commission to the Council and European Parliament "Directions for the EU on Environmental Indicators and Green National Accounting"* (COM (94) 670) called for:
- establishing a European System of Environmental Pressure Indices,
 - integrating these with national accounts, thus establishing a European System of Integrated Economic and Environmental Indices based on the NAMEA¹ system,
 - continuing and enlarging work on satellites to National Accounts (environmental expenditures, natural resource accounting, etc.).
- 1.06 As a prototype for European natural resource accounts, this manual presents a framework for a "forest satellite account" to the national accounts. The proposed Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF) deals with the physical and monetary description of stocks of forest-related assets (mainly land and standing timber), monetary accounts for forest-related activities (mainly forestry and logging) and physical and monetary supply and use tables of wood and wood products. Mass balances and the description of flows of residuals allow integrating environmental concerns (role of forests in the carbon cycle, recycling of waste, etc.) with national accounts data.
- 1.07 Whereas the physical description of non-market environmental and protective services provided by forests and of the health of forests is, to some extent, integrated in the IEEAF framework, no attempt is made at present to integrate the value of these services and functions, nor to value their degradation.
- 1.08 This manual was prepared on the basis of the work undertaken by the Eurostat Task Force on Forest Accounting. A first version of the IEEAF was presented at the London Group meeting in Stockholm 28-31 May 1996 (see Newson and Gié 1996). The proposed set of tables was tested in several countries. The results of a first set of these pilot applications were published as: 'The European Framework for Integrated Environmental and Economic Accounting for Forests: Results of pilot applications' (European Commission 1999a). The present version of the IEEAF also incorporates the conclusions of three Task Force meetings held in 1999 as well as the results of various international meetings.

¹ National Accounting Matrix including Environmental Accounts, for a general presentation see e.g. European Commission (1999b).

2. Summary

- 2.01 Objective of the IEEAF is to consistently link forest balance sheets and flow accounts for land and timber, forest-related economic activities and the supply and use of wood within the economy, in physical and monetary terms and, in a next step, to also integrate monetary and physical data on non-market environmental and protective functions of forests, biodiversity, the health status of forests, etc.
- 2.02 **Chapter 3** of the IEEAF manual is devoted to an overview of classifications, definitions, accounting frameworks and valuation issues. A study of existing statistical definitions and classifications of forest is taken as a point of departure. The objective is to determine to what extent these classifications and corresponding statistical data allow to implement the different instruments (forest and wood accounting frameworks and indicators) which describe the various aspects and functions of forests.
- 2.03 In a second step, the classification of forest-related assets (wooded land and cultivated or wild biological assets) in the 1995 ESA², the 1993 SNA³, the EAF Rev. 1⁴ and the 1993 version of the SEEA⁵ is reviewed, as well as the treatment in national accounts of the changes that affect these assets (transactions, other changes in volume, etc.). Physical accounting frameworks and indicators as well as valuation issues of forest-related assets in ESA/SNA are then analysed, with special focus on (wooded) land and stocks of standing timber. The main conclusions of Chapter 3 are presented below.

Definitions and classifications

- 2.05 Forest and other wooded land as defined in international forestry statistics do not cover all land with trees. However, the international definitions must be retained, as they offer the only basis for harmonised data at international level.
- 2.06 In forestry statistics, a basic distinction is made between “wooded land available for wood supply” and “wooded land not available for wood supply”. Complementary classifications relate to other aspects of forests: naturalness, species composition, ownership, etc. All these classifications cover features worth to be integrated within a forest accounting framework.
- 2.07 The description of other functions of forest (recreation, protection of biodiversity, soils, etc.) is still embryonic. However, the TBFR-2000⁶ has extended collection of statistical data on forests to these functions.

Accounting frameworks

- 2.08 In ESA, SNA and EAF Rev. 1 forests do not exist as such, but are separated into land on the one hand and biological assets (timber, etc.) on the other hand. Furthermore, a basic distinction is made between cultivated and non-cultivated biological assets. Whereas the natural growth of cultivated timber is accounted for as output, this is not the case for natural growth of non-cultivated timber. On the whole, ESA/SNA and SEEA provide a comprehensive framework for the recording of all changes that affect forest assets and the description of corresponding flows and transactions.
- 2.09 Physical accounting for forest-related assets is well established. National forest inventories provide a basis for forest balances in area and in volume. Material balances of wood and wood products are already developed⁷. A land accounting framework, which cross-classifies changes in land use or cover by causes (economic activities, natural or accidental processes, etc.) has been drafted by UN-ECE⁸.

² European System of Accounts. European Commission (1996). The 1995 ESA is consistent with the 1993 SNA.

³ System of National Accounts. Commission of the European Communities et al (1993).

⁴ European Commission (1997).

⁵ System for integrated Environmental and Economic Accounting – interim version. United Nations (1993). The SEEA is currently being revised.

⁶ UN-ECE/FAO Temperate and Boreal Forest Resources Assessment 2000.

⁷ See e.g. OECD (1994a).

⁸ United Nations Economic Commission for Europe. See Conference of European Statisticians (1995).

Indicators

- 2.10 The Ministerial Conference on the protection of forests in Europe, held in Helsinki, 16-17 June 1993, issued a list of criteria and quantitative indicators for European forests. These indicators relate to:
- the maintenance and appropriate enhancement of forest resources and their role in the global carbon cycle,
 - the maintenance of forest ecosystems health and vitality,
 - the maintenance and encouragement of productive functions of forests (wood and non-wood),
 - the maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems,
 - the maintenance and appropriate enhancement of protective functions in forest management (notably soil and water),
 - the maintenance of other socio-economic functions and conditions.

Most of these indicators can be consistently calculated on the basis of the IEEAF framework.

Valuation

- 2.11 On the basis of ESA/SNA principles for the valuation of assets, recommendations are made for the valuation of the main forest-related assets (forest land and timber).
- 2.12 Land should be valued on the basis of actual transactions. When actual transactions in forest real estates do not allow to directly assess the value of land alone, this value must be indirectly estimated, using e.g. hedonic analysis, surrogate markets, etc.
- 2.13 The ESA/SNA recommends for assets, for which the returns are delayed (as with timber), a valuation by the 'discounted present value of future returns' method. However, after examination of the various methods that can be used for the valuation of standing timber, the IEEAF manual advocates no particular method of valuation for standing timber. Based on comparative analyses undertaken by the Eurostat Task Force on Forest Accounting the position is taken that the choice of a method, at national level, has to be guided by several factors including compliance with ESA/SNA standards, data availability and suitability of the method for the national forest and forestry conditions.

The IEEAF framework

- 2.14 In the **Chapter 4** proposals are made for integrated environmental and economic accounts for forests. These accounts form a "forest satellite account" to the national accounts allowing for the linking of national accounts data to other environmentally oriented instruments (indicators, land accounting matrices, etc.). The final objective is to describe interactions between economic activities and forests as natural media and to integrate environmental and economic concerns about forests in a consistent and comprehensive way.
- 2.15 As concerns monetary transactions and flows of wood, wood products and residuals (waste and pollutants), the proposals are based on a NAMEA-type framework. The presentation of balance sheets and other changes in volume of assets follows the 1993 interim version of the SEEA.
- 2.16 The proposed framework covers:
- a core classification of forest-related assets, wood products and related industries,
 - balance sheets of forest-related assets, in monetary and physical units, integrating the description of all changes that affect forest-related assets,
 - monetary accounts for activities and transactions related to forests (forestry, logging, etc.), including forest protection and management activities,
 - supply and use tables, in monetary and physical units,
 - mass balances and flows of residuals accounts, in physical units.

The set of implementation tables for the IEEAF

- 2.17 In the **Chapter 5**, a set of tables for a first implementation of the IEEAF is presented. The tables cover the main aspects of the IEEAF framework: balance sheets for land and standing timber, economic accounts for forestry and supply-use tables, in monetary and physical units.
- 2.18 Objective of this set of tables is to help the implementation of the framework. Tests of a preliminary version of these tables have been made by five European countries, with a view to forest statistics (availability of data, appropriateness of classifications, etc.) and the accounting framework (consistency of proposals for valuation, classification of transactions and other changes in volume, etc.). The – rather positive - results of these tests, presented in the Eurostat publication “The European Framework for integrated environmental and economic accounting for Forests - Results of Pilot Applications” (European Commission 1999a), have been taken into account in this manual and in the set of tables.

Scope and limitations of the manual

- 2.19 Although the present IEEAF framework covers many aspects of the interactions between economic activities and the environment, it does not pretend to be a general integrated economic and environmental accounting framework, which could be applied to describe all these interactions. This manual must rather be seen as a first step towards integrating European forest issues with the national accounts, the focus being put mainly on the wood supply function.
- 2.20 Whereas it was possible to develop a “forest satellite account” to the national accounts, the integration of more complex issues, such as ecological or social functions of forests remains far from satisfactory at present. Such a situation results, among other reasons, from the fact that work in these areas at national or international level is still exploratory⁹ and that existing information systems do not provide fully harmonised data. Nevertheless important steps towards the development of more comprehensive and harmonised sets of data are being taken through e.g. the International Co-operation Programme on Forest Health and the TBFRA-2000.
- 2.21 The monetary valuation of non-market environmental and protection functions and services of forests remains largely controversial. Thus, as this manual focuses on the way the system of national accounts contributes to structure the information about forests, as far as monetary valuation is concerned, the principles retained are those of ESA/SNA and alternative valuation methods such as contingent valuation and maintenance cost valuation or “adjustments” to Gross (or Net) Domestic Product are not introduced.

⁹ See e.g. FAO (1998): Economic and environmental accounting for Forestry: status and current efforts – Draft version.

3. Definitions, classifications and valuation

Definition and classifications of forests in primary statistics

General definition of forests

3.01 Although defined by cover characteristics, wooded land is a category of the land use classification. Definitions are almost fully harmonised at international level, between Eurostat, FAO, OECD and UN-ECE. Within wooded land, forests are generally separated from "other wooded land" on the basis of various parameters, such as % of crown cover, minimum area, etc.

TBFRA-2000 definition of forests

3.02 In the TBFRA-2000¹⁰, forest is defined as land with tree crown cover (or equivalent stocking level) of more than 10 per cent and area more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity in situ. Included are:

- young natural stands and all plantations established for forestry purposes which have yet to reach the crown density of 10 percent or tree height of 5 m.
- areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.
- forest roads, cleared tracts, firebreaks and other small open areas, as well as forest nurseries and seed orchards that constitute an integral part of 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 shelter belts of trees with an area of more than 0.5 ha and a width of more than 20 m.
- rubber wood plantations and cork oak stands.

Excluded is the land predominantly used for agricultural practices.

TBFRA-2000 definition of other wooded land

3.03 In the TBFRA-2000, other wooded land is defined as 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. It excludes areas having the tree, shrub and bush cover specified above but of less than 0.5 ha and width of 20 m, which are classed under "other land" as well as land predominantly used for agricultural practices.

3.04 The TBFRA-2000 introduces a specific category for "trees outside the forest", i.e. trees on land other than wooded land. This category 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 line along streets, roads, rivers, streams and canals; trees in shelter belts and windbreaks of less than 20 m in width and 0.5 ha in area."

3.05 It results from these definitions that some "land with trees" is excluded from the category "forest and other wooded land" of the land use classification. Such areas that play an important role for amenity of urban inhabitants (city parks and gardens), or as ecosystems (hedgerows, scattered trees, etc.) should be recorded in other categories of the land classification. As an example, in France areas with scattered trees, hedgerows, etc. amount to about 5 to 10 % of the wooded land as defined above (see Annex 1 for details).

¹⁰ See UN-ECE/FAO Temperate and Boreal Forest Resource Assessment 2000: terms and definitions, July 1997.

3.06 Forest inventories are the main source for forest data. However, they do not use the same methodology or thresholds in the different countries; therefore forest areas do not always refer to the same reality. According to the publication "Europe and the Forest"¹¹ great care must be taken when comparing data between countries and even different statistics for the same country.

Statistical classifications of forest and other wooded land

3.07 The basic classification of forest and other wooded land refers to the availability of wooded land to supply wood. TBFRA-2000 definitions are as follows:

forest available for wood supply: "Forest and other wooded land where any legal, economic or specific environmental restrictions do not have a significant impact on the supply of wood. It includes areas, where although there are no such restrictions, harvesting is not taking place, for example, areas included in long-term utilisation plans or intentions".

forest not available for wood supply: "Forest where legal, economic or specific environmental restrictions prevent any significant supply of wood. It 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".

3.08 TBFRA-2000 also defines "managed forest". Managed forest is that forest which is managed in accordance with a formal or an informal plan applied regularly over a sufficiently long period (five years or more). The management operations include the tasks to be accomplished in individual forest stands (e.g. compartments) during the given period.

3.09 Data from the TBFRA-2000 will be published in 2000. However, structural forest data do not change very fast and the following tables illustrate that most of the European Union forest is exploitable (i.e. available for wood supply) and regularly managed.

Exploitable forest 1995

	Forest land (1 000 ha)	Other wooded land (1 000 ha)	Exploitable forests	
			Area (1 000 ha)	% of forest land
Austria	3 877	-	3 330	86
Belgium	620	-	620	100
Denmark	417	-	417	100
Finland	20 032	2 971	18 842	94
France	15 034	1 840	13 919	93
Germany	10 741	-	10 225	95
Greece	3 359	3 154	:	:
Ireland	570	36	464	81
Italy	6 821	3 036	:	:
Luxembourg	89	-	86	96
Netherlands	334	50	280	84
Norway	8 076	3 927	7 315	91
Portugal	2 875	363	2 444	85
Spain	10 662	15 322	8 006	75
Sweden	24 425	3 582	21 843	89
United Kingdom	2 469	-	2 469	100

Source: Eurostat Forestry statistics 1992-1996 (European Commission 1998b).

¹¹ European Parliament (1997).

Wooded forest area regularly managed

	Forest area (1000 ha)	Regularly managed (1000 ha)	%
Belgium	589	589	100.0
Denmark	406	406	100.0
France	13 470	9 428	70.0
Germany (former FRG)	6 938	6 787	97.8
Greece	2 262	1 460	64.5
Ireland	385	350	90.9
Italy	6 403	6 403	100.0
Luxembourg	80	80	100.0
Netherlands	331	260	78.5
United Kingdom	1 949	1 872	96.0

Source: Eurostat Forestry statistics 1980-1984 (European Commission 1997).

- 3.10 In the TBFRA-2000, forests are also classified according to their naturalness. Three categories are distinguished: plantations, semi-natural forest/other wooded land and forest/other wooded land undisturbed by man.

Plantations: forest stands established by planting or/and seeding in the process of afforestation or reforestation. They are either of introduced species, or intensively managed stands of indigenous species, which meet all following criteria: one or two species at plantation, even age class, regular spacing. They exclude stands which were established as plantations but which have been without intensive management for a significant period of time. These should be considered semi-natural.

Forest/other wooded land undisturbed by man: forest/other wooded land which shows natural forest dynamics, such as natural tree composition, occurrence of dead wood, natural age structure and natural regeneration processes, the area of which is large enough to maintain its natural characteristics and where the last significant human intervention was long enough ago to have allowed the natural species composition and processes to have become re-established.

Semi-natural forest/other wooded land: forest/other wooded land, which is neither "forest/other wooded land undisturbed by man" nor "plantation" as defined above.

As will be seen this classification is important from the point of view of the economic classification of forest/other wooded land.

- 3.11 UN-ECE (1992) and the OECD/Eurostat forestry questionnaire also make a distinction by uses:

- forest & other wooded land whose main use is wood production,
- forest & other wooded land whose main use is the protection of soils, water, etc.,
- forest & other wooded land whose main use is recreation.

- 3.12 The TBFRA-2000 introduced the category of "protection area", i.e. the area of forest and other wooded land managed primarily for soil protection. More generally, the protection function of the forest is defined as "the function of forest/other wooded land in providing protection of soils against erosion by water or wind, prevention of desertification, the reduction of risk of avalanches and rock or mud slides; and in conserving, protecting and regulating the quantity and quality of water supply, including the prevention of flooding. It also includes the protection against air and noise pollution".

- 3.13 As many forests have at the same time a protection and a production function, this functional classification is rather ambiguous and a distinction is generally made for protected forests rather than protection forests.

Distribution of forest and other wooded land by function
(% - estimations)

Country	Year	Wood production	Protected forests	other
Austria	1989	86.5	11.6	2.3
Finland	1985	94.1	2.7	3.2
France	1976-88	88.0	4.1	7.9
Germany (former FRG)	1987	95.1	1.6	3.4
Italy	1988	52.8	24.6	22.6
Netherlands	1985	99.0	0.9	0.1
Portugal	1980-85	82.3	2.8	14.9
Spain	1990	41.1	1.1	57.8
Sweden	1985-89	78.7	2.9	18.4

Source: UN-ECE (1992)

- 3.14 Forests are also described according to the species of trees (resinous or softwood, broad-leaved or hardwood). Diameter, age and density of plantations are other parameters used for the description of forests (high forests, coppice, coppice with standards, etc.).
- 3.15 Some other classifications of the wooded land refer to slope or altitude. Generally speaking, with the experience gained in national forest inventories, an increasing number of parameters are integrated in the classification and description of forests.
- 3.16 Finally, ownership is an important issue: in European countries, public forests represent more than one third of the total wooded area (from 72.5% in Ireland to 14.5% in Portugal). Prices, management schemes, main forest characteristics and protection status of privately owned forests may substantially differ from those of publicly owned forests. Moreover, transactions may be less frequent and representative for public forests which can make valuation more complex.
- 3.17 In summary, forest and other wooded land is classified not only on the basis of physical parameters but also on the basis of economic and technical parameters. When economic parameters are used, they generally refer to wood harvesting, the main economic use of forests.

Timber and wood

- 3.18 Forest and other wooded land is mainly described in existing statistics according to the economic use (production of wood). The description of timber and wood flows and stocks includes the description of:
- Standing and growing volume of timber,
 - Annual increment (gross and net natural growth),
 - Fellings and removals,
 - Transformation of wood in the rough into wood products.

Timber

- 3.19 Besides data on areas of forest land and other wooded land, national forest inventories also provide data on the stocks of standing timber, gross and net increment, etc. However, forest inventories mainly serve national purposes, and do not necessarily follow international guidelines. Data are derived from inventories carried out at different times; using different methods of data collection and with pronounced differences in the underlying nomenclatures. These factors have to be born in mind when the accounts are drawn up and comparability and consistency of figures across country are assessed.
- 3.20 An important issue is to make sure that the data about timber (stock of standing timber, increment, fellings and removals) relate to the same areas. Such data are often used to assess the sustainable character of forest exploitation (through for example the ratio of fellings over increment). Data on natural growth and stocks that originate from national forestry inventories often refer to the whole area of wooded land, whereas data on removals, which originate from industrial statistics, often relate to exploited forest only but include removals of trees from areas other than forest.

- 3.21 Furthermore, as forest inventories do not use the same methods or thresholds in the different countries, the volume of standing timber may refer to the whole timber volume or may take into account only wood above a certain diameter, with or without bark, etc. Some countries do not record the volume of wood in non-exploitable forests.
- 3.22 The table below illustrates the heterogeneity of wooded land across EU Member States. For example, the density (standing volume per ha) ranges from 270 m³/ha (e.g. Germany, Austria) to 23 m³/ha (e.g. Greece, Spain). The rate of natural growth (net annual increment per hectare) ranges from more than 7 m³/ha and year (Austria, Germany, Denmark and Belgium) to less than 1.5 (Greece and Spain).

Standing timber in European countries

	Standing volume (million m ³ over bark)	Standing volume per hectare (m ³ /ha)	Net annual increment as a % of standing volume	Net annual increment (m ³ /ha)
Austria	1 030	266	3.1	8.1
Belgium	96	155	4.6	7.2
Denmark	61	146	5.2	7.7
Finland	1 954	85	3.3	3.3
France	1 959	116	3.9	4.5
Germany	2 911	271	2.7	7.4
Greece	152	23	2.5	0.6
Ireland	45	74	7.4	5.5
Italy	1 071	109	3.2	3.4
Luxembourg	20	226	0.7	1.5
Netherlands	51	182	4.4	5.9
Norway	742	62	3.3	2.0
Portugal	201	62	5.9	3.6
Spain	592	23	4.9	1.1
Sweden	2 945	105	3.3	3.5
United Kingdom	240	97	4.7	4.5

Source: Eurostat Forestry statistics 1992-1996 (European Commission 1998b).

- 3.23 The following tables show that, even for a given group of species, productivity differs across countries, due to climate, age distribution, density factors, etc.

Natural growth and productivity for selected countries

Pine

	Period	Opening stock (millions m ³)	Natural growth over 5 years (millions m ³)	Natural growth as a % of opening stock
Finland	1990-94	788	159	20.2
Sweden	1990-94	937	181	19.3
Germany	1991-95	656	106	16.2

Hardwood

	Period	Opening stock (millions m ³)	Natural growth over 5 years (millions m ³)	Natural growth as a % of opening stock
Germany	1991-95	820	143	17.4
France	1991-95	773	200	25.9

Source: Eurostat IEEAF pilot applications (European Commission 1999a).

- 3.24 The TBFRA-2000 offers a set of normalised definitions.

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 d.b.h. (diameter breast height). Includes: tops of stems, large branches; dead trees lying on the ground which can still be used for fibre or fuel. Excludes: small branches, twigs and foliage.

Growing stock is the living component of the standing volume.

Gross annual increment: average annual volume of increment over the reference period of all trees, measured to a minimum diameter (d.b.h.) of 0 centimetre.

Net annual increment: average annual volume over the reference period of gross increment less that of natural losses on all trees to a minimum diameter of 0 cm (d.b.h.).

Natural losses: average annual losses to the growing stock during the given reference period, measured to a minimum diameter of 0 cm (d.b.h.), due to mortality from other causes than cutting by man, e.g. natural mortality, diseases, insect attacks, fire, windthrow or other physical damages.

Annual fellings: average annual standing volume of all trees, living or dead, measured over bark to a minimum diameter of 0 cm (d.b.h.) that are felled during the given reference period, including the volume of trees or parts of trees that are not removed from the forest, other wooded land and other felling sites. It includes: silvicultural and pre-commercial thinnings and cleanings left in the forest; and natural losses that are not recovered (harvested).

Annual removals: average annual of those fellings that are removed from the forest, other wooded land and other felling sites during the given reference period. It includes: removals during the given reference period of trees felled during an earlier period and removal of trees killed or damaged by natural causes (natural losses), e.g. fire, windblow, insects and diseases.

- 3.25 It should be noticed that the TBFRA-2000 introduced an important change in the definition of (standing) volume, which is now measured to a minimum diameter of 0 cm (d.b.h.), whereas it was previously measured to a minimum diameter of 7 centimetres.

Wood and wood-related products

- 3.26 As concerns wood and wood-related products, the Classification of Products by Activities (CPA – see European Commission 1998c) distinguishes:

Products of forestry and logging (CPA 02)

- wood in the rough (CPA 02.01.1)
 - fuel wood (CPA 02.01.14)
 - industrial round wood
 - logs (CPA 02.01.11, 02.01.12, and 02.01.13)
 - other wood in the rough (including pulp wood, split poles ...) (CPA 02.01.15)
- natural gum (CPA 02.01.2)
- natural cork (CPA 02.01.3)
- other forestry products (CPA 02.01.4)
- standing timber (CPA 02.01.5)

Wood and wood products, pulp, paper and paper products (CPA 20 & 21)

- sawn wood (CPA 20.1)
- wood boards: plywood, particle and fibre boards (CPA 20.2)
- other wood products (CPA 20.3, 20.4 and 20.5)
- pulp (CPA 21.11)
- paper and paperboard (CPA 21.12)
- articles of paper and paperboard (CPA 21.2)

Other forest goods, services and functions

Other biological assets related to forests

- 3.27 Fauna and flora statistics are less structured and developed than timber and wood statistics. Natural growth and harvesting of berries, fungi, etc. are generally not covered by current statistics. Estimations often result from monographic studies. The number of hunters, or the expenses for hunting may be available, but the production of game is not always followed by statistics.
- 3.28 Except for hunting, whose incomes may exceed those of wood harvesting in some areas, activities related to other biological assets of forests are generally of little importance.
- 3.29 Some of these activities are included in forestry and the corresponding products are classified in CPA: 02.01.2: natural gums, 02.01.4: other forestry products. Other activities such as gathering of forest mushrooms or truffles, gathering of berries or nuts, hunting, grazing and the corresponding products are classified under other headings of the NACE Rev.1 and CPA classifications: e.g. 01.02 and 01.13, 01.5 (hunting, trapping), 92.62 (hunting for recreation), etc.

Other functions of forests

- 3.30 Other functions of forest and wooded land are:
- provision of recreational, aesthetic or cultural services,
 - provision of ecological services (e.g. protection against erosion, role in the water cycle, habitat for wild fauna and biodiversity reserve, CO₂ sink, etc.).
- 3.31 Until the present generation of forest inventories and surveys, these functions were not directly followed by statistics.
- 3.32 Use of forests for recreation may be described in terms of frequentation (number of visitors x days).
- 3.33 For the CO₂ sink function data may be derived from current statistical data on the volume of timber. The role of forest as CO₂ sink may, for example, be inferred from the volume of forest woody biomass (see Eurostat 1996, TBFRA-2000, etc.). OECD has proposed two indicators related to CO₂: carbon sequestered in forests (the volume of standing wood can serve as a proxy in the short term) and carbon balance of forests (in the short term the difference between annual increment and removals can provide an approximate indicator).
- 3.34 For other functions of forests, the classification of forests in the TBFRA-2000 allows to distinguish those wooded areas for which soil or water protection is the primary management objective. Mapping of land by functions is increasingly done in many countries and is sometimes also used for valuation purposes.
- 3.35 Various attempts have been made to take biodiversity into account: see the UN-ECE "Draft standard international framework for the development of fauna, flora and habitat statistics" (1985) and the OECD-Eurostat questionnaire on wild life/fauna and flora. The OECD/Eurostat questionnaire links data on fauna and flora population with the category of land, according to the UN-ECE classification.
- 3.36 On this basis OECD developed an indicator for threatened species. Other indicators cover:
- biodiversity of wooded land by types of biotopes, or biodiversity of dominant trees,
 - distribution of age classes of trees,
 - fragmentation/connectivity of wooded areas.

Health status of forest

- 3.37 The growing concern for the effects of acid rain and its repercussions on forest has led to the implementation of information systems. In Norway for example, the Norwegian Institute of Land Inventories makes annual recordings of forest status. So far, crown density and crown colour are the most important criteria used to describe forest health. Classes are defined for crown density and colour.

- 3.38 Following the adoption of several international conventions, all countries of the European Union are engaged in programs in order to follow the health status of forests: see the UN-ECE ICP-Forests¹². However, experts believe that the results of these information networks are not yet fully stabilised.

The TBFRA-2000

- 3.39 While retaining many features of earlier assessments, the scope of the TBFRA-2000 has been adjusted to meet new information requirements. Information is collected on the services of forests, including nature conservation, biological diversity, protection and socio-economic functions. In addition, more emphasis has been put on information on changes over time in the forest resource.
- 3.40 In the TBFRA-2000 questionnaire five tables cover biodiversity and protection status (area of forest in the IUCN classes I and II, forest-occurring species at risk or endangered, etc.); three tables cover the forest condition (damage to forest and other wooded land by known causes, forest fire and forest defoliation) and five tables the protective and socio-economic functions, including the area where forest are managed primarily for soil protection, the access to, and use of, forest and other wooded land by the public and selected goods and services provided by forest and other wooded land.

Conclusion on definitions and classifications

- 3.41 Not all land with trees is included in international statistics of "forest and other wooded land". Some "land with trees" areas, which are of prime importance as concerns amenity of urban life or biodiversity are recorded under built-up land (city parks and gardens) or under agricultural land (hedgerows, trees on permanent pastures and meadows, orchards, etc.). However, in the IEEAF the international definition of forest and other wooded land is retained, as it offers the only basis for harmonised data at international level. How other categories of land with trees could be integrated should nevertheless be further analysed.
- 3.42 The basic classification distinguishes wooded land available for wood supply and wooded land not available for wood supply. Statistics are generally available and of good quality as concerns forest and other wooded land available for wood supply. Nonetheless, these data must be carefully examined in order to make sure that areas and volumes of standing timber or natural growth are consistent.
- 3.43 The description of other functions of forest requires the development of new statistics, in particular as concerns the classification of forests according to various criteria of quality (health, productivity, etc.) as well as ecological or recreational functions. To ensure consistency, such indicators should be based on accounting frameworks, such as material flow accounts, changes in quality accounts, etc.

¹² International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects in Forests (UN-ECE under the Convention on Long-Range Transboundary Air Pollution (LRTAP) and European Commission under Regulation N° 3528/86 on the protection of forests against atmospheric pollution).

Forest in ESA/SNA and SEEA

Economic assets

- 3.44 ESA and SNA consider only economic assets, i.e. those assets "over which ownership rights are enforced and from which economic benefits may be derived by their owner(s) by holding them, or using them, over a period of time" (ESA § 7.10 and SNA § 10.2). In the case of forests this means that only "economic" forests, i.e. those forests which are owned and able to provide economic benefits to their owners, are taken into account. For example, forests so remote or inaccessible that in practice they are not under the effective control of any units, are not considered as economic (SNA § 10.10, see also ESA Annex 7.1 - explanatory note to AN.213).
- 3.45 As concerns forest, the ESA and SNA distinguish in the classification of assets:
- land (AN.211),
 - biological assets, classified in various positions (AN.1114, AN.1221 and AN.213).
- 3.46 Thus, for ESA/SNA, forests as such do not exist: (wooded) land and biological assets related to wooded land (trees, etc.) are separately classified and recorded in balance sheets and in current, capital and other changes in assets accounts.

Land

Definition and classification of land in ESA/SNA and SEEA

Definition

- 3.47 Land is defined in SNA as "the ground itself, including the soil covering and any associated surface waters, over which ownership rights are enforced. Also included are major improvements that cannot be physically separated from the land itself (e.g. drainage structures, sea walls, etc.). Excluded are any buildings or other structures situated on it or running through it; cultivated crops, trees and animals; subsoil assets; non-cultivated biological resources and water resources below the ground" (ESA Annex 7.1 – AN211 and SNA § 13.54).
- 3.48 SNA § 12.18 states that: "not all land included in the geographic surface area of a country is necessarily within the System's asset boundary. Land makes its appearance in the System when it is transferred from a wild or waste state to one in which ownership may be established and the land can be put to economic use. In addition, the stock of land may be marginally increased by reclaiming land from the sea" (see also ESA § 6.17).

Classification in ESA/SNA

- 3.49 In ESA/SNA, land is divided into:
- 1 land underlying buildings and structures: AN.2111,
 - 2 land under cultivation: AN.2112,
 - 3 recreational land, amenity land, parklands and pleasure grounds: AN.2113,
 - 4 other land: land not elsewhere classified: AN.2119.

Land underlying buildings and structures: land on which dwellings, non-residential buildings and structures are constructed or into which their foundations are dug, including yards and gardens deemed an integral part of farm and non-farm dwellings and access roads to farms.

Land under cultivation is defined as "land on which agricultural or horticultural production is carried on for commercial or subsistence purposes, including, in principle, land under plantations, orchards, and vineyards." According to this definition all land on which biological resources are grown for commercial or subsistence purposes must be classified as land under cultivation.

Recreational land and associated surface water: land that is used as privately owned amenity land, parklands and pleasure grounds and publicly owned parks and recreational areas, together with associated surface water.

Other land and associated surface water: land not elsewhere classified, including private gardens and plots not cultivated for subsistence or commercial purposes, communal grazing land, land surrounding dwellings in excess of those yards and gardens deemed an integral part of farm and non-farm dwellings and associated surface water.

3.50 In ESA/SNA the land classification is primarily based on the economic use. Although some cases may need clarification (e.g. land of urban parks or national parks), wooded land, as defined in forestry statistics, is mainly classified under two headings of the SNA classification, the distinction referring to the existence of an economic activity that uses the land for producing an output:

- land under cultivation: wooded land on which a forestry (silvicultural) activity is carried on, in order to produce or enhance the production of timber,
- other land: wooded land on which no forestry (silvicultural) activity is carried on, although logging of "naturally grown" timber may occur.

3.51 This distinction is fundamental. In the first case the standing timber will be classified as a produced asset and the value added corresponding to the growth of timber will enter GDP. In the second case the standing timber will be classified as a non-produced asset and value added will only occur when the timber is harvested.

Classification in the 1993 SEEA

3.52 The 1993 SEEA reorients the SNA classification of assets towards environmental concerns. First, SEEA does not restrict the description of assets to economic assets: e.g. virgin forests are included even when not commercially exploited. Second, in the land classification, wooded land is explicitly distinguished. Moreover an explicit separation is made between cultivated and non-cultivated land. See in Annex 2 the SEEA classification of selected non-financial tangible assets (CNFA).

3.53 In the 1993 SEEA, land, with connected ecosystems, is divided between:

- 2.1.3.2 Cultivated (economically used) land areas
 - 2.1.3.2.1 Land underlying buildings and works (reference is made to AN. 2111)
 - 2.1.3.2.2 Agricultural land (ref. AN.2112)
 - 2.1.3.2.3 Forest (timber tracts) and other wooded land (no reference to SNA classification)
 - 2.1.3.2.4 Recreational and other open land for economic purposes (ref. AN.2113-part)
 - 2.1.3.2.5 Areas of artificial watercourse or water impoundment (ref. AN.2119-part)
- 2.1.3.3 Uncultivated land areas (ref. AN.2113-part and AN.2119-part)
 - 2.1.3.3.1 Wet open land
 - 2.1.3.3.2 Dry open land with vegetation cover¹³
 - 2.1.3.3.3 Open land without, or with insignificant, vegetation cover

3.54 The classification suggests that "cultivation" and "economic use" are equivalent. It also suggests that wooded land is always economically used, i.e. cultivated. However, in § 149 the SEEA indicates: "national parks should be classified as uncultivated land because the protection and not the economic use of these areas could be considered their main function". In the same paragraph the SEEA recognises that the distinction between cultivated and other types of land could be difficult.

Discussion and conclusions

3.55 ESA § 7.11 gives a definition of economic benefits: they consist of primary incomes (operating surplus by using, property incomes by letting others use) derived from the use of the asset and the value, including possible holding gains or losses, that could be realised by disposing of the asset or terminating it. Given this definition of economic benefits, it could be considered debatable whether, in European countries, land is always an economic asset. Although land is always owned (either privately, collectively by groups of units or by government on behalf of entire communities) some land areas may

¹³ As the SEEA classification of land is derived from the UN-ECE classification, it seems that this category refers to open land with special vegetation cover (heathland, dry tundra, mountainous grassland, etc.), which excludes "wooded land".

be so remote or have a so low productivity that their owners are not able to derive economic benefits by holding it or using it in production. This is in particular the case for that part of the European forest and other wooded land which is classified as not available for wood supply: for example wooded land located in protected areas with explicit prohibition of fellings, or so remote or low productivity wooded land that the costs of harvesting and transporting the timber would be higher than the price received for the felled timber.

- 3.56 However, the position adopted in the IEEAF is that, by convention, all wooded land in European Union countries should be classified as economic asset. The introduction of a non-economic category for wooded land would have neither conceptual nor practical interest, as ('economic') wooded land that does not bring any significant economic benefits to its owner, may simply receive a zero value¹⁴.
- 3.57 Within wooded land available for wood supply some part may be non-cultivated, in the sense that no forestry activity is carried out on these areas. This is in particular the case of that part of the forest (e.g. in the Nordic countries) where the timber is felled without having been "cultivated", i.e. without any expenses other than those related to felling.
- 3.58 An economic classification of European forest/wooded land should therefore distinguish:
- wooded land available for wood supply from wooded land not available for wood supply,
 - cultivated wooded land from non-cultivated wooded land.
- 3.59 Whereas the first distinction is rather straightforward (and in any case already made by international forest statistics), this is not the case for the second distinction and criteria must be defined for classifying forest land (and timber) as cultivated or non-cultivated. See below § 3.73 sq. and § 4.94 for the criteria retained in the IEEAF.

Transactions in land

Transactions

- 3.60 In ESA/SNA actual transactions of (wooded) land between institutional units are recorded in the capital account under the heading "acquisition less disposals of land and other tangible non-produced assets". In many cases wooded land is sold together with the standing timber located on it and it may be difficult to separate the value of the land and the value of the standing timber. By default, when such a separation is not possible, the ESA and SNA recommend (ESA § 7.40 and SNA § 10.125 and § 13.57) to classify the composite asset - and hence the corresponding transaction - in the category representing the greater part of its value. In the case of wooded land, if the value of the standing timber exceeds the value of the land, the transaction would be classified as a transaction in standing timber and hence as changes in inventories.
- 3.61 In the IEEAF it is recommended to always separate the value of land and the value of standing timber.

Improvement to land

- 3.62 The value of land may increase as a consequence of gross fixed capital formation in the form of improvement to land. In ESA/SNA, acquisitions and works that lead to major improvements in the quantity, quality or productivity of land, or prevent its deterioration, are treated as gross fixed capital formation: reclamation of land from the sea, clearance of forests, rocks, draining of marshes, prevention of flooding or erosion by sea by the construction of breakwaters, sea walls or flood barriers (ESA § 7.40 and SNA § 10.51). Although improvement to land is classified as gross fixed capital formation and is therefore subject to consumption of fixed capital, it is not shown separately from land in balance sheets.

Land: other changes in assets

ESA/SNA

- 3.63 In ESA/SNA, changes in the value of land that result from other flows - i.e. flows that are not transactions - are recorded in the "other changes in assets account". The "other changes in assets

¹⁴ France for example gives a zero value to some land areas in balance sheets.

account" is subdivided into two accounts: the "revaluation account", that records holding gains and losses due to changes in the level and structure of prices and the "other changes in the volume of assets account".

3.64 For land in general, the main headings of the "other changes in the volume of assets account" are:

- (quality) changes due to changes in economic use, e.g. when, following deforestation, wooded land under cultivation changes to land underlying buildings, or when, following afforestation, agricultural land changes to forest land,
- (quality) changes due to economic activity, e.g. degradation of land due to either ordinary or less predictable erosion, due to nutrient losses, due to acidification of land (acid rain), etc., including changes in ecosystems or landscape,
- (quality) changes due to catastrophic events: deterioration of quality of land due to abnormal flooding, earthquakes, volcanic eruption, drought, etc.,
- changes in classification, e.g. when, following a change in economic use, the value of a parcel of land is shifted from the old category of the classification to the new category.

3.65 In the "other changes in the volume of assets account", the changes in land use are recorded in two steps: changes in classification, from one use to another which implies only a shift in classification and has no impacts on the market value of land; and changes in land quality connected with changes in land use, which implies a change of the market value.

1993 SEEA

3.66 The 1993 SEEA recommends that degradation of land connected with changes in land use be usually described in physical terms as changes in land areas classified by type of land cover, and this often also implies a description of the type of ecosystems connected with the areas.

3.67 The 1993 SEEA points out the possibility to extend this recording of quality changes due to changes in economic uses to other quality changes: "Degradation of land due to recurrent land use practices, could be described through categorising of land areas by quality class (for example quality of soil, quality of ecosystems). Thus land areas have to be cross-classified by type of appearance (*category*) - with additional information on type of use, if necessary - and by type of quality of soil and ecosystems" (SEEA § 250).

3.68 Depending upon the way land is classified in balance sheets, the "changes in classification" item allows recording the change, even when there is no change in monetary value. Examples are:

Basic SNA land classification: clearing of forests for urban development is recorded in the "other changes in the volume of assets" account as follows:

- change in quality due to change in land use: the difference between the market value of built-up land and forest land is entered in the column corresponding to built-up land,
- change in classification: shift of the original market value from forest land to built-up land.

Land erosion classification: an increase in erosion is recorded in the "other changes in the volume of assets account" as follows:

- change in quality due to changes in erosion: difference between market value of land due to increased erosion,
- change in classification: shift from erosion category i to category j.

Landscape (or ecosystem) classification: even if a monetary impact cannot be assessed, the change in landscape quality is recorded in the "other changes in the volume of assets account" only as change in classification: shift from landscape category i to category j.

Conclusion

3.69 Wooded land in European Union countries is always an economic asset. Basic distinctions are first between wooded land available for wood supply and wooded land not available for wood supply and then between cultivated and non-cultivated wooded land.

3.70 The "other changes in the volume of assets account" provides the framework for recording of the changes in the "quality" of (wooded) land. Therefore a large part of the changes in wooded land due to economic or human activities may be described either in physical or in monetary terms, provided that statistical data exist. As has been seen, complementary classifications of wooded land and ecosystems, which cover recreational and ecological quality issues, are being implemented in statistical surveys. Quality accounting for land and ecosystems should be developed, to the extent that some complex issues, including aggregation of local data and monetary valuation, can be solved.

Biological assets

3.71 Biological assets (animals and plants), which can be related to forest/other wooded land, consist of stocks of trees, fauna and other flora of forests. Biological assets are distinguished from land and valued separately. Produced (cultivated) biological assets are distinguished from wild (non-cultivated) biological assets.

Biological assets in ESA/SNA

3.72 Biological assets in ESA/SNA (trees, vegetation, animals, birds, fish, etc.) are divided into cultivated and non-cultivated biological assets (see the ESA/SNA classification of assets in Annex 2).

Cultivated (biological) assets

3.73 These are animals and plants whose natural growth and/or regeneration is under the direct control, responsibility and management of an institutional unit (ESA Annex 7.1 – explanatory notes to AN.1114 and AN.1221 as well as SNA § 10.12). Natural growth of cultivated biological assets is recorded as output of the institutional unit that exerts the control. Natural growth refers to the increase in value of an individual specimen during a given period as a result of biological development.

3.74 There are difficulties for the practical implementation of this criterion. It is e.g. necessary to make explicit that the processes involved (control, management and responsibility) constitute production in the SNA sense and do not consist just of legislative control. For biological assets examples of production are (i) control of regeneration, e.g. seeding, planting of saplings, controlling the fertility of livestock, (ii) regular supervision of the animals/plants to remove weeds, parasites, attend to illnesses, to control the area over which animals may roam to be within a supervised or otherwise designated area.

3.75 Environmental and national accountants grouped together in the London Group suggest that the process of production should be one that is classified to the corresponding industrial activity (agriculture, forestry or fishing) and would not be relevant if it were only part of government administration. Further, the level of this activity should be significant relative to the value of the resource and directly connected with the forest, animal or fish stock in question.

3.76 There is a strong relationship between the classification of land and the classification of biological assets. In the case of timber, the status of biological assets determines the status of land. When the timber is classified as cultivated, then the corresponding land should be classified as land under cultivation.

3.77 Cultivated biological assets are classified either as fixed assets (animals and plants yielding repeat products) or as inventories - work in progress on cultivated assets - (animals and plants yielding once-only products on destruction, e.g. timber). According to this distinction plantations of trees yielding once-only products on destruction should be classified as additions to inventories and not as fixed capital formation.

Non-cultivated biological resources

3.78 These are animals and plants that yield products over which ownership rights are enforced but for which natural growth and/or regeneration is not under the direct control, management or responsibility of institutional units. Non-cultivated biological resources (AN.213) appear in the balance sheets under the general heading of non-produced assets (AN.2).

- 3.79 Natural growth of non-cultivated biological assets is not output but is recorded as "natural growth of non-cultivated biological resources" in the "other changes in the volume of assets account" (ESA 6.16). Off-take of non-cultivated biological assets is also recorded in the "other changes in the volume of assets account", as "depletion of natural assets". However, the value of the harvested product is output of the harvesting activity: the value of the timber removed from non-cultivated forests enters the output of the logging industry.
- 3.80 In principle, natural growth should be recorded gross and the depletion of non-cultivated biological resources should be recorded separately. In practice, however, many countries record natural growth net because the physical measures that are likely to be the only basis for the recording are, in effect, net measures (ESA 6.20).

Catastrophic losses

- 3.81 Any exceptional destruction of economic cultivated or uncultivated biota is entered separately in the "other changes in the volume of assets" account, under the heading "catastrophic losses".

Biological assets in the 1993 SEEA

- 3.82 The classification of biological assets in the SEEA is similar to the classification in SNA, although more detailed (see Annex 2). The SEEA offers a classification of biological assets that is consistent with its classification of land. The SEEA (§ 149) explicitly states that "in the case of forests and other wooded land, the distinction between cultivated and non-cultivated forest land should be made compatible with the distinction between forest (timber) as produced and as non-produced biological asset."
- 3.83 However, § 147 of the SEEA recognises the difficulties in the practical implementation of the classification: "Furthermore, it often seems difficult to distinguish between cultivated and non-cultivated forests. There are different degrees of economic influence on forests, which may complicate the distinction between cultivated and non-cultivated ones. Further conventions on these borderline cases need to be developed for the purpose of environmental accounting".
- 3.84 The SEEA classification distinguishes, among other positions, the "crops and plants of cultivated forests", under the general heading of "cultivated natural growth assets" and the "trees and other plants of uncultivated forests" under the heading of "non-produced natural assets: wild biota".

Natural media and ecosystems

- 3.85 In ESA/SNA, land includes associated surface water and the soil covering. Water resources (aquifers and other groundwater resources) are recorded as a specific classification item (AN.214) to the extent that their scarcity leads to the enforcement of ownership and/or use rights, market valuation and some measure of economic control.
- 3.86 According to UN-ECE, "natural watercourse" is a specific heading of the land use classification, as is wet open land. However, "Forest and other wooded land should be classified irrespective of the characteristics of the soil; for example wet forest should be shown under forest and not under wetlands" (United Nations 1993c, p. 137).
- 3.87 In the 1993 SEEA, water and soil are distinguished from land, whereas ecosystems are recorded with land. In view of the importance of soil erosion, soil is added as a classification item of non-produced assets, even though no monetary data on stocks can be recorded. Water is registered both as an item of land classification, referring to water areas in square kilometres (km²), as in UN-ECE, and separately in terms of water quantities in cubic meters (m³). However, only water resources included in SNA assets (i.e. aquifers and other groundwater resources) are given a monetary value.
- 3.88 SEEA also introduces air as an asset even though no monetary value can be applied to it. All the non-economic assets of the classification (air, water, soil and eco-systems) are used in physical accounting only. However, degradation costs of using these assets may be imputed.

Conclusion

- 3.89 In ESA/SNA and SEEA, wooded land is separately recorded as land on the one side and as biological assets on the other side. ESA and SNA offer the possibility to record changes in quantity and quality of land and biological assets when these changes reflect changes in the value, i.e. the economic benefits provided to their owner by these assets.
- 3.90 When degradation of land or biota is not reflected in changes in their value this degradation is not recorded in ESA and SNA and may only be retraced in physical accounting.
- 3.91 In SEEA, a different approach is adopted: in addition to the SNA valuation of depletion and degradation of non-produced assets, imputed environmental costs of using natural assets (including natural media and ecosystems) are introduced. Although no monetary value is applied to e.g. soil and ecosystems, the costs that would be necessary to sustain at least the present level of these natural assets, and the services they provide, could be recorded.

Physical accounting and indicators

Physical accounting

Physical accounting of wooded land

- 3.92 Instruments and frameworks have been developed for land accounting that can be used for wooded land. Main instruments are balances of wooded land, and matrices recording changes in classification of land during a given period. When a classification of flows is available, such tables, and the derived matrices, allow relating changes in wooded land to human (economic) activities and natural causes. See for example Conference of European Statisticians (1995), pages 47-50.
- 3.93 An early example for such accounting are the French natural patrimony accounts¹⁵.

Forest area balance, France 1971-1980 (Hectares)

Opening stock	13 420 000
Clearings	-50 000
Natural colonisation	350 000
Plantations (new areas)	150 000
Closing stock	13 875 000

Internal changes	
Temporary clearings	140 000
Clear cuttings	106 000
Fires	30 000
Infestations	4 000
Other	0
Replenishment of wooded areas	140 000
Plantations	69 000
Natural regeneration	71 000

Source: INSEE (1985)

¹⁵ See Natural Patrimony Accounts, INSEE (1985).

OECD accounting framework for wood flows and stocks

3.94 On the basis of experience gained by Norway and other Nordic countries, OECD launched a pilot project on forest natural resource accounting, led by Norway. The framework was based on the establishment of three tables:

- a forest balance,
- a sector/commodity balance,
- an industry mass balance.

The forest balance

3.95 The forest balance is a rough stock account. It shows net changes in m³ of stocks of wood over time. Changes of stocks are due to annual increment, natural losses and removals. This account can be subdivided (when information is available) according to species (conifers, broad-leaved), age classes or other structural parameters.

3.96 This type of account is well known to foresters and reflects to a large extent the information needs for forest resource management. Almost all OECD countries make use of forest balance data in order to monitor and evaluate stock/flow relations.

3.97 Several countries have emphasised the need for integrating in forest balances more and better data on uses of the forest other than for wood production, for example on environmental values.

The sector/commodity balance

3.98 The sector/commodity balance shows physical inputs and outputs of wood and wood products in the economy. It consists of balances for extraction, processing and use. It depicts the raw material flows through wood processing industries and final uses of raw materials and wood products by end user categories (including import/export balance). Unit of measurement is m³ or tonne.

3.99 The sector/commodity balance may be used for analysis of trends in input coefficients in processing industries and for estimating future demand of forest products, combined with macro-economic planning and forecasting models. The experience gained by OECD countries with regard to that account indicates that this is not a very complicated or costly balance to establish.

The industry mass balance

3.100 The industry mass balance for wood materials shows transformation processes in a common denominator (tonne of dry matter). It describes flows of main wood products entering the forest product industries, energy use, output of by-products, waste and emissions of wood-based residuals. The rows are the same as in the sector/commodity balance. The columns reflect, however, the specific transformation process of the raw and processed wood.

3.101 On the basis of this table, it is possible to show the total amount of wood used for energy, the "hidden potential" of wood raw material for improved processing efficiency, the total resource utilisation rate or the wood-based emission volumes (organic matter emissions to water, BOD).

3.102 In Norway¹⁶ the forest accounts were established partly in order to produce forecasts of future Norwegian demand of forest products. The consumption part of the forest accounts was also closely connected to the energy accounts. An innovation was the attempt to classify growing stock according to felling and transport costs.

¹⁶ See K.H. Alfsen, T. Bye and L. Lorentsen (1987).

3.103 In addition to Norway, four countries have drawn up, at least partially, the OECD pilot accounts: Finland, France, Japan and the United Kingdom. Only Norway and Finland succeeded in establishing the industry mass balance.

Results of the OECD Pilot Forest Accounts

	Norway	Finland	France	UK	Japan
Forest balance	yes (1985)	Yes (1985)	yes (1988)	no	yes (1985)
Sector/commodity balance	Yes (1985)	Yes (1985)	yes (1984)	yes (1988)	yes (1985)
Industry mass balance	Yes (1983)	Yes (1985)	no	no	no

Indicators

Quality classifications: indicators and matrices of changes

3.104 Quality indicators must rely on a rather detailed classification of forest areas according to various criteria: diversity of forest (number of wood species, etc.), role in soil or water protection (related for example with relief), role as habitat, role for recreation, etc.

3.105 For each of the functions of forests, as well as for the health status of forest, categories of the classification must be defined. At a later stage, changes in quality may be related to a classification of the flows, which would allow for the description of the impact of economic activities on forests and the capacity of forests to fulfil their ecological functions.

Indicators

3.106 OECD has submitted in September 1994 a document for discussion to the Group on the State of the Environment on a core set of indicators on forest¹⁷. Three categories of indicators were distinguished:

- indicators reflecting sectoral trends of environmental significance (trends relating to forest (wood) resources and uses, and the balance between resources and uses);
- indicators reflecting forestry-environment interactions (relating to climate change, biodiversity and landscape, soil and water resources, artificial inputs and forest disturbances);
- indicators reflecting economic and forestry aspects (i.e. aspects relating to prices and values, management and regulation and international trade).

The OECD set of forestry-environment indicators focuses on:

- the national level,
- the primary forest sectors,
- the environmental component of sustainable forestry.

The indicators were selected according to three criteria:

- policy relevance,
- analytical soundness,
- measurability.

Indicators referring to sectoral trends of environmental significance

3.107 Besides the well known "resources" indicators (*total wooded areas, forest cover, total volume of standing wood, growth, annual allowable cut*), a number of "**uses of forest resources**" indicators are proposed: *total demand (domestic and foreign) for domestic wood and wood products, domestic demand for domestic and foreign wood and wood products, recycled inputs rate in pulp and paper industry, annual harvest*. The relation between resources and uses allows drawing a balance indicator for resource use: *actual harvest per productive capacity*. A complementary indicator is "forest

¹⁷ OECD (1994c).

exploitation intensity", i.e. annual removal per growth, with removal defined as: wood extraction + natural mortality + accidents. Above 1, this indicators shows a decline of the wood stock and implies that sustainable development is not ensured if such a trend continues. Most of the indicators referring to sectoral trends of environmental significance (resources, uses and balance) can be refined and disaggregated by type of wood, origin etc.

Indicators referring to forestry-environment interactions

3.108 This second category of indicators is more innovative. Five areas are covered:

a) Forest and climate change: *carbon storage; carbon sequestered in forests, carbon balance of forests, share of the total energy from biomass.*

b) Biodiversity and landscape: it is assumed that "the quality of the landscape is generally solidly linked to the quality of diversity". As a result "the same indicators have been retained to express biodiversity and quality of landscape". There are four indicators: Biodiversity of wooded lands by types of biotopes, equilibrium between age classes of trees, fragmentation/connectivity of wooded area, threatened species per species potentially present on forest land, plantation of exotic species per total plantation and regeneration.

c) Soil and water resources: *net conversion of wooded land area into other land cover, erosion-prone area protected by wooded land, water catchment areas protected by wooded land.*

d) Artificial inputs: *use of fertilisers, use of pesticides.*

e) Forest disturbances: *forest areas affected by dieback, forest areas affected by acidification, forest areas affected by wildfires, forest areas affected by pests and diseases, forest areas affected by climatic accidents.*

Indicators referring to economic and forestry policy aspects

3.109 This set of indicators covers:

a) Prices and monetary value: *Aggregate price index of wood commodities, value added in the forestry sector, value of subsistence products from forests, forest recreation, value of ecological benefits, opportunity costs of forest preservation versus other land uses, employment in forestry.*

b) Management and regulation: *forest area under public ownership or control per total area of forest, forest area under sustainable management rules per total area of forest, forest area covered by ecological assessment per total forest area, average size of clear-cut, protected area per total forest area, other regulatory instruments, economic instruments, public environmental expenditures relating to forest, private environmental expenditures relating to forest.*

c) International trade: *Net export/import balance of timber, quantity of tropical timber imports, timber imports harvested on a sustainable basis per total timber imports.*

The Helsinki Conference

3.110 The Ministerial Conference on the protection of forests in Europe, held in Helsinki, 16-17 June 1993, issued a list of criteria and quantitative indicators most suitable for European forests.

1. Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles
 - 1.1 Area of forest and other wooded land and changes in area (classified, if appropriate, by forest and vegetation type, ownership structure, age structure, origin of forest)
 - 1.2 Changes in:
 - a. total volume of standing timber
 - b. mean volume of the growing stock on forest land (classified, if appropriate, according to different vegetation zones or site classes)
 - c. age structure or appropriate diameter distribution classes
 - 1.3 Total carbon storage, and changes in the storage, in forests stands

2. Maintenance of forest ecosystem health and vitality
 - 2.1 Total amount of, and changes, over the past 5 years, in depositions of air pollutants (assessed on permanent plots)
 - 2.2 Changes in serious defoliation of forests using the UN-ECE and EU defoliation classification (classes 2, 3, and 4) over the past 5 years.
 - 2.3 Serious damages caused by biotic or abiotic agents:
 - a. severe damages caused by insects and diseases with a measurement of seriousness of the damage as a function of (mortality) loss of growth
 - b. annual area of burnt forest and other wooded land
 - c. annual area affected by storm damage and volume harvested from these areas
 - d. proportion of regeneration area seriously damaged by game and other animals or by grazing
 - 2.4 Changes in nutrient balance and acidity over the past 10 years (pH and CEC¹⁸); level of saturation of CEC on the plots of the European network or of an equivalent national network
3. Maintenance and encouragement of productive functions of forests (wood and non-wood)
 - 3.1 Balance between growth and removals of wood over the past 10 years
 - 3.2 Percentage of forest area managed according to a management plan or management guidelines
 - 3.3 Total amount of and changes in the value and/or quantity of non-wood forest products (e.g. hunting and game, cork, berries, mushrooms, etc.)
4. Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems
 - 4.1 Changes in the area of:
 - a. natural and ancient semi-natural forest types
 - b. strictly protected forest reserves
 - c. forests protected by special management regimes
 - 4.2 Changes in the number and percentage of threatened species in relation to total number of forest species (using reference lists, e.g. IUCN Council of Europe or the EU Habitat Directive).
 - 4.3 Changes in the proportion of stands managed for the conservation and utilisation of forest genetic resources (gene reserve forests, seed collection stands, etc.); differentiation between indigenous and introduced species
 - 4.4 Changes in the proportion of mixed stands of 2-3 tree species
 - 4.5 In relation to total area regenerated, proportion of annual area of natural regeneration
5. Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water)
 - 5.1 Proportion of forest area managed primarily for soil protection
 - 5.2 Proportion of forest area managed primarily for water protection
6. Maintenance of other socio-economic functions and conditions
 - 6.1 Share of the forest sector in GNP
 - 6.2 Provision of recreation: area of forest with access per inhabitant, % of total forest area
 - 6.3 Changes in the rate of employment in forestry, notably in rural areas (persons employed in forestry, logging and forest industry)

¹⁸ Cation Exchange Capacity

Valuation issues

Principles of valuation

3.111 In this section the valuation of land, biological assets and other services provided by forests is examined. The following categories of assets are reviewed:

- forest land,
- cultivated timber,
- non-cultivated timber,
- other non-produced biological assets,
- other services provided by forests.

Land

3.112 The principles of valuation of land are well established in ESA (§ 7.40) and SNA (§ 13.55). Land must be valued at its current price paid by a new owner, including written-down costs of ownership transfer.

3.113 When no exchange value is at hand, the value must be assessed indirectly. The value should be taken from markets in which the same or similar items are traded currently in sufficient numbers and in similar circumstances against cash (SNA § 3.72). As a second best, valuation could be derived from prices that are established in less closely related markets.

3.114 If none of these methods can be applied, stocks are to be recorded at the discounted present value of expected future returns (ESA § 1.52, SNA § 3.75). In the case of land, when land is rented, expected future returns are the streams of the "net rent" on land as defined by ESA (§ 4.72) and SNA (§ 7.130) over an infinite period. When the net rent is not known or must be imputed (e.g. when the productive unit is at the same time the owner of the land), it may be assessed by the net operating surplus/mixed income of productive activities carried out on the land less (imputed) return on the produced capital engaged in the production process and (imputed) compensation for non-salaried work.

3.115 According to the SNA (e.g. § 10.121 sq.), the value of land includes neither the value of plantations nor the value of the cultivated (or uncultivated) biological assets situated on it. However, the value of land includes the value of the stock of major improvements that cannot be physically separated from the land itself. Thus, although expenditures on land improvements are treated as gross fixed capital formation, they do not lead to tangible assets that can be shown in the balance sheets separately from the land itself (ESA Annex 7.1 and SNA § 13.55).

3.116 When actual transactions in land are recorded, one must make sure that the current prices of the recorded transactions do not include the value of biological assets (mainly the value of standing timber), as the latter are valued and recorded elsewhere in the balance sheets. In practice, recorded transactions generally cover both land and standing timber and one has to separate the value of land and the value of timber.

3.117 One must also make sure that recorded prices of actual transactions are representative of real prices. Recorded prices often result from official (fiscal) databases and may mis-estimate the real prices of the transaction for various reasons.

3.118 In any case, "the current market value of land can vary enormously according to location and the uses for which it is suitable or sanctioned. It is therefore essential to identify the location and use of a specific piece or tract of land and to price it accordingly" (SNA § 13.57).

3.119 Thus, in principle, a detailed classification of wooded land is necessary and prices of actual transactions must be recorded for each category of this classification. This classification must refer to the capacity of land to generate income and economic benefits to its owner and must take into account not only the species, dimension, age and uses of the wood on the parcels of wooded land, but also the distance to the sawmill and the costs of logging and transportation, as well as any present or potential other economic use of land, for example use for hunting, gathering of forest products, grazing of

animals, future use for construction, etc. Insofar as land is distributed according to homogeneous categories, i.e. that economic benefits or returns are similar, market prices of actual transactions for a category of land may be used to value the whole category.

- 3.120 However, as for a given accounting period only a small part of land may be exchanged, the problem is to determine whether the whole stock of wooded land may be valued on the basis of the price of this small part. In fact prices of actual transactions only reflect the partial equilibrium on the market of wooded land that has been exchanged. Following the Lancaster approach, hedonic analysis allows to determine "prices" of the characteristics of the transacted pieces of land and then to value the whole stock, classified according to these characteristics.
- 3.121 When no transactions in land are recorded, the land may be valued on the basis of the discounted future streams of the "net rent" on land, either observed or calculated. In many cases the net rent cannot be observed, e.g. due to the vertically integrated character of the forestry and logging industries. In such cases the level of the rent has to be imputed from data about the whole wood industry.
- 3.122 When the "net rent" on wooded land is known the comparison between prices of land as they result from actual transactions and the (calculated) sum of discounted streams of rent may provide relevant information. Such comparison allows to verify whether recorded prices are representative and to calculate the discount rate to be used in the calculation of the net present value of future returns.
- 3.123 Valuation through the net present value method may be extended to other (market or own account) economic uses: hunting, gathering of forests products, pasture for animals, market recreational services, etc. When there is no, or only marginal, economic use (protected areas, wooded land in mountainous areas) this approach may generate very small or zero values.

Cultivated timber

- 3.124 Timber is by far the most important cultivated asset related to wooded land. Whereas in the 1968 SNA and, at the European level, the 1970 ESA¹⁹ and 1989 EAF²⁰, the output of forestry and logging industries was defined as the value of felled timber, in the 1993 SNA and the 1995 ESA, the natural growth of cultivated timber is classified as production.
- 3.125 The Manual on Economic Accounts for Agriculture and Forestry (Rev.1) (European Commission (1997) - thereafter referred to as EAF Rev.1) allows for a flexible interpretation of the ESA and SNA principles under certain conditions. The EAF Rev.1 states in § 2.06.13: "Output of standing timber for felling spans several years and should be recorded in the form of work-in-progress. However this treatment only applies in the case of production organised, managed and supervised by an institutional unit, i.e. in the context of an activity in the economic sense (as opposed to the natural growth of wood which does not form part of the field of production and the product of which is only recorded at the felling stage). Nevertheless, the implementation of the ESA rule is relatively complex. It also requires a large number of data (especially for calculating output) which is why although the ESA 95 recommendation forms the reference principle to be applied in the drawing of the EAF, it is agreed that in the cases where standing timber stocks are relatively regular (i.e. their volume does not fluctuate substantially from one year to the next), timber output is to be recorded only at the time of felling. In this practical rule, standing timber is not regarded as stocks of work-in-progress".
- 3.126 Therefore, the treatment of natural growth depends on the conditions prevailing in the Member States. The collection of data according to the EAF Rev.1 has started in 1999. Based on the results, Eurostat will analyse the application of paragraph 2.06.13 in Member States as well as the corresponding forestry conditions.
- 3.127 In the IEEAF, in accordance with ESA 95, natural growth of cultivated timber is always considered output, which accumulates in inventories (work in progress) until timber is harvested. Valuation of timber should distinguish mature standing timber and immature standing timber.

¹⁹ Please refer to the second edition – European Communities (1980).

²⁰ Economic Accounts for Forestry - please refer to the version of 1992 – European Communities (1992).

Mature timber

- 3.128 There are several ways of selling mature timber (i.e. timber ready to be harvested), and therefore of valuing it: standing, felled or “delivered to roadside”.
- 3.129 In order to measure the output of the forestry “industry”, in the EAF Rev.1 the value of the timber felled during the reference period is measured at “price delivered to roadside” for timber ready to be removed minus the value of taxes on products (other than VAT) and plus the value of subsidies on products (EAF Rev.1 § 2.31.4). Therefore it includes not only the value of standing timber as stock of finished product but also the cost of felling, skidding to the roadside and stacking the wood. As stated in EAF Rev.1 § 2.31.7, “in forestry sellers and buyers do not always choose or invoice the “delivered to roadside” price for timber. Often, standing timber is sold standing and the buyer takes over the felling and transport of the timber to the roadside. In such cases, the price entered in the EAF should include not only the agreed price, but also the price for felling and delivery to the roadside.”
- 3.130 As it includes costs for felling, skidding to the roadside and stacking the wood, the “price delivered to roadside” (or roadside pick-up price) is not convenient for valuing mature standing timber before harvesting. Mature standing timber is to be valued at “stumpage prices”. The stumpage price is the value of, or price paid for, timber as it stands uncut in the woods. Stumpage prices should be established for the different categories of standing timber: by species, age classes, locations and uses (e.g. logs, pulpwood, fuel wood).
- 3.131 In some cases, the stumpage price must be calculated deducting from the roadside pick-up price the costs for felling, skidding to the roadside and stacking the wood. As previously indicated, vertical integration of forestry and logging industries may make the observation of the roadside pick-up price difficult. Moreover, in some countries, many of the buyers of timber have monopsonic markets (single buyer), so that even a market transaction might not represent a competitive market price²¹.

Immature standing timber

- 3.132 According to the SNA, stocks of standing timber, cultivated (§ 13.49) or not (§ 13.61), have to be valued on the basis of the sum of the discounted flows of the expected future net returns. This valuation is also called the “net present value method”. The net present value method requires calculating the present discounted value of the (future) receipts from the sales of standing timber when mature, net of any future expenses (when standing timber is cultivated²²). Therefore the value of cultivated standing timber depends on the volume that will be harvested in the future, prices, future expenses of bringing the timber to maturity and rate of discount. This valuation method requires a lot of assumptions (volume at maturity, time to achieve maturity, discount rate to apply, future prices and expenses, etc.) on a time horizon of up to 100 years and more.
- 3.133 When calculating the value of timber one should take into account the future incomes (and costs) of thinning, etc., i.e. the receipts and costs of an optimal management of the forest. In practice, due to the shortcomings of data and the numerous hypotheses necessary, a simplified discounted value is often used; in this method the only (future) receipt considered is that resulting from clear-cutting the mature timber.
- 3.134 In the net present value method, a major problem is the choice of the discount rate. The ESA (§ 7.30) and SNA (§ 13.34) state that in the case of assets for which the returns are delayed (as with timber) a rate of discount must be used to compute the present value of the expected future returns. The rate of discount should be derived from information based on transactions in the particular type of assets under consideration rather than using a general rate of interest, such as one derived from the yield on government bonds.
- 3.135 When the price of land is known, the discount rate may be taken as equal to the internal rate of return, the latter being calculated equalising receipts and costs.

²¹ See Statistics Canada (1995).

²² In the case of cultivated timber, this is equivalent to the standard way of valuing work in progress as the sum of past production costs plus a mark-up for expected operating surplus or estimated mixed income (SNA § 6.78).

- 3.136 Other problems are related to future prices and costs to be used. In order to be consistent with ESA/SNA principles, one should assume that they are equal to present prices and costs. However, prices vary widely between periods and for timber that will be harvested a long time after the present period, the market value of the stock reflects price anticipation. According to converging experience, prices cannot easily be predicted and there is no indication that a sophisticated model for future prices gives better results than the hypothesis of stability.
- 3.137 Many countries calculate the value of the stocks of standing timber applying simplified methods, which consist in multiplying the stocks in volume (m³) distributed by species and diameter/age classes by the present stumpage price for the respective categories. Rationale of the simplified methods is that the natural growth of the standing timber offsets the need for discounting: due to natural growth the present volume of (immature) standing timber has more or less the same value as the volume of standing timber at maturity time, discounted to the present time (see Annex 3 for details).

Non-cultivated timber

- 3.138 Characteristic of non-cultivated standing timber is that by definition its natural growth does not imply any cost. The value of standing timber is therefore calculated as the present value of future receipts. Future receipts are given by the stumpage value of the timber felled when mature. Calculation only requires assumptions as concerns the future streams of harvest from the timber stock and the rate of discount. Simplified methods may be used (see Annex 3 for details).
- 3.139 Theoretically, non-cultivated timber stands do not give rise to direct cultivation (forestry) costs. However, generally there are public (or private) expenses on various services incidental to forestry: inventories, protection against fires or insect attacks, disease control, liming of soil against acidification, construction of forests service roads, etc. Even when these expenses are too small to qualify the timber as cultivated, they should nonetheless be identified and measured as they contribute to the output of "services incidental to forestry".
- 3.140 In the SNA, natural growth of non-cultivated forests, classified as "other changes in the volume of assets", covers the "increase in value of timber due to the fact that the stands grow taller" (SNA § 12.26 sq.). Depletion covers the reduction in the value of non-cultivated forests as a result of harvesting (SNA § 12.30). The value of depletion is given by the stumpage value of felled trees, either directly or indirectly assessed.
- 3.141 Although natural growth should, in principle, be recorded gross, and the depletion should be recorded as an economic disappearance, in practice many countries record natural growth net (of depletion) because the physical measures that are likely to be the only basis available for the recording are, in effect, net measures. The SNA states that "these measures may be used in conjunction with a market price for a unit of the asset to estimate the value of the volume change to be recorded"²³.

Other biological assets

- 3.142 Other assets such as berry trees, herds of deer and other wild animals also contribute to the overall value of forest. Various attempts have been made to value these assets, in particular in Nordic countries, Canada and Germany. Conclusion was that such assets are difficult to value and in any case that their value is low in relation to the value of timber, although they may contribute in some cases to the value of land.
- 3.143 In general the collection of the corresponding products is free so that these assets cannot be considered as economic assets in the SNA sense. Therefore only the value of the products resulting from harvesting, hunting and fishing, is recorded either as market output or output produced for own final use. According to ESA/SNA rules, when output is produced for own final use, these products should be valued on the basis of the basic price of similar marketed products.

²³ See SNA paragraph 12.27. However, Vincent and Hartwick (1997) demonstrate that this way of calculating net accumulation can be misleading when the forest is not even-aged. Hence, depletion and natural growth should be calculated separately.

Valuation of other services provided by forests

- 3.144 When recreation takes place on privately owned forest, and is restricted to its owner, the value of the recreational or amenity services provided by the forest is reflected in the market value of the land, as is the value of any other benefit provided by the wooded land (including those resulting from harvesting of other biological non-produced assets). When recreational or amenity use is free, no value is attributed either to the land or the service.
- 3.145 Valuation of these free services through contingent valuation, travel cost method, hedonic pricing, etc. was tested in some countries. Results are not conclusive at the level of a national economy.
- 3.146 Concerning other environmental services provided by forests (carbon storage, protection against erosion, maintenance of biodiversity, etc.), as they do not translate into market transactions no value is recorded in the SNA. Some attempts have been made, e.g. by Nordic countries, to value these services, e.g. to value the forests in their capacity of CO₂ assimilation, or as a source of lichens for deer or to value the damages to the forest environmental functions.
- 3.147 At the present stage this manual deals with degradation of forest ecosystems only through physical indicators, e.g. indicators for the state of forest health, unless the degradation has an impact on the market value. The reason is that the valuation of "non-ESA/SNA" uses or functions is still a rather controversial issue. In the case of the CO₂ sink function, the situation may however quickly change if markets for CO₂ emissions permits are established.
- 3.148 In the absence of market values, valuation of such non-ESA/SNA functions is only possible through e.g. contingent valuation or through the modelling of the economic effects of the environmental standards or norms fixed by society in order to maintain these functions.
- 3.149 A detailed physical description of forest states and functions as well as a description of forest-related economic activities is necessary as a basis for valuation of non-ESA/SNA functions. The IEEAF contributes to such a description through the development of:
- monetary satellite accounts: environmental protection expenditure accounts applied to forests, forest resource management accounts, monetary supply and use tables for wood and wood products,
 - physical accounts: forest land and standing timber balances, raw wood and wood products supply and use tables, material balances and quality accounts.
- 3.150 Although "ecological" functions of forest (carbon storage, protection of soils against erosion, protection of biodiversity, etc.) have no market prices, maintaining ecological functions do have costs for forestry units (and may be compensated for by subsidies). General government units may incur regulation and control costs, which may give rise to non-market output. Monetary accounts allow to separate these costs from total forestry costs and to assess their influence on forestry profitability or on the value of land or standing timber.

Valuation of European forests

Trends in European forests

- 3.151 Trends in European forests are rather well known. During the last ten years the increase of EU-12 forest areas has been one million hectares and harvest was well below natural growth. Moreover, according to various estimations a (large) part of the 6 to 10 millions hectares which will be withdrawn from agricultural use, will be afforested in the future (see European Parliament (1997), p. 505).
- 3.152 This situation is confirmed by forest statistics. In 1995, for EU-15, fellings represented about 60% of net annual increment (European Commission 1998b). Also the first set of IEEAF pilot applications (European Commission 1999a) confirms this trend. The four pilot countries (Germany, France, Finland, Sweden) represent about 60% of wooded land in the European Union. In these countries, the average annual net increment was about 360 million cubic meters and fellings were about 220 million cubic meters. Therefore, the stock of standing timber increased at a rate of about 1.4 % per year.

Methods for valuing European forests

- 3.153 In the IEEAF, following the work of the Eurostat Task Force on Forest Accounting, no single valuation method is recommended, although, following ESA/SNA prescriptions, valuation based on market prices is privileged. The Task Force developed a set of valuation methods for forests, forest land and standing timber – for details see Eurostat (1999c). The methods were tested by the participating countries and the results compared. Annex 3 provides a practical description of valuation methods.
- 3.154 A clear distinction must be made between methods for valuing flows and stocks, and within flows between fellings and natural growth. For each of these elements, the range of applicable methods differs. Combined valuation methods (which value land and standing timber together) may be distinguished from separate valuation methods (which value either land or standing timber).

Valuation of stocks

Transaction value method applied to forest real estates

- 3.155 This method gives a combined value of forest land and standing timber (and potentially includes other aspects such as hunting rights, the potential to use the land for construction, etc.). Often observed transactions are few, not representative of the whole forest and potentially seriously biased. Resulting values may be inconsistent with the valuation of flows leading to substantial statistical discrepancies.
- 3.156 Hedonic price decomposition can be used to remove several of the biases and increase representativeness – but not all biases can be removed, e.g. fiscally motivated under-reporting or a lack of transactions for public forests. Hedonic pricing also allows to separate land and timber which is necessary for the balance sheets. The data requirements – and thus compilation costs – may be high.
- 3.157 The transaction value method may be extremely useful for comparing the values of protected forests with the value of other forests in countries where governments (or private institutions) purchase forests for protection reasons.

Net present value method

- 3.158 The method is theoretically correct but requires substantial data inputs and is very sensitive to assumptions on discount rate, future costs and prices (and implicitly technological progress and demand in future) as well as present and future structure of the stocks and the fellings. It serves microeconomic (e.g. evaluation of single stands) and didactical (e.g. analysis of the effects of different management options) purposes but is considered as less useful for both national accounts and integrated environmental and economic accounting.

Consumption value method and stumpage value method

- 3.159 These are 'simplified' methods that use stumpage prices to value the timber stocks. They can be seen as special forms of the net present value method (with implicit discounting) and it can be argued that they are in line with ESA and SNA principles. Different variants exist which differ in the data requirements. The most detailed variants distinguish diameter/age categories, species, locations/regions, uses, etc. The most simplified methods use an average harvest price and apply this to the total volume of standing timber. The simplified variants are very easy to apply and need less data inputs, with these data generally being available.
- 3.160 The main difference between the consumption value method and the stumpage value method is that the consumption value method uses the structure of the stock for weighting the stumpage prices of individual categories of timber, whereas the stumpage value method uses the structure of fellings. These structures will usually differ and may also change over time. Furthermore, the structure of fellings is volatile and reacts to e.g. price changes, windfalls, etc. Hence for the stumpage value method an average structure of fellings (and maybe prices) is recommended for the weighting procedure. For details see Annex 3.
- 3.161 The detailed description of the stocks that is needed for the detailed variants of the consumption value method is also very useful for other purposes including environmental and economic analyses. However, detailed and regular forest inventories are necessary for this.

- 3.162 Consumption value and stumpage value methods give very similar results in some countries (e.g. in Austria) but different results in other countries (e.g. France and Germany). One reason for such differences is the structure of the stock. For example, in Germany, major re-forestation was undertaken after World War II, which results in a high proportion of "young" stands. In France, a special effort was made to fully account for fuel wood use. Hence the average stumpage price is low.
- 3.163 This experience illustrates that structures of timber stocks and fellings differ across countries. An important issue is to consider whether forests are 'overmature', 'young' or in a more or less stable state and managed in a sustainable way or not. Also, valuation methods are sensitive to the comprehensiveness of the physical balances. Care must be taken to assure consistency between flows and stocks also in the physical balances. Further, this illustrates that comparability of results across countries does not necessarily mean the application of the same valuation method. It is recommended that countries choose the method best suited to the specific conditions of their forests (age structure of stocks, etc.), forest exploitation patterns, uses of timber and, last but not least, the data available.
- 3.164 It is recommended to perform a comparative analysis of the results of different methods and analyse the reasons for the differences before this choice is made. In some countries the differences are quite small and regular over time so that the choice of a simple method is justified.

Valuation of flows

Fellings

- 3.165 The method must be to apply stumpage prices to the physical quantities of felled timber. When the observed price concept is the roadside pick-up price, it is necessary to deduct logging costs to arrive at stumpage prices of fellings. In any case a cross-check with the results of the Economic Accounts for Forestry is recommended.

Natural growth

- 3.166 Three methods are available for valuing natural growth.
- Net present value,
 - Cost of forest management (including a mark-up for net operating surplus/mixed income) and
 - Consumption value or stumpage value methods.
- 3.167 The net present value method may be rather difficult to apply (see § 3.158 above). The cost of forest management (production of standing timber) of the current year may bear very little relation to the natural growth of that year (unless the forest structure is stable and management is assumed to be sustainable) and may be difficult to identify and assess. Thus, the consumption value or stumpage value methods may often be used to value natural growth.
- 3.168 In the ESA, natural growth is an addition to an inventory of work in progress. There are uncertainties as regards future uses and volumes of timber, which may require ex post corrections. Some part of the annual natural growth may not be recoverable and a deduction could be made under a heading "non-recoverable increment" based on expert opinion (10% of natural growth was mentioned as an indication).
- 3.169 It must be noted that the physical estimates of natural growth are subject to some uncertainties inherent in the growth estimation models used. These uncertainties decrease with the regularity of forest inventories. In any case, growth estimates for past years may need to be adjusted when new forest inventory data become available.

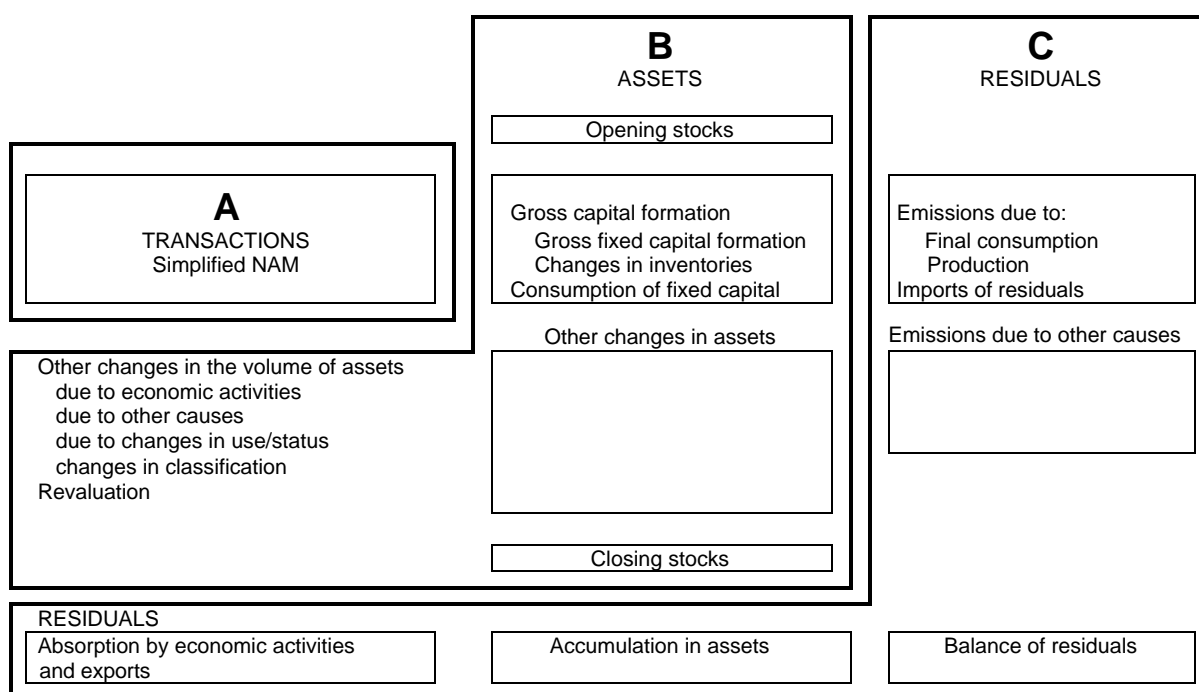
Other changes in volume

- 3.170 The net present value method or the consumption or stumpage value methods may be used to value other changes in volume.

4. The European Framework for Integrated Environmental and Economic Accounting for Forests

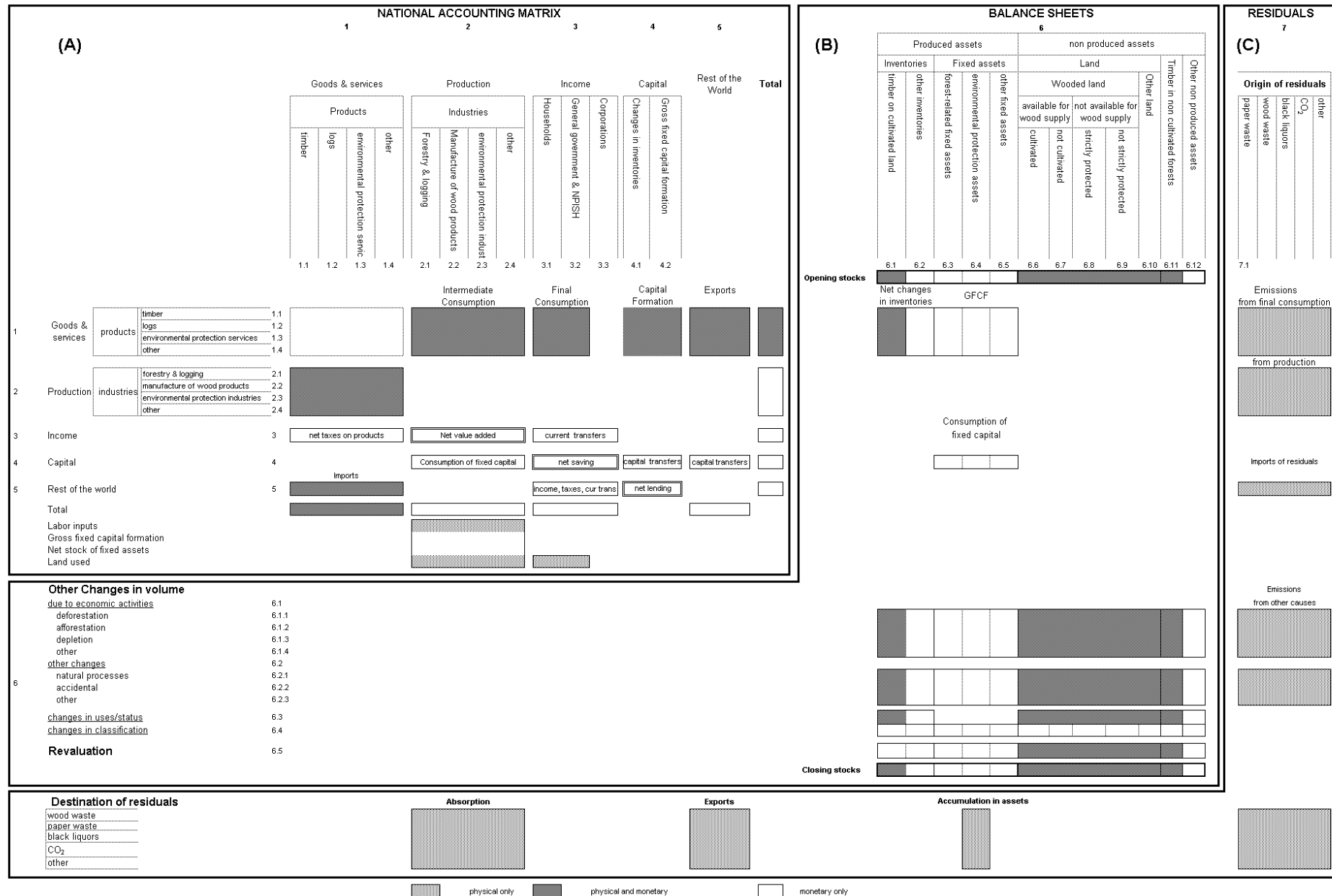
General presentation of the framework

- 4.01 The general structure of the proposed framework is adapted from the 1993 SEEA and the NAMEA. A simplified national accounting matrix (NAM) is used for the presentation of transactions. The presentation of balance sheets and other changes in assets is quite similar to SEEA. The presentation of flows of residuals is made according to the NAMEA presentation, but no allocation to themes is made.
- 4.02 In the present stage the framework consists of three parts, which are schematised below (for a more elaborated version see next page).



- 4.03 The first part of the framework (**A**) is a reduced NAM (see SNA Table 20.1. and ESA Table 8.20). It includes the supply (output of domestic industries and imports) and uses (intermediate and final consumption, gross capital formation and exports) tables of the national accounts supply and use tables. Income, capital and rest of the world accounts are also presented, although only in a summarised way.
- 4.04 As concerns classifications, forest-related products (timber, wood, etc.) and industries (forestry, logging, manufacture of wood products, of pulp and paper, etc.) are presented in detail.
- 4.05 Supply and use tables are drawn up both in monetary and physical terms. This allows:
- to elaborate material balances of timber, wood and other forest products within a framework similar to the OECD or Nordic natural resources accounts,
 - to describe economic accounts for forestry, as well as forest management and protection activities.
- 4.06 Physical data on the uses of timber and other forest-related products (wood in the rough, wood products, pulp and paper), whether they originate in domestic or foreign forest assets can be linked to the monetary accounts.
- 4.07 Activities related with the direct or indirect management of forest resources (forestry, services incidental to forestry, recycling of waste paper, etc.) as well as environmental protection expenditure related to forests, and corresponding monetary flows could also be specified.

Developed Framework



- 4.08 The second part of the framework (**B**) describes in monetary and physical terms the stocks of non-financial assets and changes in these stocks. Particular attention is paid to the "other changes in the volume of assets account".
- 4.09 Assets are primarily classified according to the ESA/SNA classification of assets. More detail is provided for forest-related assets (forest land and other wooded land, standing timber, etc.). This part allows describing:
- forest balances in area (forest land) and volume (standing timber),
 - changes in forest-related assets,
 - changes in classification of assets,
 - and revaluation.
- 4.10 As concerns changes in forest-related assets a distinction is made between changes due to economic activities and changes due to other causes:
- Changes due to economic activities cover afforestation, deforestation, depletion.
- Changes due to other causes are disaggregated according to their natural (e.g. natural colonisation or regression of wooded land), accidental (fires, storms, etc.) or multiple, non-referable cause.
- Changes due to changes in use/status cover the changes in status/uses of the various categories of land, e.g. from available for wood supply to strictly protected, etc.
- 4.11 Through quantitative (or qualitative) changes in assets (and corresponding changes in value, when monetary values are assessed), this approach permits to relate opening and closing stocks of forest-related assets with the pressures exerted by economic activities. It would thus allow linking forests indicators with the system of national accounts, giving them a coherent basis in order to identify and assess appropriate economic instruments and policies.
- 4.12 The third part (**C**) describes - in physical terms - the flows of residuals by origin (production, consumption, imports and other origins) and destination (absorption by economic activities - e.g. waste incineration or exports, accumulation in fixed assets, etc.) in a NAMEA-type presentation.
- 4.13 Balances of residuals (corresponding to net emissions to nature) are drawn. A link with the costs of the environmental protection activities (internal costs for preventing emissions, external costs for the treatment of residuals) may be established.
- 4.14 Emissions of residuals originating in forest-related activities are separately identified (e.g. black liquors from chemical pulp industry). CO₂ balances are also drawn up.
- 4.15 These different aspects are illustrated below. Flow accounts (part **A**), balance sheets (part **B**) and flows of residuals (part **C**) are successively presented.
- 4.16 The IEEAF offers a consistent basis, which *inter alia* allows for the calculation of some of the quantitative indicators retained by the Helsinki Ministerial Conference on the protection of forests in Europe, or the OECD indicators for forest.
- 4.17 As indicated in the summary, although general in some of its aspects, the framework is not designed as a general integrated environmental and economic accounting framework. Its objectives are limited to describe the main interactions between economic activities as defined in the ESA and the European forests as a component of the environment.

Flow accounts

4.18 This section describes the flows of products in the economy in physical and monetary terms. As the framework and classifications are the same for physical and monetary flows, the link between the two categories of data is direct.

Simplified NAM

General presentation

4.19 Part **A** of the framework is a simplified NAM (see SNA Table 20.1. and ESA Table 8.20).

		1	2	3	4	5	
		Goods & services	Production	Income	Capital	Rest of the world	Total
1 Goods & services		Products	Industries	Institutional sectors			
	Products		Intermediate consumption	Final consumption	Gross capital formation	Exports	
2 Production	Industries	Output					
3 Income		Net taxes on products	Net value added	Property income, current taxes on income, current transfers			
4 Capital			Consumption of fixed capital	Net saving	Capital transfers	Capital transfers	
5 Rest of the world		Imports			Net lending		
Total							
Supplementary data							

4.20 The **first group of rows and columns** records transactions in goods and services. Uses (intermediate and final consumption as well as gross capital formation and exports) are presented in the rows and output of domestic industries, net taxes on products and imports in the columns.

4.21 The basic classification of products is the standard classification of products of the ESA supply and use tables (see e.g. ESA Annex 4 – Classification and accounts Part I, E). This classification is disaggregated further for some categories relevant for forest accounting. Other categories may be grouped together when their separation is not relevant for the domain or the specific purposes of the framework (see proposed classification of products - § 4.37 sq.).

4.22 In order to relate monetary transactions with physical flows, including material balances, some harmonisation remains necessary between classifications of products and industries (monetary data) and classifications used in forestry statistics (physical data).

4.23 The **second group of rows and columns** presents transactions of the production account, by industries. The rows record the output of industries and the columns record intermediate consumption and consumption of fixed capital. Net value added is the balancing item.

4.24 The classification of industries corresponds to the classification of products, see § 4.37 sq.

4.25 As far as necessary, the description of external environmental protection activities and services is made specifying these activities and products in the classifications. Following the principles of functional classifications and satellite analysis (see SNA Chapters XVIII & XXI), for the description of *internal environmental protection or forest resource management activities* of given industries, the outlays of the production account that correspond to these activities may be isolated in a specific sub-column of the column corresponding to this industry (see page 49).

- 4.26 The **third group of rows and columns** summarises the income accounts. Net taxes on products, net value added, current transfers between institutional sectors and current receipts from the rest of the world are presented in the rows. The columns record final consumption (households and general government), net current transfers and other current outlays to the rest of the world. The balancing item is net saving, which is distributed among institutional sectors.
- 4.27 The **fourth group of rows and columns** summarises the capital account. Net saving enters, with consumption of fixed capital and capital transfers, in the rows. Gross capital formation, capital transfers and net capital transfers from the rest of the world enter the columns. Net lending/borrowing of the total economy is the balancing item.
- 4.28 Finally the **fifth group of rows and columns** summarises the rest of the world account (current and capital transactions). Imports and net current outlays are recorded in the rows; exports and net capital transfers in the columns.

Specific features

Complementary information

- 4.29 The simplified NAM is complemented by four rows that describe, by industry, the labour inputs, the gross fixed capital formation, the closing stocks of fixed assets and the land used. The first three rows correspond to the standard supplementary information of the ESA use table.
- 4.30 The fourth row records the closing area of the land used by industries. Economically used land is distributed among industries according to the ESA classification of land. Other recreational land and other land are distributed among institutional sectors (in columns 3) according to the owner: households or general government.

Further disaggregation

- 4.31 Some of the cells, and respective headings in rows and/or columns, may be further disaggregated. Examples of such disaggregation are the following:

Goods and services and income accounts

- 4.32 Output may be distributed according to the nature of output and industries:
- market output
 - own account output
 - other non-market output
- 4.33 Net taxes on products: one may distinguish taxes from subsidies and within taxes and subsidies those that are environment-related.
- 4.34 Net value added: net value added has to be broken down into its various components: compensation of employees, net other taxes on production and net operating surplus/mixed income. Within net other taxes on production, one may distinguish other taxes on production from subsidies and within taxes and subsidies those that are environment-related.
- 4.35 The disaggregation of taxes and subsidies is important for the description of transfers related to forest protection or forest development (see § 4.45 sq.).

Capital account

- 4.36 Capital transfers between institutional sectors: when "environmental" capital transfers (e.g. investment grants for environmental purposes) can be identified, they should be separated and recorded by institutional sectors. The same holds for capital transfers to/from the rest of the world e.g. "debt for nature" swaps applied to tropical forests.

Monetary flows

Economic accounts

4.37 The simplified NAM describes economic transactions. Product and industry classifications allow for the detailed description of the transactions of the forest-related industries and corresponding units. The accounting framework integrates economic accounts for specified industries. It also describes:

- gross fixed capital formation, changes in inventories and net acquisitions of land,
- subsidies, investment grants, as well as other transfers to producers,
- finally, labour inputs, fixed capital formation, closing stocks of fixed assets and land.

Proposed classification of industries

	NACE classification		
Forestry & logging	02		Forestry , logging and related activities
Manufacture of wood products	20	20.1 20.2 20.3 20.4 20.5	Saw milling and planing of wood ... Manufacture of veneer sheets, plywood ... Manufacture of builders' carpentry and joinery Manufacture of wooded containers Manufacture of other products of wood
Manufacture of pulp		21.11	Manufacture of pulp
Manufacture of paper		21.12	Manufacture of paper and paperboard
Printing, publishing	22	22.1 22.2	Publishing Printing
Environmental protection	37	37.2	Recycling
	90 part.		Waste management
Other			All other industries, either grouped together or by division of the NACE Rev.1

4.38 Some other economic activities related to forest or to forest products pertain to the following NACE Rev.1 classes:

01.12 Growing of vegetables, horticultural specialties and nursery products (this class includes: ... growing of mushrooms, gathering of forest mushrooms or truffles),

01.50 Hunting, trapping and game propagation including related service activities,

36.1 Manufacture of furniture

92.62 Other sporting activities (this class includes: ... hunting for sport or recreation)

Proposed classification of products

	CPA	Products
Standing timber	02.01.5	Standing timber
Wood in the rough		
Saw logs	02.01.11 to 13	Logs (by species)
Fuel wood	02.01.14	Fuel wood
Pulp wood	02.01.15	Pulp wood
Wood and wood products	20.1 to 20.5 except : 20.10.4 & 20.52	Sawn wood, etc. Wood waste Products of cork ...
Wood waste	20.10.4	Wood waste
Paper pulp	21.11	Paper pulp
Paper and paper products	21.12 except 21.12.6	Paper Waste and scrap of paper
	21.2	Articles of paper and paperboard
Waste paper	21.12.6	Waste and scrap of paper
Books, newspapers, etc.	22 except	Books, newspapers, etc. 22.14, 22.24 & 22.3
Other		All other products

Economic Accounts for specified industries

Forestry and logging

- 4.39 In the IEEAF natural growth of cultivated timber is recorded as forestry output. Forestry and logging accounts are separated on the basis of a **functional analysis** of the economic accounts for forestry. On the basis of the NACE Rev.1 definitions, forestry is defined in the IEEAF as the activity of growing standing timber, coppice and pulpwood, including operation of forest tree nurseries and growing of Christmas trees. It includes all related services (forest inventories, timber evaluation, fire protection, etc.). Logging is defined as the activity of felling timber and producing wood in the rough; it includes all related services activities (transports of logs within the forest, etc.).
- 4.40 Forestry output takes the form of work in progress and accrues to inventories of standing timber. The value of timber removed from the forest (valued at stumpage prices) enters the intermediate consumption of logging.
- 4.41 On the whole, this separation increases the value of output of the forestry and logging industry by the value of the changes in inventories of standing timber. The integration of Economic Accounts for Forestry into the IEEAF is presented on page 48.

Manufacture of wood and wood products, manufacture of pulp, paper and paper products

- 4.42 These industries are described according to the general structure of ESA 95 production accounts.

Other industries

- 4.43 For other industries listed above, it is necessary to examine how existing information systems allow to identify transactions that correspond to productive activities which bring into play forest or forest-related products (grazing of animals, harvesting of forest-growing plants, recreational activities, etc.). No specific reference to these industries is made in the framework, although two of the tables proposed for a first implementation (see Chapter 5) cover the output related to wooded land by industry, type and institutional sectors.

Development of specific accounts

- 4.44 Two specific accounts are proposed in order to describe transactions whose purpose is the protection of forest and related assets and the development and management of wooded areas and related resources. These two accounts apply the SERIEE framework (see European Commission 1994b) of which they constitute specifications as concerns forest.

The Environmental Protection Expenditure Account

- 4.45 The simplified NAM allows for the description of the transactions covered by the Environmental Protection Expenditure Account (EPEA) of SERIEE²⁴. Supply and use of environmental protection services are described differently according to their nature:

External environmental protection activities

- 4.46 They are separated in the classification of industries. Supply and use of products (environmental protection services), as well as the production account of related industries may be described in the simplified NAM, through a specific column and row for the external environmental protection industries and products (see page 49 for a diagrammatic presentation of the integration of the EPEA and FRMA into the framework). In the proposed classification of industries (see § 4.37), recycling and waste management activities are grouped together.

Internal (ancillary) environmental protection activities

- 4.47 Transactions related to internal (ancillary) environmental protection activities (namely intermediate consumption, compensation of employees and consumption of fixed capital) are described, for those industries considered as relevant for the purpose of the description of emissions, or absorption of residuals, through a sub-column for internal environmental protection expenditure. However, in line with ESA/SNA principles no corresponding output is recorded.

²⁴ A full reformatting of the EPEA into the NAM approach would also necessitate the specification of connected and adapted products.

4.48 Specific environmental protection activities are described in the framework:

- those, either external or internal, which concern the protection of forest (e.g. protection of forest against fires)
- those related to residuals from forest-related industries or products (for example treatment of black liquors by the pulp industry, treatment of wood waste, etc.).
- those which are intended to prevent degradation or to restore the environmental conditions of the forest-related media.

4.49 As far as forestry is concerned, environmental protection activities, as identified in the Standard European Classification of Environmental Protection Activities (CEPA) are few. They mainly consist in the heading 6.2.1 "protection of forest".

4.50 Some other positions of the CEPA may be of interest for forestry accounting.

Protection of soil against erosion often consists in afforestation programs. Corresponding expenditure is recorded in the EPEA when the purpose is not economic, but responds to environmental protection concerns. One may wonder about the possibility to separate, in practice, those afforestation programs that respond to environmental protection from those which have economic objectives. For those programs there is a risk of double accounting in the EPEA (protection of soil and groundwater, protection of landscape and biodiversity) and the Forest resources use and management account (FRMA, see § 4.51 sq.). Joint collection and treatment of data would allow avoiding this double counting.

In the EPEA, **recycling and recovery** are considered as environmental protection activities. The EPEA "waste management account" records the secondary output of waste disposal services by units whose principal activity is recycling, as well as subsidies paid to these units. As recycling and recovery of waste wood or paper are also Forest Resource Management activities (see below), a risk of double counting exists between EPEA and FRMA. Generally speaking, the separation between «environmental protection» and «forest management» activities needs further investigation. In any case joint collection and treatment of data is necessary.

The Forest Resource Management Account (FRMA)

Objective of the FRMA

4.51 Objective of the Forest Resource Management Account, as introduced by the SERIEE system, is to describe, adopting a functional approach (see 1993 SNA Chapter XVIII), for the units which belong to specified industries (mainly forestry, logging and other industries concerned with the production or the use of forest-related products) the parts of their outlays that are aimed at:

on the one hand:

- expansion and maintenance of wooded areas,
- their development for economic or social use,
- inventories and assessment of forest resources,
- forest-related research, education, formation and information activities.

on the other hand:

- development of new uses for forest resources,
- recycling, recovery, reuse or savings of forest products and by-products.

4.52 Excluded are the transactions whose purpose is protection of forest as natural medium (protection against pollution, fires, landscape and habitat protection, fauna and flora protection, ecosystems protection, etc.), which are described in the Environmental Protection Expenditure Account (see above).

Outlays related to forestry and other economic uses of forest.

- 4.53 On a functional basis, the Forest Resource Management Account groups together, for the units (local KAU) which pertain to the listed industries, and whatever their institutional sector and nature of output:
- a) current uses (intermediate consumption, compensation of employees, consumption of fixed capital, net taxes on production) corresponding to afforestation, replenishment of wooded areas and to current maintenance of wooded areas, as well as capital expenditure: construction of buildings and forest roads, acquisition of equipment for the various economic uses of forest.
 - b) current and capital outlays of producers for the assessment of forest resources (forest inventories) as well as outlays for research, education, formation activities related to forest. In this latter case units pertaining to other industries, and in particular to the divisions 73 (research and development), 80 (educational services), 91 (91.33 environmental and ecological movements) and 92 (92.53 operation of nature reserves including wildlife preservation, 92.62 hunting for sport or recreation) of the NACE Rev.1, may be concerned.
 - c) net acquisitions of land for afforestation purposes.

Other outlays

- 4.54 Other outlays which must be identified and accounted for in the Forest Resource Management Account are those outlays intended for the development of new uses of forest resources, for the recycling of wood and paper products, i.e. producers' outlays whose purpose is to modify (develop) the uses of wood and other forest-related products.
- 4.55 In fact, provided that exploited areas are replenished, the development of wood use (for construction, furniture, use of woody biomass as fuel, etc.) may be considered as being beneficial for the environment, as it substitutes products based on non-renewable resources (plastics, concrete, fossil fuels, etc.) by renewable resources and increases the net fixation of carbon dioxide. The same conclusion holds for recycling of waste paper so as to reduce waste disposal and pollution.
- 4.56 Due to the importance of public financing, whether they consist in transfers to producers for afforestation or maintenance of wooded areas, or in expenditure by general government units engaged in other non-market activities (management, control, regulation of forest and forestry), the Forest Resource Management Account records separately the transfers intended to compensate forest resource management expenditure as well as collective consumption of general government.
- 4.57 In addition to subsidies, investment grants and other transfers listed above, the development and maintenance of wooded areas may benefit from other incentives. Specific reductions in taxes on forest assets, reduction on interest rates etc. may respond to explicit forest development objectives.

Integration of Economic Accounts for Forestry into the framework

		1 Goods & Services				2 Production						3 Income			4 Capital	5 Rest of the world	Total	
		Products				Industries						Households	General government	Corporations				
		Standing timber 1.1	Wood in the rough 1.2	Wood products 1.3	Other 1.4	Forestry & logging 2.1	(of which) forestry 2.1.1	(of which) logging 2.1.2	Manufacture of wood products 2.2	EP industry 2.3	Other 2.4	3.1	3.2	3.3	4	5		
1	Goods & Services	Products				Intermediate consumption						Final consumption	Final consumption		Gross capital formation	Exports		
		Standing timber																
		Wood in the rough																
		Wood products																
		Other																
2	Production	Output																
		Forestry & logging																
		Manufacture of wood products																
		Environmental protection industry																
		Other																
3	Income	Net taxes on products				Net value added						Property income, current taxes on income, current transfers						
		Taxes less subsidies																
		Environmental taxes																
		Environmental subsidies																
		Compensation of employees																
		NOS/mixed income																
4	Capital					Consumption of fixed capital						Net saving			Capital transfers	Capital transfers		
5	Rest of the world	Imports										Net incomes, taxes and current transfers			Net lending			
Total																		
	Labour inputs																	
	GFCF																	
	Changes in inventories																	
	Stock of fixed assets																	
	Land used																	

Shaded areas indicate transactions related with Economic Accounts for Forestry (EAF Rev.1).

Integration of environmental protection expenditure and forest resources management expenditure into the framework

		1 Goods & Services					2 Production					3 Income			4 Capital	5 Rest of the world	Total	
		Products					Industries					Households	General government	Corporations				
		Standing timber	Wood in the rough	Wood products	External EP Services	Other	Forestry & logging	(of which internal EPE & FRME)	Manufacture of wood products	EP industry	Other							
		1.1	1.2	1.3	1.4.1	1.4.2	2.1		2.2	2.3	2.4	3.1	3.2	3.3	4	5		
1 Goods & Services	Products	Standing timber																
		Wood in the rough																
		Manufacture of wood products																
		External EP services																
		Other																
2 Production	Industries	Forestry and logging																
		Manufacture of wood products																
		EP industries																
		Other																
3 Income	General government	Other taxes less subs.																
		Environmental taxes																
	Households	Environmental subs.																
		Compensation of employees																
4 Capital	Corporations	Net operating surplus																
		Net value added																
5 Rest of the world	Imports	Imports																
		Income, taxes, current transfers																
Total																		
Labour inputs																		
GFCF																		
Changes in inventories																		
Stocks of fixed assets																		
Land used																		

Shaded areas indicate transactions related with Environmental Protection Expenditure Account and Forest Resource Management Account.

Material flows and balances

General presentation

- 4.58 Natural resource accounts as developed e.g. by Nordic countries for forests and forest products include three accounts in physical quantities: a forest balance, a supply/use table (or sector/commodity balance) and an industry mass balance (see Chapter 3 - Physical accounting and indicators).
- 4.59 Forest balances describe stocks and changes in stocks of forest areas and stocks and changes in stocks of volume of standing timber. For forest areas, they integrate flows such as afforestation, deforestation, and for standing timber the increment (natural growth) of standing timber as well as removals of timber due to economic activities. They are presented in § 4.75 sq.
- 4.60 Sector/commodity and industry mass balances describe the physical counterpart of economic transactions in standing timber, wood and wood products: supply and use of timber, wood and wood products in physical quantities, as well as the "wood content" of the corresponding flows.

Sector/commodity balance

- 4.61 The sector/commodity balance is disaggregated in two matrices, which correspond to the supply and use matrices of the supply and use tables of the ESA/SNA system. Units are m³ or tons according to the type of products.
- 4.62 The use matrix of the sector/commodity balance describes the uses of the products. Uses are intermediate consumption by industries and final uses (final consumption by households, changes in inventories and exports). Products are those of the proposed classification of products (see § 4.38): timber, saw logs, fuel wood and pulp wood, sawn wood and other wood products (plywood, inc. particle and fibre board, etc.), paper pulp and paper and paper products. Wood waste and paper waste are also included in so far as they are classified as products. Industries are those of the proposed classification of industries (see § 4.37): forestry and logging, manufacture of wood products (sawing, manufacture of veneer sheets, etc.), manufacture of paper pulp and manufacture of paper, paperboard and articles of paper and paperboard, publishing and printing, other industries. "Other" industries may be disaggregated in order to show explicitly some industries, which use large quantities of wood products, e.g. manufacture of furniture.
- 4.63 The supply matrix of the sector/commodity balance describes the supply of products: output of industries and imports. Classifications are the same as in the previous matrix; as they are the same as those used in national accounts, physical quantities are directly related to monetary accounts. For the specified products the total of uses and supply should be equal, as in monetary supply and use tables.

Industry mass balance

- 4.64 For specified industries, the industry mass balance describes the wood content of flows of products. Unit is the ton of dry matter. The industry mass balance is also disaggregated in two matrices, which correspond to the intermediate consumption and output matrices of the ESA/SNA supply and use tables.
- 4.65 The use matrix of the industry mass balance describes the wood content of the intermediate consumption of selected industries in timber and wood products: for example the wood content of the logs used by sawing or plywood veneers industries. Industries and products are those of the use matrix of the sector commodity balance. Wood equivalents are derived from that matrix using coefficients that relate the tons of dry matter to the intermediate consumption in physical units (m³ or tons). The total of the wood content of all products used for intermediate consumption give the total entry of wood into the respective local kind of activity units and industries. However, it may happen that some units use waste containing wood or paper waste not classified as products and therefore not accounted for in intermediate consumption (e.g. wood waste from discarding fixed assets).
- 4.66 The make matrix of the industry mass balance describes the wood content of these industries' output. Output in physical units from the output matrix of the sector commodity balance is transformed into wood content using coefficients.

- 4.67 Wood contents are not normally balanced between intermediate consumption and output, i.e. between the make and use matrices of the industry mass balance: the wood content of the output of an industry is not equal to the wood content of its intermediate consumption, the difference being the wood content of by-products, wood waste etc. which are not accounted for in the output by products, as well as the wood content of non-specified intermediate consumption and output. The use of wood and waste containing wood for energy production is also a potential source of discrepancy: although being accounted for as an entry the wood content of the wood and residuals used as fuel is not accounted for in the output.
- 4.68 Therefore the industry mass balance has to be extended to the wood content of the flows of residuals and uses for fuel. These flows are presented in the part C of the framework, see § 4.131 sq. Integration of the two categories of flows is also made in the proposed tables for a first implementation (see Chapter 5).
- 4.69 In the following pages, a reformatting of the Finnish material balances²⁵ is made in order to illustrate the integration of wood and wood products material balances into the framework.
- 4.70 The Finnish material balances do not incorporate flows of timber (gross increment, removals; losses and change in inventories). These should be integrated in the sector/commodity balance. Gross increment of standing timber has to be recorded as output of forestry or natural growth, removals are recorded as intermediate consumption of the logging industry, and gross increment less removals less losses as changes in inventories of standing timber (capital formation), for that part that is produced.

Integration of material flows and balances into the framework

- 4.71 The scheme for the integration of matrices describing supply and use of wood and wood products as well as the wood content of the flows into the framework is presented on the following page.
- 4.72 This scheme is further extended to the flows of residuals (including wood content) in the part C of the framework, see § 4.131 sq.
- 4.73 In order to draw a comprehensive balance of the wood content, another extension should be to describe wood content of products used as fixed assets and households durable consumption goods, as well as the discard of these products, e.g. by using the perpetual inventory method. This seems to be feasible in so far as the framework is extended to cover the main products containing wood that are used for final consumption and gross fixed capital formation. This has for example been done by Germany in their physical input/output tables.²⁶

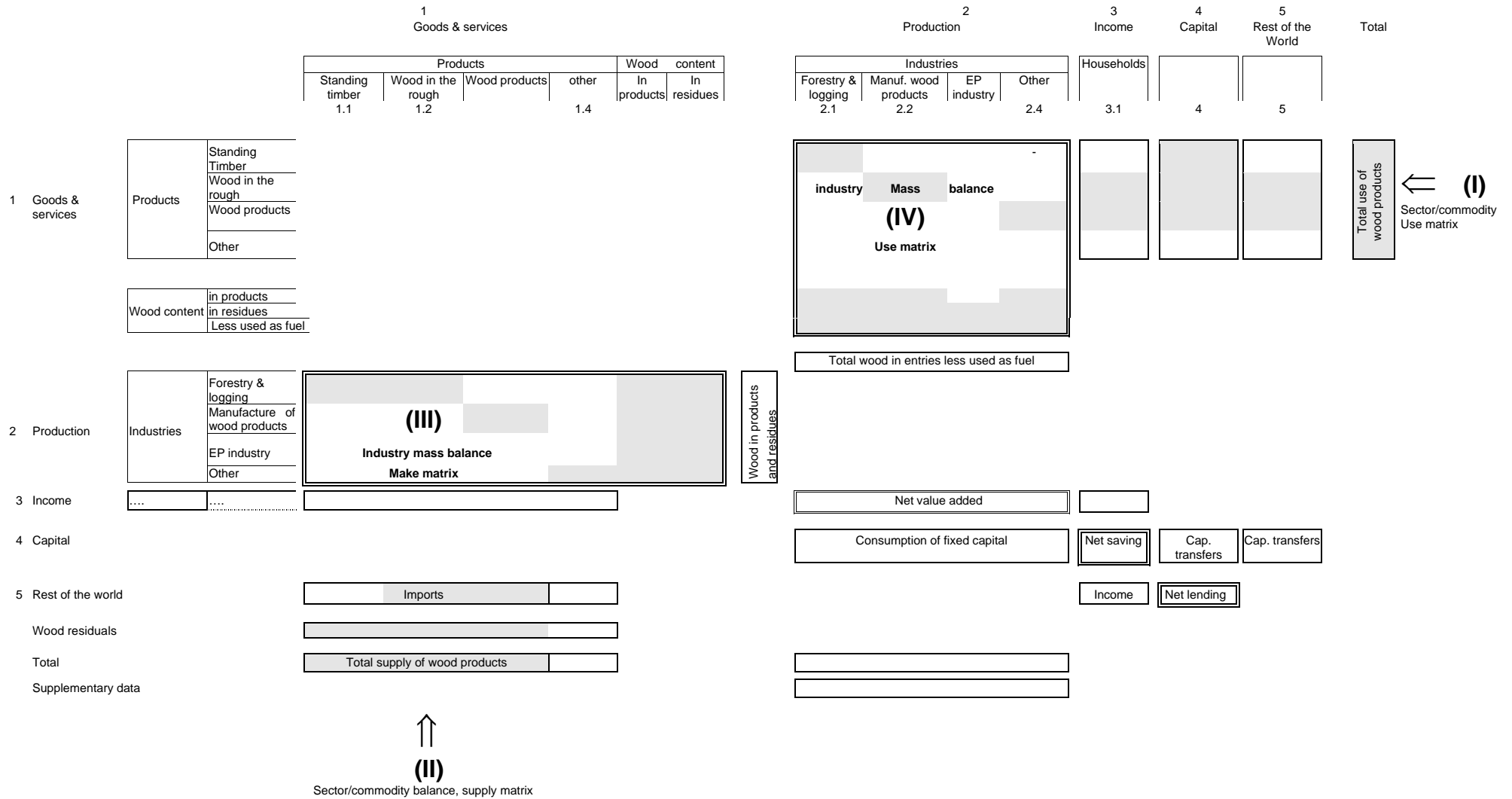
CO₂ and carbon balances

- 4.74 Mass balances may be directly applied for the establishment of carbon or CO₂ balances. In these balances, the wood content of the flows of products is transformed into carbon content (and implicitly into CO₂ absorption), see § 4.131 sq.

²⁵ See Muukkonen (1997).

²⁶ See Eurostat (1998).

Integration of material flow accounts into the framework



Shaded areas indicate physical flows of the sector/commodity balances and the industry mass balances.

Sector/commodity balance (supply/use tables)
(Finland – 1990)

USE MATRIX (I)

		Intermediate Consumption of industries						Total intermediate consumption	Final consumption	Changes in inventories	Exports	Total
		logging 02.01	sawing 20.10	Man. of plywood ... 20.20	pulp industry 21.11	paper industry 21.12	other industry					
Products	Unit											
timber	1000 m3	53 680						53 680		22 050		75 730
saw logs	1000 m3		17 040	2 200	1 250		587	21 077		163	280	21 520
pulp wood	1000 m3		630	20	30 370		70	31 090		-1 290	350	30 150
fuel wood	1000 m3		500	117			5 450	6 067	3 310	-445		8 932
sawn wood	1000 t.		350	86			2 470	2 906		451	4 173	7 530
plywood	1000 t.			42			444	486		101	769	1 356
paper pulp	1000 t.					7 316	148	7 464		8	1 461	8 933
paper	1000 t.			5	57	340	1 097	1 499		-60	7 698	9 137
residuals												
wood residues	1000 t.			1 160	6 540		106	7 806		1 080		8 886

SUPPLY MATRIX (II)

Industries	Products								residues
	1000 m3				1000 metric tons				
	timber	saw logs	pulp wood	fuel wood	sawn wood	plywood ...	paper pulp	paper	
forestry	75 730								
logging		21 160	24 360	8 543					5 242
sawing		20	90	8	7 400				1 106
manufacture of plywood, etc.				11	56	1 289			2 251
pulp industry							8 886		
paper industry								8 958	
other industries				340	16				7
Imports		340	5 700	30	58	67	47	179	280
Total	75 730	21 520	30 150	8 932	7 530	1 356	8 933	9 137	8 886

**Industry mass balance
(Finland, 1990)**

(Wood content in 1000 tonnes of dry matter)

USE MATRIX (IV)

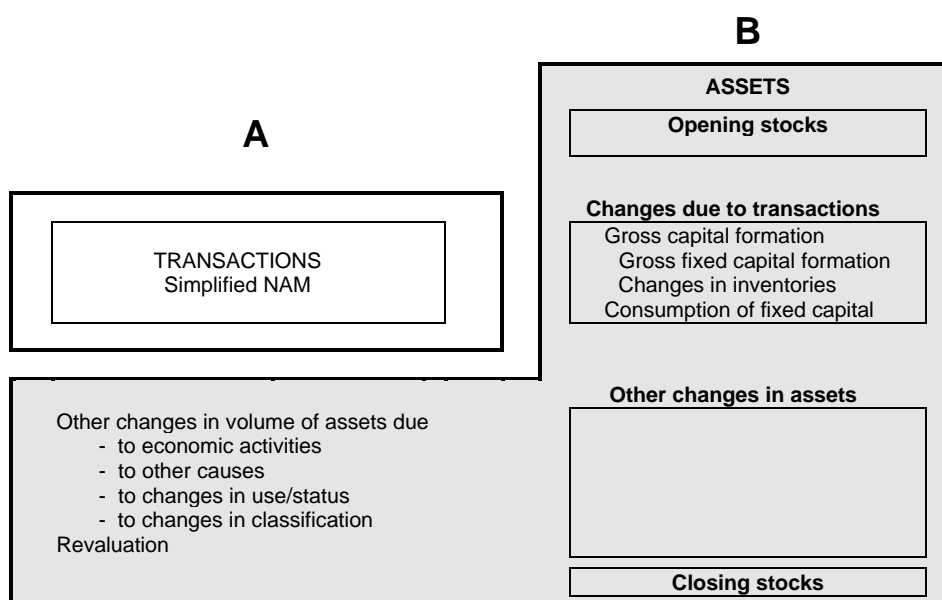
Products	Industries			
	Sawing	Manufacture of plywood	Pulp industry	Paper industry
Saw logs	6 986	1 034	513	
Pulp wood	246	8	11 844	
Fuel wood				
Sawn wood	140			
Paper pulp		15		6 300
Paper				
Total in products	7 372	1 057	12 357	6 300
Use of residues and by-products		490	2 846	255
Total used	7 372	1 547	15 203	6 555
Less used as fuel	209	51	5 754	-
Total	7 163	1 496	9 449	6 555

MAKE MATRIX (III)

Industries	Products							Total in products	In residues, waste	Total
	Saw logs	Pulp wood	Fuel wood	Sawn wood	Plywood	Paper pulp	Paper			
Sawing	8	35	959	3 034				4 036	3 127	7 163
Manufacture of plywood			143		883			1 026	470	1 496
Pulp industry						8 370		8 370	1 079	9 449
Paper industry							6 539	6 539	16	6 555

Balance sheets and changes in assets

- 4.75 Part **B** of the framework describes the balance sheets: opening stocks, changes in stocks, and closing stocks of the various categories of assets are recorded. Main categories of assets and changes that affect them are presented below.
- 4.76 In the IEEAF, as in ESA and SNA, changes of assets are divided into two categories: changes that result from transactions and changes that result from "other flows", i.e. flows that are not transactions. The first category of changes is described through an extension of the rows of the simplified NAM. The second category of changes constitutes a complementary set of data. Balance sheets may be complemented by a "land accounting matrix", describing the changes from one category of land to another.
- 4.77 Assets are described either in monetary values or in physical units or both. All economic assets are described in monetary value, according to ESA/SNA rules of valuation. Physical units are used for inventories (and changes in inventories) of standing timber (m³) and for land areas (ha).



Classification of assets

- 4.78 In general the classification of assets corresponds to the ESA/SNA classification of assets. However, only tangible non-financial assets are dealt with (i.e. explicitly described) in the IEEAF. Intangible assets are omitted, as well as financial assets. Consumer durables may be introduced as a complementary category.
- 4.79 The ESA/SNA classification is rearranged in order to match with forest concerns. Specific disaggregation is made for assets related to forests, i.e. either wooded land, inventories of forest-related products (timber, wood, paper, etc.) or produced assets used by forest-related industries and in particular by forestry and logging. Specific categories are introduced for land and for inventories of standing timber. Produced assets and non-produced assets are separated.

Produced assets

4.80 They are described in five columns, three for fixed assets and two for inventories.

Fixed assets

Fixed assets related to forests

4.81 They refer to fixed assets of the forest-related industries, as specified in the industry classification. They mainly consist in machinery and equipment, non-residential buildings, and other structures. They cover:

<i>non-residential buildings</i>	AN.11121	
<i>other structures</i>	AN.11122	Forest roads
<i>transport equipment</i>	AN.11131	Forestry tractors, trailers, etc.
<i>other machinery and equipment</i>	AN.11132	Rotivators, machinery for soil preparation, felling trees, etc.

4.82 Mature trees yielding repeat products (AN.2114: cork oak, gums trees; etc.) are also concerned. Leisure or tourism infrastructures, buildings of natural parks, etc. may also be considered, when located in forests.

4.83 Stocks of fixed assets of the forest-related industries are thus described twice in the framework: by categories of assets in the balance sheets and by industry as supplementary data.

Fixed assets for environmental protection

4.84 They refer to the fixed assets used for environmental protection (waste water treatment plants, waste treatment plants, landfills, etc.).

Other fixed assets

4.85 They refer to all fixed assets, which are not recorded in the previous columns. The total of forest-related fixed assets, assets for environmental protection and other fixed assets is equal to the sum of fixed assets in the economy, as recorded in the ESA balance sheets.

Inventories

4.86 As concern forests, inventories mainly consist of standing timber.

Cultivated standing timber

4.87 Cultivated standing timber corresponds to standing timber on "cultivated forest land available for wood supply".

4.88 A detailed description of inventories of cultivated standing timber according to species or other parameters may be necessary in order to assess their value. However, this detailed description is not made directly in the framework but in supplementary tables.

4.89 Description of inventories (and changes in inventories) of standing timber is made in physical units (m³ with bark) and in monetary value. Valuation follows the principles outlined in § 3.111 sq.

Other inventories

4.90 They consist of all other inventories. They are described only in monetary terms.

Non-produced assets

4.91 Land is distinguished from other non-produced assets (non-cultivated standing timber either available for wood supply or not, other wild biota, other non-produced assets). Non-economic assets, which are only described in physical terms, are recorded in a specific column.

Land

Basic land classification

4.92 In the IEEAF, land is classified in accordance with forestry statistics definitions. Therefore the first level of classification distinguishes:

- wooded land (i.e. forest land and other wooded land), and
- other land.

4.93 Wooded land is further separated into "wooded land available for wood supply" and "wooded land not available for wood supply".

4.94 Within the first category, a distinction is made between "cultivated" wooded land and "non-cultivated" wooded land. The category "cultivated wooded land" corresponds to areas where forestry interventions (thinning, etc.) are significant and that are more or less regularly managed, or to new plantations (see also § 3.73 sq.). The category "non-cultivated wooded land" corresponds to areas without human intervention for long periods (thirty or more years, depending on the species) and where forestry interventions are so small that they may be neglected and the standing timber, although exploitable and having exceeded by far the normal felling age, is left without being cut.

4.95 Within the category "not available for wood supply" a distinction is made between "strictly protected wooded land" and "not strictly protected wooded land". The category "strictly protected wooded land" corresponds to wooded land with severe legal restrictions on wood production, e.g. national parks, nature reserves and other protected areas such as those of special scientific, historical or cultural interest (see e.g. the three first positions of the IUCN protection categories). The category "not strictly protected wooded land" corresponds to wooded land where physical productivity is too low or harvesting and transportation costs are too high to warrant regular wood harvesting.

Other classifications

4.96 As has been seen many other classifications are also relevant. Wooded land may be described according to the species (resinous, deciduous, mixed), age structure, etc. Wooded land is often divided into high forest, coppice, standards with coppice, etc. Wooded land available for wood supply may be managed or not according to an explicit management plan, wooded land may also have a protection function, without being strictly protected (protection of soil, water, habitat, etc.). Type of ownership is also an important parameter for economic analysis.

4.97 However, in order not to overburden the IEEAF, it was decided not to integrate these classifications directly into the framework. They should rather be used to set up supplementary tables. For example, forest balances (see Chapter 5 - Proposed tables for a first implementation) may be drawn up for main groups of species. In most cases these tables are relatively easy to fill in on the basis of forest inventories. Some of these tables are already included in the TBFA-2000 survey and tables.

4.98 Moreover, these supplementary tables could be necessary in order to assess the progress towards sustainable management of forests. For example indicators of the Helsinki conference refer to changes in the proportion of forest area managed primarily for soil and water protection (indicators 5.1 and 5.2), to changes in the area of forests protected by special management regime (indicator 4.1 c.), to percentage of forest area managed according to a management plan or management guidelines (indicator 3.2.), etc.

Quality classifications

4.99 A second type of classifications, that relates to the quality of forest ecosystems (including biodiversity and landscape), could be integrated into the IEEAF framework.

Under this general heading are grouped together:

- health of trees, measured by defoliation or discoloration,
- damages to trees by abiotic or biotic aggressions,
- level of biodiversity, measured by number of (threatened) forest species,
- wooded land soil acidification or degradation,
- fragmentation or connectivity of wooded areas, etc.

4.100 As has been seen, the European forest health survey provides information on the distribution of a sample of trees according to the defoliation rate of crown and discoloration of leaves. However, no comprehensive, common and harmonised monitoring system exists for other aspects.

4.101 As an experiment, tables are proposed that distribute the forest according to the rate of defoliation (see Chapter 5 - Table 2c defoliation). Only two categories of quality are retained: land with (severely) defoliated standing timber (corresponding to the classes 2, 3 and 4 of the UN-ECE/EU defoliation classification) and land without (severe) defoliation. Other quality aspects will be introduced as soon as a synthetic indicator for forest ecosystems quality will be defined and available at European level.

Land classification

	COVER	USE	CULTIVATION
1	Wooded land*	Available for wood supply	Cultivated
1.1			
1.1.1			Not available for wood supply
1.1.2			
1.2		Strictly protected	
1.2.1			
1.2.2	Not strictly protected		
2	Other land		

*.... May be split into "forest" and "other wooded land".

4.102 Land is described in physical units (ha) and monetary value. The valuation is made according to the principles described in § 3.111-3.170.

Non-cultivated standing timber

4.103 Three categories of non-cultivated standing timber are considered, which correspond to the classification of non-cultivated land:

- a) standing timber located on wooded land that, although available for wood supply, is classified as non-cultivated,
- b) standing timber located on forest land classified as strictly protected and therefore not available for wood supply,
- c) standing timber located on forest land classified as not available for wood supply but not strictly protected.

4.104 These timber stocks are described in physical units (m³) and in monetary terms. Stocks pertaining to the first category have a monetary value, calculated as specified in § 3.111-3.170. Due to the specific features of these stocks, their value may be lower than that of standing timber located on cultivated land. Timber stocks of the second and third categories may have a zero value.

Other wild biota

4.105 Although not explicitly shown in the framework, wild biota could be introduced as a specific category of non-cultivated biological assets. Wild biota mainly consist of wild flora and animals in forests: mushrooms, truffles, game, birds, etc., when they are not considered as "cultivated", i.e. when they do not result from game propagation activities. As they are rarely owned by an institutional unit, it is not clear to what extent they are "economic" assets and how they should be valued. In physical terms, data on wild biota may allow the follow up of "biodiversity". This aspect has to be further integrated in quality classifications. Stocks of non-produced biological assets related to forests are not described in the IEEAF. Only flows resulting from harvesting or hunting activities (berries, edible fungi, wild game meat, lichen, etc.) are recorded in the "other changes in volume of assets account".

Other non-produced tangible assets

4.106 This category is included in the framework only in order to give a complete picture of economic assets. In fact there is no specific relationship between forest and other non-produced tangible assets (except maybe for peat when extracted from forest land, as is the case in e.g. Finland).

Changes in balance sheets

4.107 Changes in balance sheets are described in the framework in physical and monetary terms. They are presented below successively for the two main categories of assets: standing timber and wooded land. According to ESA/SNA, changes are divided into transactions and "other changes".

Standing timber

Physical accounts

4.108 Although the TBFRA-2000 does not provide any standard forest balance, according to the definitions, the changes in stocks of standing timber between the beginning and the end of the accounting period are equal to gross increment less removals less any losses not accounted for in removals.

4.109 Changes must be described for each category of timber, namely for cultivated standing timber and other categories. One may expect that for the non-cultivated timber, the increment would be negligible in Europe, as non-cultivated would usually correspond either to overmature trees, or to low productivity areas.

4.110 Removals that originate from trees outside the forest should be distinguished.

Losses

4.111 According to the definition of the TBFRA-2000 losses resulting either from normal mortality or from exceptional events like tempests, insect attacks, flooding, etc. do not affect the standing volume of timber, but only the volume of growing timber, except when the corresponding (dead) timber cannot be recovered (for pulp or fuel). That part of natural losses (either normal or exceptional) that cannot be recovered has to be recorded under the heading "other losses of standing timber". This item would mainly include destruction of standing timber by forests fires but it should also include the decrease of the volume of standing timber due to natural processes: decomposition of dead trees, etc.

Changes in use/status

4.112 As the classification of standing timber may change during the accounting period, other changes must be introduced in order to explain the changes between the beginning and the end of the accounting period: changes in use and status. They generally correspond to a change in the use/status of the corresponding land. For example when, due to changes in economic, technical or legal conditions, wooded land is reclassified from the category "available for wood supply" to "not available for wood supply" or vice-versa, standing timber must also be reclassified.

Classification of standing timber

	Standing timber on wooded land				Standing timber on other land	Total
	Available for wood supply		Not available for wood supply			
	Cultivated	Not cultivated	Strictly protected	Not strictly protected		
Opening stocks						
Gross increment						
Removals						
Losses						
Changes in use/status						
Closing stocks						

Monetary accounts

Transactions in standing timber

4.113 Changes due to transactions only apply to cultivated standing timber: they consist of "changes in inventories" recorded as an item of gross capital formation. The "changes in inventories of cultivated standing timber" are equal to gross increment (of cultivated standing timber) less removals (of cultivated standing timber) where gross increment represents the value of cultivated standing timber acquired (i.e. output of forestry) and removals the value of cultivated standing timber disposed of (i.e. used as intermediate consumption by the logging industry).

4.114 Plantations are additions to inventories of cultivated standing timber (except for trees yielding repeat products). Their value is already included in the value of natural growth. However, it may be worth distinguishing the actual expenditure for plantations. This should be done when describing the detailed uses of forestry.

Other changes in the volume of standing timber

Natural growth and depletion (non-cultivated timber)

4.115 Increment and removals of non-cultivated timber are to be recorded as other changes in volume. Occasional fellings on wooded land not available for wood supply deserve a specific treatment: as the value of the standing timber stocks is nil, they first have to be recorded as appearance and then as depletion. However, if the monetary values are small, which is presumably the case, it is preferable to record neither the appearance nor the depletion.

4.116 Occasional fellings may take place e.g. on areas not available for wood supply or on other land. In such cases a reclassification of the standing timber has to be made.

Other losses of standing timber, changes in use/status

4.117 They correspond to the value of losses recorded in the physical flows. Changes in use/status record the changes in the value of the standing timber due to the changes in use/status (e.g. from available for wood supply to not available for wood supply), as recorded in the physical accounts (see § 4.112).

Changes in classification

4.118 Changes in classification records the shifting of the value of standing timber whose category has changed between the beginning and the end of the period with the same absolute value used for both entries – a negative entry for the old category and a positive entry for the new category.

Revaluation of standing timber

4.119 This row records the change in value due to changes in prices of standing timber between the beginning and the end of the period.

4.120 In ESA/SNA (see e.g. ESA § 7.08 and SNA § 12.104 sq.) the revaluation item, i.e. the value of the holding gains/losses is given by the difference between the value of opening and closing stocks less the value of [additions minus withdrawals], on the condition that additions (gross increment) and withdrawals have been valued at the current prices prevailing at the time transactions have taken place and other changes in the volume of assets are also taken into account.

4.121 When balance sheets are made on a yearly basis, the revaluation item resulting from the changes in prices used to value opening and closing stocks may dwarf the other flows in the accumulation accounts. Transactions and other changes in volume only represent, on a yearly basis, some 2 to 3 % of the stock (and the net flows only 1%). Therefore, e.g. a 10% change in prices results in a revaluation item 10 times higher than the net changes due to economic transactions or other flows.

4.122 It may therefore be convenient to smooth the revaluation item by using averaged prices for opening and closing balance sheets (e.g. a moving average of 3-5 years).

Transactions in land

4.123 As the framework does not distinguish institutional sectors, no transactions in land are recorded in the balance sheets. Improvements to land are recorded as gross fixed capital formation (produced assets).

Other changes in volume of land

4.124 According to ESA/SNA, other changes in the volume of land mainly consist of:

- changes in land quality due to changes in economic uses,
- degradation of non-produced assets due to economic activity,
- other changes in volume in non-financial assets n.e.c.,
- changes in classifications.

4.125 Following the SEEA and based on the specific classification of changes in land use/land cover applied to forests (see Conference of European Statisticians 1995), a reclassification of these changes is proposed. This classification separates "other changes due to human activity", "other changes in volume due to natural, multiple or non-referable causes" and "changes in classifications".

Other changes in volume of land due to economic activities

4.126 They correspond to all other changes in volume that may be attributed to a specific and identifiable human activity.

- deforestation (as change in cover),
- afforestation (as change in cover),
- restoration (as change in quality, for example liming of forest soils, restoring of ecosystems by introducing species),
- degradation (as a result of frequentation, forestry activity, etc.),
- other changes due to human activity.

Other changes in the volume of (wooded) land due to natural, multiple or non-referable causes

4.127 They correspond to all other changes in the state of forest assets of which the causes are unknown or cannot be directly related to human activity:

- natural (e.g. change in cover due to natural colonisation or regression)
- accidental
 - forest fires
 - damages caused by storms, tempests, insect attacks, etc.
- environmental conditions (e.g. changes in defoliation rates)
 - droughts
 - general pollution (e.g. acidification)
- other changes due to natural, multiple or non-referable causes

Changes in use/status of land

4.128 During the accounting period wooded land may change category. The changes in use/status records those changes that affect wooded land e.g. when the wooded land becomes protected and is no longer available for wood supply. It should be noted that changes between wooded land and other land are already recorded under changes due to economic activities (afforestation, deforestation) or under changes due to natural causes (e.g. colonisation or regression), therefore changes in use/status only records changes within the wooded land category.

Changes in classification of land

4.129 Changes in classification records the shifting of the value of land between categories with the same absolute value used for both entries – a negative entry for the old category and a positive entry for the new category.

Simplified classification of changes in the volume of land

- changes due to human activities
 - deforestation
 - afforestation
 - restoration
 - degradation
- natural and non-referable changes
 - natural processes
 - changes in environmental conditions (including pollution)
- changes in use/status
- changes in classification

Revaluation of land

4.130 Changes in the value of land due to changes in prices of land between the beginning and the end of the period are recorded as a revaluation item.

Flows of residuals

Objective and general structure

4.131 Part **C** of the framework is intended to describe in a simplified way the flows of residuals in physical units. Residuals are "any material that is unwanted by its producer and is disposed of, either directly to the environment, or through another economic agent without, or with only nominal, remuneration to the producer" (Smith 1995). Flows of residuals refer to emissions and absorption by domestic economic units, accumulation in fixed assets and cross-boundary flows.

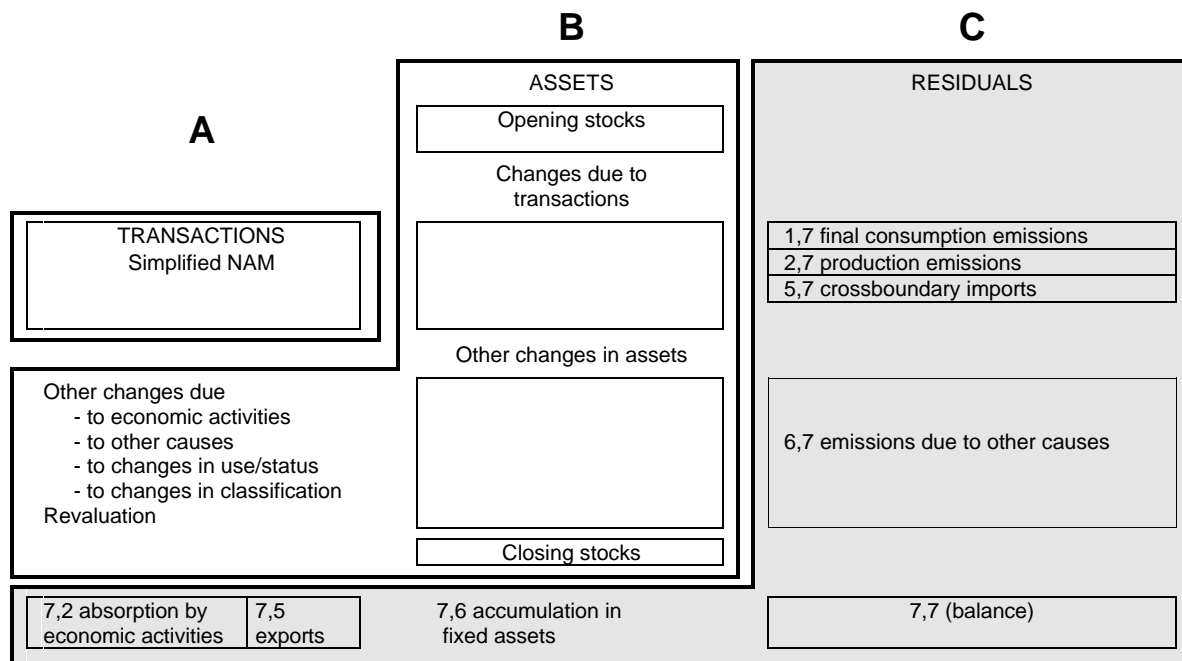
4.132 Emissions refer to that part of the residuals that is disposed of by domestic economic units, i.e. that "leaves" the unit. Residuals reused or recycled, used as fuel or stored on site by the unit itself are not accounted for in emissions.

4.133 Absorption by domestic economic activities refers to the treatment of residuals by "external" environmental protection activities. It also includes the absorption of CO₂ by trees in the process of their natural growth.

4.134 Accumulation in fixed assets refers to the storage of residuals in (controlled) landfills when this storage results from an external environmental protection activity.

4.135 Transboundary flows refer to the transportation of residuals into, or out of, the domestic economy, either by natural media (atmospheric and water flows) or by human-controlled means of transport. In the IEEAF only human-controlled transport is described. This covers for example the (physical) counterpart of the import of waste treatment services.

- 4.136 The proposed framework allows for a direct linking of the flows of residuals to activities in a NAMEA-type approach. Balances of residuals (i.e. residuals released into natural media) may be allocated to global and national environmental themes, as in NAMEA. Another possible extension is the linking of flows to stock accounts of residuals, allowing the establishment of comprehensive "residual flow accounts" and the allocation of balances of residuals to accumulation in media. The relation with mass balances for wood requires careful analysis: although not accounted for in emissions, waste containing wood used as fuel or stored on-site should be recorded in the "residuals" part of mass balances.
- 4.137 The framework is drafted so as to describe all residual flows. However, the focus is put on "forest-related" residuals (see § 4.143 sq. - classification of residuals), i.e. residuals that either originate from forest and forest-related products or activities, or are damaging to trees or wooded land.



Description of residual flows

4.138 The description of flows of residuals is made in physical units through several matrices and vectors.

- **Matrix 1,7** describes emissions due to household final consumption; emissions may be presented according to household final consumption by products (goods) or according to household final consumption by function.

The linking of household final consumption to emissions requires some care. In the SNA, household final consumption refers to consumption of **resident** households. Therefore, theoretically, emissions recorded in matrix 1,7 should correspond to the emissions due to the final consumption of resident households only. They should correspond to the total of these emissions, whatever the country where they occur; as concerns mobile sources, emissions in foreign countries by resident households should be included and emissions on the economic territory due to non-resident households should be excluded, even when these emissions correspond to goods purchased in the economic territory (for details see e.g. United Nations and United Nations Environmental Programme (1999), pages 140-142).

However, as far as the state of the "national" environment is concerned, emissions of resident households abroad have only limited significance, whereas emissions by non-resident households (atmospheric emissions of air pollutants, waste and waste water emissions) may have a direct impact on the national environment. Emissions by non-residents may be important in small countries or in countries with an important tourism sector.

As far as possible, residuals due to discards of durable household goods should be included in matrix 1,7. However, as this type of residuals is not related to current consumption, but to consumption that occurred in previous periods, ways of this inclusion are still controversial (see e.g.

Smith 1995). The problem may be significant for waste containing wood (books, furniture, etc.) and is directly related to the storage of carbon in products.

- **Matrix 2,7** describes emissions due to industries. These emissions should theoretically correspond to emissions due to resident production units, whatever the country where these emissions occur. For some countries that have important international transport industries (shipping, air and road transport by residents units abroad) emissions by resident units should take into account consumption of fuel bunkered abroad.

As far as possible, residuals due to discards of fixed assets should be included in matrix 2,7; they may be related to consumption of fixed capital. Treatment of demolition waste should be specified.

- **Matrix 6,7** describes emissions due to other causes, i.e. emissions that are not referable to final or intermediate consumption or to the discard of fixed assets or of durable household goods. Such emissions include emissions corresponding to "other changes in the volume of assets" either due to economic activities, e.g. emissions of CO₂ due to deforestation, or to other causes (natural emissions and emissions due to catastrophic events: forest fires, etc.).
- **Matrix 7,2** describes the absorption of residuals by economic activities. It covers absorption of residuals by "external" environmental protection activities (waste treatment, waste water treatment, recycling, etc.) and other activities, e.g. absorption of CO₂ by forestry. Absorption of pollutants is said to have occurred only when the environmental protection activity has changed the physical/chemical form of the residuals. Thus, collection, sorting and transport are excluded. This implies in particular that, when solid waste treatment only consists in storage in a (controlled) landfill, solid waste is not considered as "absorbed", but accumulated in fixed assets.
- **Matrix 7,6** describes the accumulation of residuals in fixed assets. Accumulation of residuals in fixed assets corresponds to the storage of waste in (controlled) landfills, and other specific installations.
- **Vectors 5,7 and 7,5** describe imports or cross-boundary inflows of residuals, and exports or cross-boundary out-flows of residuals. In the IEEAF only transport by human-controlled means of transport is included. All "transport" by natural media is excluded.

4.139 The balance appears in the **matrix 7,7**. It corresponds to the accumulation of residuals in environmental media (air, water and soils), either "national", foreign or global. As previously indicated this balance may be allocated to themes (NAMEA approach) or enter into more comprehensive "residual flow accounts" (see e.g. Conference of European Statisticians 1995). Such accounts may be drawn up for elements and may take into account transfers between media (from air to soils, etc.) as well as natural processes of transformation and assimilation.

4.140 For a given level of activity, emissions and absorption of residuals change, *inter alia*, according to the level of environmental protection measures. Corresponding expenditure are described, in monetary terms, in part A of the framework (see § 4.45-4.50).

- changes in emissions (for a given output) may be related to changes in "internal" prevention measures (either of industries or households). Internal prevention measures of industries are described by industry in a sub-column of the production account (column 2 of the simplified NAM). "Internal" prevention measures of households may be specified, through their expenditure for connected and adapted products²⁷.
- changes in absorption may be related to changes in "external" environmental protection activities, which are separately identified in the classification of industries of the simplified NAM.

4.141 However, as numerous studies have shown, a direct link is difficult to establish between the emissions and the environmental protection measures, due, in particular, to the impact of the changes in output or activity structure.

4.142 The application of this general structure to the forest domain is outlined below, specifying residuals and activities.

²⁷ For connected and adapted products, see SERIEE 1994 version § 2024 sq.

Application to forests: classifications

Classification of residuals

4.143 Although various classifications have been proposed, there is no agreed general classification of residuals. Classifications may rely either on the physical state of residuals or on the media into which they are spilled (land, water, and air).

4.144 In the case of forests, the classification of residuals must allow to describe, through a specific disaggregation, residuals that:

- originate from forest and forest-related products, or activities,
- are damaging to trees or wooded land.

4.145 As concerns the first category of residuals, a distinction should be made between:

- specific pollutants such as "black liquors" from the pulp industry, or some specific chemical products used in forestry (fertilisers, pesticides, etc.), or for the preservation of wood, manufacture of boards, etc.,
- waste from wood and paper products or even residues from wood industries, or atmospheric emissions from wood combustion,
- non-specific pollutants such as atmospheric emissions from fossil energy consumption by industries related to forest and forest products, etc.,

4.146 Waste wood and paper are sometimes classified as products; "residues of wood" for example is a position of the CPC, the CTCl Rev.3 and the CN (positions are: 39280, 246.2 and 4401.30); the same holds for "waste paper" (positions are: 39240, 251.1 and 4707).

4.147 Furthermore, they are used in large quantities in the wood or pulp industries themselves either for manufacturing pulp, or for energy production and therefore do not appear as solid waste in the residuals flows.

4.148 As concerns the second category of residuals, residuals of main interest are, first, all those pollutants, which contribute to the acidification of environmental media (sulphur and nitrogen oxides), but also photo-oxidants, heavy metals and eutrophication substances. Some countries (e.g. Austria) have drawn up a list of substances damaging to forests.

4.149 In a first step the residuals integrated into the framework and the proposed tables for a first implementation (Chapter 5) have been limited to two categories of solid waste (wood waste and paper waste) and to black liquors and CO₂.

4.150 An "other" category groups together all other pollutants. It may be disaggregated according to the relevant issues.

Classification of residuals

Wood waste
Paper waste,
Black liquors,
CO₂,
Other (all other residuals).

Classification of activities

4.151 The classification of activities used to describe emissions of residuals by industries is the classification retained in the part A of the framework (see § 4.37).

4.152 This classification allows describing the treatment of residuals by "external" environmental protection activities. The proposed treatment is the following:

Incineration and recycling of waste by the waste treatment industry is recorded as absorption by environmental protection industries. Recovered products (as output of recycling) are then used by other industries. Storage in controlled landfill is recorded as accumulation in assets.

Internal environmental protection activities are described in monetary terms (see § 4.45-4.50). However internal treatment of residuals is not described in the flows of residuals, but only in the mass balances for wood. For wood and paper waste, it would be possible to relate the level of emissions to the internal activities and internal use (as fuel) of wood and paper waste.

4.153 According to the TBFRA-2000 definitions, silvicultural waste, i.e. that part of felled trees (including pre-commercial thinnings), which is left in the forest (tops of stems, branches, etc.), is not accounted for in removals. However, it may be partly included in standing timber. The proposal is not to include silvicultural waste in residual flows. However, in order to balance changes in standing timber stocks, and as it may be an important aspect of forestry management it is suggested to integrate silvicultural waste in the physical part of the standing timber balances.

4.154 The description of residual flows gives specific attention to the impact of forestry and logging on the carbon cycle (see below - CO₂ balances). Forestry, as an industry, is described as a CO₂ sink whose role in the protection of global climate is often emphasised.

Possible extensions: allocation to themes, accumulation in assets and natural media

4.155 For each residual or category of residuals, the framework allows calculating the balance between emissions, absorption, accumulation in fixed assets and cross-boundary flows.

4.156 Balances of pollutants may be allocated to themes as in the NAMEA approach. They may also be allocated to natural media through "residual flow accounts" (see e.g. Conference of European Statisticians 1995).

4.157 Such description is especially interesting for those pollutants, which accumulate in the soil of forests, as they may affect natural, and hence economic, productivity of forests, biodiversity, etc.

4.158 However, there are limitations to the establishment of residual flow accounts. Natural assimilation and transformation of residuals, as well as the release of residuals accumulated in the past must be taken into account, which seems far from easy.

4.159 Even when residual flow accounts can be set up, no direct link between accumulation of residuals in media and the state of forests can be made:

- the state of forests depends on complex interactions between several factors including climate (drought, etc.) and there is no scientific evidence of the relationship between accumulation of residuals and productivity of forests yet.
- thresholds and buffer phenomena hamper the immediate manifestation of pollutant accumulation.

4.160 Although the IEEAF does not integrate such comprehensive accounts, it may prove interesting and feasible to draw-up these accounts for wood. A draft of such accounts is presented in § 4.58-4.74. However, their establishment requires an adequate treatment for durable goods, which contain wood, as they may transform into waste, but may also act as a carbon sink.

CO₂ balances

4.161 The role of forests as a CO₂ sink is emphasised in numerous reports. In various sets of forest-related indicators (OECD, Helsinki Conference, etc.) the contribution of forests to the fight against global warming is described through "carbon storage" and "changes in carbon storage" by forests, which can be directly derived from the stock of standing timber by species.

CO₂ absorption in wood

	Carbon content kg C/kg dry matter	Dry matter Content (kg/m ³)	CO ₂ absorption (1) kg/m ³ wood
pine	0.519	409	697.5
spruce	0.519	388	661.7
broadleaves	0.504	488	811.2

(1) Carbon content was transformed into CO₂ absorption using a 46/14 ratio.

Source: Eurostat 1996

4.162 The IEEAF allows calculating such indicators in a direct way. It also allows compiling the forest part of CO₂ (or carbon) balances at national level. CO₂ balances for forests result from:

- emissions, and
- absorption by natural growth of timber.

4.163 **CO₂ absorption** is calculated on the basis of gross increment (natural growth) of standing timber by species, as recorded in the IEEAF.

4.164 **CO₂ emissions** are calculated at the same time as the other atmospheric emissions.

4.165 Statistics on atmospheric emissions of CO₂ may integrate emissions corresponding to the totality of the wood removed from forest ecosystems: the CO₂ content of the wood used for the manufacture of wood products and manufacture of pulp industry is then accounted for in these industries' emissions and emissions resulting from direct use of wood for energy production are accounted for in the emissions of the respective economic units.

4.166 On this basis the contribution of forest to the carbon cycle is limited to the "net changes in the volume of standing timber", which is one of the criteria retained by the Helsinki Conference for the description of the carbon sink function of forests.

4.167 However, carbon fixed in the standing volume is only a part of the carbon fixed by trees. Small branches, twigs and roots also contribute to the storage. Furthermore, stocks of carbon in the soil of forests are estimated as being five times the stocks in trunks. CO₂ assimilation by forests is thus certainly higher than the gross increment of standing volume. Nevertheless, as changes in accumulation of carbon in soils are difficult to assess, they are not integrated into the IEEAF.

4.168 Moreover:

- First, there is no reason to allocate the CO₂ content of the wood used in the manufacture of wood products or pulp industries to these industries. Only the emissions directly generated by the production process should be allocated to these industries. Emission related to the wood content of the corresponding products should be allocated to users. In particular, as emissions normally refer to domestic use, either intermediate or final, wood products which are exported do not give rise to domestic emissions - these emissions should be accounted for by the country where products are used (however, detailed data are needed to fully account for all these flows).
- Second, except for the wood used as fuel, the consumption of wood products does not directly result in emissions: some wood-containing products only release their carbon content after a long time (household durable goods, including furniture, books, and fixed assets including carpentry products, etc.). According to available data only a small part of removals are used directly as fuel wood. Recycling of paper is increasing, which enlarges the period of binding the carbon in paper products.

4.169 It would be worth to draw balances of CO₂ (emissions minus absorption) which take into account these various factors. Results would differ markedly from the balance drawn on the basis of the changes in stocks of standing timber.

4.170 As an example, for Nordic countries, whereas the net binding of carbon in forests corresponds only to 24.7 % of emissions, the gross increment represents 71.5 % of emissions.

Emissions and assimilation of CO₂ in Nordic countries

Million tonnes CO₂

	Emissions to air	Assimilation by forest growth	Assimilation in % of emissions
Denmark	49.9	2.3	4.6
Finland	51.4	54.5	106.0
Norway	34.3	15.4	44.9
Sweden	58.4	66.6	114.0
Total	194.0	138.8	71.5

Assimilation of CO₂ is calculated multiplying natural growth in cubic meter by coefficients of the previous table.

4.171 Tables describing all aspects of the carbon storage have been developed as a part of the work of the Eurostat Task Force on Forest Accounting on the physical description of non-ESA/SNA functions of forests (Eurostat 1999a). Some of these tables are directly derived from the TBFRA-2000. They are briefly presented below.

Carbon balances and accumulation in standing timber (1000 tons of carbon)

	Total	Coniferous	Broad-leaved
Opening stock			
Natural growth			
Fellings			
Catastrophic losses			
Other changes			
Deforestation			
Closing stock			

Balance and accumulation of woody biomass (1000 metric tons of dry matter)

	Opening stock	Natural growth 3)	Fellings	Catastrophic losses	Other changes Deforestation	Changes in land classification	Closing stock
Above stump biomass 1)							
-Trees on wooded land							
- available for wood supply							
- coniferous							
- broad-leaved							
- not available for wood supply							
Other woody biomass 2)							
Total							

1) The mass of the woody part (stem, bark, branches, twigs) of trees, alive or dead, shrubs and bushes, excluding stumps, roots and foliage.

2) Stumps and roots

3) Natural growth in forests afforested from 1990 onwards is to be separated, as requested by the Kyoto Protocol

Carbon accumulation related to woody biomass (1000 tons of carbon)

	Opening stock	Natural growth (3)	Fellings	Catastrophic losses	Other changes Deforestation	Changes in land classification	Closing stock
Above stump biomass 1)							
-Trees on wooded land							
- available for wood supply							
- coniferous							
- broad-leaved							
- not available for wood supply							
Other woody biomass 2)							
Total							

Notes: see previous table

Changes in carbon stored (1000 tons of carbon) in the forest ecosystem

	Opening stock	Changes in carbon stored	Closing stock
Woody biomass in forest			
Needles and leaves			
Ground vegetation			
Forest soils			
Total			

Changes in land cover (1000 ha)

	Forest and other wooded land	Agricultural land	Artificial surfaces	Other Land	Total Land
Opening area					
Afforestation					
Deforestation					
Natural colonisation or regression					
Other changes					
Changes in land classification					
Closing area					

Table 4b intends to establish a link between land cover changes and changes in carbon stored in the forest ecosystem and constitutes a basis for estimating carbon binding in forest soils.

Changes in total carbon storage (forest related resources and products)

	Opening stock	Changes	Closing stock
Forest biomass 1)			
Forest Soils			
Wood Products 2)			
Peatland			
Total			

1) Tree and ground vegetation biomass

2) Net of additions (to be derived from supply and use of wood) and withdrawals (to be based on a perpetual-inventory-type method or on waste statistics)

Non-wood and non-ESA/SNA functions of forests

4.172 Numerous studies attempted to describe and value non-wood products and non-ESA/SNA functions of forests²⁸. Some of these studies concluded that the values of these functions were higher than the wood production function.

4.173 The IEEAF does not incorporate the valuation of non-ESA/SNA functions of forests at this stage. However, it provides some possibilities for the physical description of these functions.

Non-wood products of forests

4.174 Non-wood products provided by forests are numerous.

4.175 Main non-wood goods are:

- forestry products other than timber: cork, natural gum, etc.
- agricultural products growing in forests: berries, edible mushrooms, nuts, lichen, game meat, furs, skins, etc.
- mining products: peat from peat land in forests

4.176 Main services are hunting as a sport or recreation, the operation of reserves, national parks, and other recreational services in forests.

²⁸ For a summary see e.g. FAO (1997).

Classification, valuation and treatment of the non-wood products of forests

- 4.177 Although a significant part of the harvest of some non-wood goods is market output, the majority of these goods, and in particular agricultural products growing in forests are produced as output for own final use. The whole harvest (either market or for own final use) has to be recorded as output in national accounts. For the valuation of the marketed products, the wholesale price paid to the pickers seems to be the best candidate. The same price should be used for products harvested for own final use.
- 4.178 Services should only be included in so far as they are market or other non-market output (services for own final use are not recorded as output in national accounts). These services mainly concern the provision of hunting rights to third parties by the owners of wooded land and the provision of recreational services: accommodation and camping services (partly by public bodies that operate national parks, natural reserves, etc. located in the forest). When the value of hunting rights is recorded, their relation with the value of game meat should be assessed. Double counting should be avoided, depending upon the way the hunting rights are fixed.

Integration into the framework

- 4.179 As they are already recorded in national accounts, output and use of these products are implicitly within the IEEAF. However, in order not to overburden the presentation they are not explicitly identified and separated. On the other hand, they are described in some details in two of the proposed tables for a first implementation (see Chapter 5): Table 3a "Output related to wooded land by industry" and Table 3b "Output related to wooded land, by type and institutional sector".
- 4.180 Whereas Table 3a distributes the output between the corresponding industries, Table 3b is intended to distribute the output according to its nature (market, other non-market and for own final use). This allows identifying those forest management and protection activities that are undertaken by units of the general government sector.

Non-ESA/SNA functions

4.181 Besides wood and non-wood products recorded in the national accounts, i.e. products that entail a direct cost when produced or used, forests provide a set of "free" services. Although not being recorded in national accounts aggregates (output, GDP, final or intermediate consumption, capital formation) these services contribute, directly or indirectly, either to the production, or to the "welfare" of individuals or communities. Non-ESA/SNA functions of forests designate the capacity to provide these free services. This capacity represents intangible assets not recorded in national accounts balance sheets.

List of non-ESA/SNA functions of forests

4.182 Numerous lists of non-ESA/SNA functions of forests (and the corresponding services) exist, and there is some arbitrariness in choosing a particular list (and the implicit corresponding classification).

4.183 The main categories of non-SNA functions of forests (see Eurostat 1999b) are related to the free provision of:

- recreational services and aesthetic values,
- environmental protection services,
- pollutant sink or deposition services,
- cultural, symbolic and spiritual values.

4.184 Whereas recreational services and aesthetic values on the one side and cultural, symbolic and spiritual values on the other side directly contribute to the welfare of individuals and communities (they are called consumer services), the characterisation of environmental protection services and pollutants sink and deposition function is more complex. They cover:

- Soil and land protection
- Water cycle stability and water retention, including protection against floods
- Ground water protection and water purification services
- Stabilisation of micro climate
- Noise protection
- Avalanche and land slide protection
- Biodiversity and habitat protection
- Stabilisation of global climate, carbon sequestration
- Other pollutants sink and deposition

Monetary valuation

4.185 No attempt is made to value non-ESA/SNA functions of forests in the IEAAF. Main reasons are a) that there are no generally agreed methods for this valuation, b) that the integration of non-ESA/SNA values with ESA/SNA values is problematic, and c) detailed physical data and comparable results of valuation studies are lacking. Other problems are international comparability, treatment in the accounts, complexity of the physical description of the functions and of the economic analysis etc. (for details see Eurostat 1999b).

4.186 However, some of the functions could justify experimental valuation and tentative monetary accounting: this is in particular the case for recreational functions and carbon sequestration functions. From a physical point of view these two functions are relatively easy to describe. In addition, methods for monetary valuation are well-explored (recreational functions) or markets may be established soon at international level (carbon sequestration functions).

4.187 The position has been taken in the IEAAF to limit the integration of non-ESA/SNA functions and services to a physical description for the time being.

Physical description

4.188 The objective of the physical description of non-ESA/SNA functions or services of forests is to expand the analytical capability of the national accounts system by introducing accounting in physical terms, to be able to better track interrelationships between the natural environment and the economy as well as environmental effects of economic activities.

4.189 This will include information on environmental and recreational services or functions of forests. The following non-ESA/SNA functions and services of forests are covered:

- provision of habitat to wildlife and protection of biological diversity,
- recreational services,
- soil and water protection services.

4.190 The role of the forests for carbon binding has already been presented above. The pollutant sink function is indirectly taken into account through the monitoring of forest health and a table is proposed in Chapter 5 (see Table 2c: defoliation).

4.191 The following tables are derived from the TBFRA-2000 and OECD/Eurostat forest questionnaires.

Maintenance of biodiversity

4.192 Objective of this table (derived from the TBFRA-2000 table 10 and from the OECD-Eurostat forest questionnaire) is to provide information on the number of forest-occurring species (plants and animals) that are endangered, giving an indication of the state of biological diversity in forest and other wooded land.

Forest-occurring species at risk or endangered

	Total number of known species	Of which: endangered (1)	Percent of total (%)
Trees (coniferous and broad-leaved species)			
Other vascular plants (flowers)			
Total Vascular Plants			
Mosses			
Lichens			
Macrofungi			
Algae			
Total non-vascular plants			
Mammals			
Birds			
Other vertebrates (fish, amphibians, reptiles, etc.)			
Total Vertebrates			
Insects			
Other invertebrates			
Total Invertebrates			

(1) A species is endangered when it is facing a high risk of extinction in the wild in the medium-term future (IUCN-categories). For this table, critically endangered species are also included.

4.193 No direct link can be established with the IEEAF, except with the classification of forest areas according to cultivation and protection status. Ideally, the table should be established for cultivated forests and for non-cultivated forests separately. Analysis of the relationship between the wood supply function and the protection of biodiversity protection function of forests could then be done, in particular as concerns the diversity of tree species. The above table should be set up for various years so as to allow accounting for the changes in the number of known and endangered species.

Recreational functions

4.194 For describing recreational functions and services of wooded land a basis could be table 1A of the OECD/Eurostat forest questionnaire. The table describes the wooded land predominantly used for recreation.

Recreation areas of forest and other wooded land

	1000 ha	Area per inhabitant	Number of visits/year
Wooded land predominantly used for recreation (1)			
of which in national parks and other protected areas			
of which urban recreational wooded areas (2)			
of which privately owned			
Parks and gardens with trees within the cities			

(1) Applies only to wooded land where the public is legally entitled to visit wooded land. Some activities by the visiting public may however be forbidden or restricted

(2) Wooded land, with legal right of access, within a certain distance from urban areas according to national definitions. Area per inhabitant has to be calculated on the basis of urban population.

4.195 The table allows monitoring indicator 6.2 (provision of recreation) set up by the Helsinki Conference. It provides physical data for the characterisation of the recreational uses of forest. However, for monetary valuation more detailed data are necessary, e.g. data disaggregated at regional level, or by cause of visit. No direct link is established with the IEEAF framework.

Protective functions

4.196 The following table describes protective functions of wooded land. A basis for this table could be the OECD/Eurostat forest questionnaire (table 1A) or table 21 of the TBFRA-2000. The table describes the wooded land for which protective function (protection of the soil, water, etc.) is the major use (OECD/Eurostat questionnaire). Table 21 of the TBFRA-2000 only refers to the area where wooded land is managed primarily for soil protection.

Primary management objective of forest and other wooded land

	Area (1000 ha)	Of which: legal protection (1000 ha)
Wooded land predominantly used for protection		
of which for soil protection		
of which for the protection of water resources		
of which for protection against avalanches		
of which other or multiple objectives (1)		

(1) e.g. when soil, avalanche and water protection are overlapping

Note on the tables

4.197 The above tables are to be provided for two reference periods, that should correspond, for comparison purposes, with the closing and opening years of the forest balances. In this way, balances can be set up and opening and closing stocks as well as changes can be recorded.

Implementation and future developments

4.198 This section describes the first steps proposed for the implementation of the IEEAF. In Chapter 5, a set of 20 tables is presented, which cover the main aspects of the IEEAF framework: balance sheets for land and standing timber, economic accounts for forestry and logging, supply and use tables in monetary and in physical units. Several European countries have tested a preliminary version of these tables, with a view to forest statistics (availability of data, appropriateness of classifications, etc.) and the accounting framework (consistency of proposals for valuation, classification of transactions and other changes in volume, etc.). See European Commission 1999a.

First steps for the implementation

Transactions (monetary current accounts)

4.199 As concerns monetary current accounts, on the basis of existing national accounts, the proposed tables cover:

- disaggregation of the accounts for industries of the division 02 of the NACE Rev.1, in order to separate forestry activities (the growing of standing timber, including forestry service activities) from logging activities (felling of timber and production of wood in the rough), on the basis of a functional analysis of the Economic Accounts for Forestry,
- economic accounts for industries of the divisions 20 and 21 of the NACE Rev.1 with the description of resources and uses of the corresponding products, disaggregated for some groups and classes (20.1, 20.2, 20.3, 20.4 and 20.5; 21.11, 21.12 and 21.2),
- analysis of economic data for the divisions 37 and 90 of the NACE Rev.1 in order to identify their use of wood and paper waste and their supply of recovered paper,
- identification of transactions (including transfers) related to forest protection (fire protection, etc.) and management of forest resources (forestry inventories, etc.), whether they correspond to principal or secondary activities or are executed as ancillary (internal) activities by specific industries,
- identification of output related to forest other than wood in the rough.

4.200 The objective is, in particular, to establish supply and use tables for these industries and products, as well as to describe in detail the output (including, as concerns forestry, by type of output), intermediate consumption, gross value added by component, gross capital formation and transfers, etc.).

Material flows and balance

4.201 For the retained industries and products, material balances in physical quantities (supply and use tables in m³ or tonnes) are established, on the basis of current forestry and wood products statistics. Through coefficients, material balances of the wood content of products are drawn up.

Residuals

4.202 As concerns residuals, the proposal is to integrate emissions and absorption into material balances of wood content, for:

- wood and paper waste (production by industries and households and absorption by waste treatment activities, including recycling and use as fuel),
- waste liquors.

Balance sheets and description of forest-related assets

Land

Physical data

4.203 Data on wooded land areas result from national forestry inventories and land use surveys (generally conducted by agricultural statistical services). European ICP on forests (see § 3.38) may provide data about defoliation rates. The main problem is the cross-classification of defoliation classes with types of land areas, as data come from different sources.

Monetary balance sheets

4.204 At the present time only a few countries compute monetary balance sheets for land as part of the regular national accounts. When they exist, these balance sheets do not distinguish land according to the IEEAF classification. Thus, these balance sheets must be set up separately.

Standing timber

4.205 The stock of standing timber in volume is generally available through national forestry inventories.

4.206 Most of the data necessary to draw up the balance sheets already exist from various sources. Some complementary work may be necessary in order to ensure consistency and completeness. This work concerns:

- *identification of transactions related to the protection or management of forests*
There is a need to identify and classify the activities related to the protection or management of forest, in a way similar to the Standard European Classification of Environmental Protection Activities (CEPA), and to define the systems for gathering the data.
- *valuation*
The standard ESA/SNA valuation of standing timber by the net present value and its treatment as work in progress is rather complex and requires a huge amount of data and some (rather arbitrary) hypotheses (discount rates, etc.). Hence, simplified methods (e.g. stumpage value or consumption value methods) may be used.
- *material balances and flows of residuals*
The main items of material balances and flows of residuals (waste wood and paper) are integrated in the framework but the treatment of wood and paper waste and wood used as fuel needs special attention. Some arbitration may be necessary between a fully consistent and comprehensive treatment and the resulting complexity of the framework.

Limits and future developments

4.207 Some aspects of the interactions between economic activities and forest environment-related issues are not dealt with in the IEEAF. Such aspects mainly relate to the valuation and integration of quality aspects.

Monetary valuation

Valuation of other (non-wood) uses of forest

4.208 Theoretically, as far as ESA/SNA values are concerned, the market value of land incorporates the present value of all present and future economic benefits derived from forests, whatever the activity and use they originate in. However, transactions in land are rare, and not always representative of the whole stock. Therefore, the value of land has often to be calculated.

4.209 Besides the necessary assumptions to be made (e.g. discount rate for the benefits related to wood supply), there is a problem of data availability and accounting treatment for the uses other than wood supply. Hedonic analysis of actual transactions is useful to estimate the value attached to other uses such as private recreational uses, including those related with the existence of wild biota, game, etc.

4.210 Such market-related, indirect methods cannot be applied to protective functions of forests, nor to their role in the carbon cycle. A possible valuation seems to be through costs of maintaining or developing forests in their capacity to provide these ecological services. The proposed Forest Resources Management Account provides a basis for the recording of actual costs. Hypothetical costs can only be assessed through modelling of the measures necessary to achieve standards fixed by society.

Quality aspects

4.211 Only defoliation is currently taken into account in the IEEAF. Other quality aspects are not yet covered, e.g.:

- damage to trees by abiotic or biotic aggressions,
- level of biodiversity, measured by number of (threatened) forest species,
- forest soil acidification or degradation,
- fragmentation or connectivity of wooded area, etc.

4.212 The main reasons for these limitations are that:

- there are no harmonised data at European level on these other quality aspects at present,
- integration of quality through classification of land (by category of quality) quickly results in an unmanageable classification with numerous embodied levels,
- these quality aspects generally have a geographical or local dimension, which cannot easily be incorporated into a national accounting framework.

4.213 At the present stage it is recommended to treat these aspects through supplementary tables, which are only loosely connected to the IEEAF 'central' framework. Some categories of land should be further described in detail according to these complementary quality aspects.

5. Proposed tables for a first implementation

- 5.01 Twenty tables have been drafted for a first implementation. They cover the main aspects of the IEEAF:
- Balance sheets for land and standing timber (tables 1a – physical balances of wooded land areas, 1b – monetary balances of wooded land areas, 2a - physical balances of standing timber and 2b – monetary balances of standing timber). Table 2c records defoliation.
 - Output related to wooded land (table 3a), detailed accounts for forestry and logging (table 3b) and economic accounts for forestry and logging (table 3c)
 - Supply and use tables, in physical (tables 4a and 4b) and in monetary units (tables 5a and 5b).
 - Material balances (tables 6a and 6b)
 - Tables describing origins and destinations of waste containing wood or paper (7a and 7b), of black liquors (7c) and the corresponding wood contents (8a, 8b and 8c).
- 5.02 Pilot applications of a preliminary version of these tables have been made by several European countries, with a view to forest statistics (availability of data, appropriateness of classifications, etc.) and the accounting framework (consistency of proposals for valuation, classification of transactions and other changes in volume, etc.). Results of a first set of these pilot applications are presented in the publication: The European Framework for Integrated Environmental and Economic Accounting for Forests: Results of pilot applications (European Commission 1999a, Eurostat catalogue number CA-22-99-329-EN-C).

The tables presented below have been modified in order to take into account the lessons learned from these pilot exercises.

Table 1a Forest balance: area of wooded land (1000 ha)

	Forest and other wooded land						Other land	Total land
	Available for wood supply			Not available for wood supply				
	Cultivated	Not cultivated	Total	Strictly protected	Not strictly protected	Total	Total	
Opening area								
Changes due to economic activities								0
Afforestation								0
Deforestation								0
Other changes								0
Natural colonisation								0
Natural regression								0
Other								0
Changes in use/status (wooded land)						0		
Closing area								

Notes on the table

The table applies to wooded land, i.e. to forest and other wooded land as defined in UN-ECE/FAO TBFRA-2000. Except otherwise indicated, terms and definitions of the UN-ECE/FAO TBFRA-2000 apply. In order to provide a description of all land, a category "other land" (i.e. non-wooded land) was added.

Categories of wooded land are:

- wooded land available for wood supply,
- wooded land not available for wood supply.

Within wooded land available for wood supply, cultivated and not cultivated areas are distinguished. Not cultivated wooded land is defined as this wooded land where a) there is a significant number of overmature trees (e.g. trees whose age exceeds for more than 30 years the standard felling age, given the conditions of the stand) and b) there was no forestry intervention for e.g. 25 years.

Within wooded land not available for wood supply, strictly protected and not strictly protected areas are distinguished. Strictly protected areas cover these areas where legal restrictions exclude or severely limit wood supply (see TBFRA-2000 terms and definition).

Supplementary disaggregation of the table may be done for forest and other wooded land, as well as by predominant species (coniferous, broad-leaved, mixed, etc.).

Changes

Changes due to economic activities: afforestation, i.e. the increase in the wooded land area (generally for wood production) due to human activity; and deforestation, i.e. the reduction in the area of wooded land due to human activity (for building use, agricultural activities, etc.)

Other changes: other changes in area due to natural, multiple or non-referable causes; e.g. natural colonisation or regression, etc.

Changes in use/status (wooded land): this category of changes includes all changes in classification within the wooded area (from available for wood supply to not available for wood supply, etc.).

Periodicity

The table has to be drawn up every ten years, the changes being cumulated over this ten-year period. Yearly only afforestation and deforestation are requested.

Table 1b Forest balance: value of wooded land (million national monetary units)

	Forest and other wooded land						Other land	Total land	
	Available for wood supply			Not available for wood supply					Total
	Cultivated	Not cultivated	Total	Strictly protected	Not strictly protected	Total			
Opening area									
Changes due to economic activities									
Afforestation									
Deforestation									
Other changes									
Natural colonisation									
Natural regression									
Other									
Changes in use/status (wooded land)									
Changes in classification								0	
Revaluation									
Closing area									

Notes on the table

The rows and columns of Table 1b strictly correspond to the rows and columns of Table 1a, with the only exception of the addition of the rows "changes in classification" and "revaluation".

Valuation

In general, land is valued on the basis of market transactions, either directly or as a ratio of the value of exchanged forest real estates. Hedonic analysis may be used in this context. Therefore, the land value integrates not only wood production values but also all other ESA/SNA values, as revealed by market transactions. Wooded land not available for wood supply either strictly protected or not strictly protected may thus receive a positive value. When forests are bought for environmental protection purpose, and thus felling of standing timber is prohibited, the value of standing timber is integrated within the value of land.

Classification of changes

Changes in value due to changes due to economic activities (afforestation, deforestation), other changes (natural colonisation or regression, other changes) and changes in use/status are recorded on the respective rows, in the column corresponding to the final category: e.g. when wooded land is deforested for building purposes the value of the land increases; this increase in value has to be recorded in the cell corresponding to the row "deforestation" and the column "other land".

The row changes in classification records the transfer of the (initial) value of the land whose category has changed between the beginning and the end of the period, as an increase in the column corresponding to the final category, and a decrease in the column corresponding to the initial category.

Revaluation records the change in value of land due to changes in prices between the beginning and the end of the period. On the condition that flows are valued at the prices prevailing at the time when they occurred, the revaluation item is given by [value of the closing stock less value of the opening stock] less [value of changes].

Periodicity

The table has to be drawn for a ten-year period, changes being cumulated over this ten-year period. Yearly only afforestation and deforestation are requested.

Table 2a Forest balance: volume of standing timber (1000 m³)

	Standing volume on wooded land						On other land	Total
	Available for wood supply			Not available for wood supply				
	Cultivated	Not cultivated	Total	Strictly protected	Not strictly protected	Total		
Opening stocks							0	
Gross increment							0	
Total removals								
Other changes								
Changes in use/status								0
Closing stocks							0	

Notes on the table

The table describes the changes in the volume of standing timber between the beginning and the end of the period, due to gross increment and removals, as defined in the UN-ECE/FAO TBFRA-2000 and to other changes and changes in use/status. Unit is 1000 m³. Volume is measured to a minimum diameter breast height of 0 cm, over bark. Opening and closing stocks refer to the "standing volume" as defined in TBFRA-2000 terms and definitions: volume of standing trees, living or dead, including tops of stem, large branches, dead trees lying on the ground, which can still be used. Columns are the same as in Table 1a. The standing volume therefore corresponds to the volume located on the categories of land of Table 1a.

Given the definition of removals, some timber may be removed from "other land". This category comprises: land that meets the definition of 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, urban parks and gardens, hedgerows etc. The stock of standing volume and the increment are not requested for this category of land.

Changes

Gross increment: volume of gross biological growth during the period. Gross increment (or natural growth) is generally calculated by modelling (which necessitates opening stocks by age and species, biological parameters etc.). Given the definition of not cultivated wooded land, the gross increment may be considered negligible.

Removals refer to those fellings that are removed from the wooded land and other felling sites during the period. Included are removals of trees felled during an earlier period, and removal of trees killed or damaged by natural causes.

Other changes: they cover all reductions in the volume of standing timber, which are not accounted for in removals. They include that part of the timber burnt by forests fires, flooded in dam construction, destroyed by landslides or avalanches, that is unrecoverable (i.e. not accounted for in the stocks). This item may include a "reconciliation" item.

Changes in use/status: they refer to changes in the standing volume due to "changes in use/status" of (corresponding) land area in Table 1a. They are recorded twice: as a decrease in the column corresponding to the initial category and, as an increase in the column corresponding to the final category. They may also refer to the occasional removals of standing timber located on land "not available for wood supply". In this case a positive flow is recorded on the row "changes in use/status", which is the counterpart of the negative flow recorded under "removals".

Periodicity

The table has to be drawn for a ten-year period, changes being cumulated, when they are calculated on an annual basis. Yearly only main changes, i.e. those changes necessary for the establishment of annual economic accounts (gross increment, removals) are requested.

Table 2b Forest balance: value of standing timber (million national monetary units)

	Standing volume on wooded land						On other land	Total
	Available for wood supply			Not available for wood supply				
	Cultivated	Not cultivated	Total	Strictly protected	Not strictly protected	Total		
Opening stocks								
Gross increment								
Total removals								
Other changes								
Changes in use/status								
Changes in classification								
Revaluation								0
Closing stocks								

Notes on the table

The rows and columns of Table 2b strictly correspond to the rows and columns of Table 2a, with the only exception of the addition of the rows "changes in classification" and "revaluation".

Valuation

Valuation of stocks and flows of standing timber is discussed in § 3.111 sq. and in Annex 3. One of the conclusions is that there is no recommended method at European level. However, removals must be valued consistently with economic transactions in the national accounts; therefore the value of removals has to be consistent with the total value of raw wood output (CPA 2.01.1), as assessed either directly (through stumpage prices when they are available) or as a residual (the full harvesting costs being deducted from the total value of raw wood output (CPA 2.01.1), whatever the nature of this output and the classification of its producer.

Other conclusions are:

- a zero value should be given to the stocks of standing volume located in wooded land not available for wood supply. However, timber located on wooded land not available for wood supply may be occasionally harvested. In this case, a positive increase in value is recorded in the row "changes in use/status", which is the counterpart of the decrease recorded in the row "removals".
- the gross increment on not cultivated wooded land is generally negligible although the stocks have a value.
- in some conditions an allowance has to be made when valuing stocks and gross increment on cultivated wooded land in order to account for the part of the standing timber that will probably never be harvested or will not be recoverable.

Changes

The row "Changes in classification" records the transfer of the (initial) value of the standing volume of timber whose category has changed between the beginning and the end of the period, as an increase in the column corresponding to the final category, and a decrease in the column corresponding to the initial category.

Revaluation records the change in the value of the volume of standing timber due to changes in prices between the opening and the end of the period. On the condition that flows are valued at the prices prevailing at the time they occurred, the revaluation item is given by [value of the closing stock less value of the opening stock] less [value of changes].

Periodicity

The table has to be drawn for a ten-year period, changes being cumulated when they are calculated on an annual basis. Yearly only main changes, i.e. those changes necessary for the establishment of annual economic accounts (gross increment, removals) are requested.

Table 2c Defoliation

	1		2		3	
	Transnational survey data Defoliation % > 25		National survey data Defoliation % > 25%		Corresponding area and/or standing volume	
	Reference year	Current year	Reference year	Current year	Reference year	Current year
Pine						
Spruce						
Broad-leaved						
Total						

Notes on the table

Although the development of Geographical Information Systems linked to National Forests Inventories allows for extending the cross-classification of data, it is generally admitted that data on defoliation cannot be presented according to the Table 1a format. A specific table on defoliation is proposed. The table should be based on data collected under the aegis of the International Co-operative Program (ICP Forests) of the Executive Committee for the Convention on Long-range Transboundary Air Pollution in Europe.

As far as possible, data on the % level of defoliation for sample trees have to be transformed into areas of wooded land and volumes of standing timber.

Columns

Column 1 records the % of trees in the defoliation classes 2 to 4 of the UN-ECE and EU classifications, i.e. with needle/leaf loss of more than 25%, according to the transnational survey. Defoliation is recorded for the reference year (ideally the year corresponding to the closing year of the last available forest balance) and to the current year.

Column 2 records the % of trees in the defoliation classes 2 to 4 of the UN-ECE and EU classifications, i.e. with needle/leaf loss of more than 25%, according to the national survey. Defoliation is recorded for the reference year (ideally the year corresponding to the closing year of the last available forest balance) and to the current year.

Column 3 records an estimate of the area and/or standing volume corresponding to trees in the defoliation classes 2 to 4 of the UN-ECE and EU classifications. As far as they are statistically more significant, area and standing volume should be based on national data. Area and standing volume refer first to a reference year (ideally the year corresponding to the closing year of the last available forest balance) and to the current year.

Rows

Only main species are considered in the rows. If necessary more species may be distinguished. Data by age class may also be judged useful.

Periodicity

The table has to be drawn yearly, on the basis of the annual ICP forests results.

Table 3a Output related to wooded land by industry

Products	Industries				Total output by product
	Agriculture 01	Forestry & logging 02	Recreational, cultural and sporting activities 92	Other industries	
Products of forestry and logging					
Natural growth		X			X
Wood in the rough		X			X
Other forestry products (1)		X			X
Forestry and logging-related services		X			X
Afforestation and reafforestation		X			X
Other forestry contract work		X			X
Forests inventories and evaluation		X			X
Protection of forest against fires, etc.		X			X
Other products related to wooded land					
Agricultural products growing in forests (2)	X				X
Growing of animals in forests	X				X
Meat, fur, skin from hunting and trapping	X				X
Recreational services in forests (3)			X	X	X
Other products (4)				X	X
Other products	X		X	X	X
Total output by industry	X	X	X	X	X

(1) natural gum, cork, other forestry products

(2) mushrooms, truffles, other forest growing products (berries, nuts, etc.)

(3) hunting as a sport or recreation, operation of reserves, national parks and other recreational services in forests

(4) peat, charcoal, etc.

Notes on the table

This table is intended to record all output that may be related to wooded land, i.e. all output from activities that take place on wooded land. This output and corresponding activities are classified according to the CPA classification of products (in rows) and the NACE rev.1 classification of industries (in columns). In principle, the table follows the format of the "Make" matrix of national accounts (output by product and by industry at basic prices). As far as possible the table must be entirely filled in (including the row and the column "total output"). A cross **X** indicates that an output normally exists. Given the definition of industries in ESA/SNA, an output may also exist in cells other than those with a **X**. Some estimation may be necessary for products that are not regularly followed in economic statistics and national accounts. Additions to the standard national accounts aggregates have to be specified.

Classification of products and industries

For characteristic products of forestry and logging see the Eurostat Manual on Economic Accounts for Forestry Rev.1, pages 98-99, as well as NACE Rev.1 classes 02.01 and 02.02. EAF Rev.1 § 1.43 states that "It should be noted that the product of other production activities may be attached to the forestry activity industry as other inseparable non-forestry activity (game, wild mushrooms, berries, fish caught in forest lakes and watercourses, non-energy minerals without ores, peat, products from quarries located in forests".

Other products related to wooded land are first all agricultural products and animals (see NACE rev.1 classes 01.12 and 01.50). They also cover recreational services, for that part that takes place in forests (hunting, operation of "wooded" natural reserves, etc.). Also, some products, like peat, may be extracted from forest soils.

Periodicity

The table has to be drawn every year.

Table 3b Output related to wooded land, by nature and institutional sectors

	Type of output			Total output	Institutional sector			
	Market output	Output for own final use	Other non-market output		Households	Private non-financial corporations	Public non-financial corporations	General government and NPISH
Products of forestry and logging								
Natural growth								
Wood in the rough								
Logs								
Pulp wood								
Fuel wood								
Other forestry products (1)								
Forestry and logging-related services								
Afforestation and reforestation								
Other forestry contract work								
Forests inventories and evaluation								
Protection of forest against fires, etc.								
Other products related to wooded land								
Agricultural products growing in forests (2)								
Growing of animals in forests								
Meat, fur, skin from hunting and trapping								
Recreational services in forests (3)								
Other products (4)								
Other products								
Total output								

Notes (1), (2), (3) and (4): see Table 3a.

Notes on the table

The purpose of the table is to separate the "commercial" part of the output related to wooded land and in particular of the output of forestry and logging activities as recorded in EAF and national accounts.

The approach is twofold. In the left part of the table, the output, as recorded in Table 3a, is distributed according to its type:

- market output covers in particular the total value of the changes in inventories of finished products and work-in-progress intended for sale at economically significant prices (including natural growth of vegetable products). By convention, as it would be impossible to separate that part of natural growth, which relates to market output, natural growth is always classified as market output.
- output for own final use covers the total value of goods and services that are retained either for final consumption or for gross fixed capital formation by the same institutional unit. In the forest context, it applies to wood in the rough removed for own final use (e.g. fuel wood), a part of other forestry products, a part of agricultural products, etc.
- other non-market output: this type of output exclusively refers to services, in particular to forest inventories, protection of forest against fires and recreational services.

In the right part of the table, the output is distributed according to the institutional sector to which the producing unit belongs. With the help of the left side, the distribution is straightforward for a part of the output. For natural growth, the proposal is to distribute the output according to ownership. However, for public ownership, the output would often be recorded under "public non-financial corporations", and not under "general government", except if sales of standing timber are explicitly recorded as secondary market output for some units of the general government sector.

Table 3c Economic accounts for forestry and logging

	Forestry and logging industry		
	Total	of which forestry	of which logging
Current transactions			
Output (basic prices)			
Market output	X	X	X
Own account output	X	X	X
Other non market	X	X	
Intermediate consumption			
Standing timber	X	-	X
Other products			
Seeds and plants	X	X	-
Energy	X	X	X
Fertilisers and soil improvers	X	X	X
Material, small tools etc.	X	X	X
Services	X	X	X
Other and adjustment	X	X	X
Gross value added			
Compensation of employees	X	X	X
Other taxes less subsidies on production	X	X	X
Consumption of fixed capital	X	X	X
NOS/mixed income			
Imputed unpaid labour	X	X	X
Imputed return to fixed capital	X		
Return to land and standing volume	X		
Capital formation			
Gross fixed capital formation			
Construction	X	X	X
Equipment	X	X	X
Other gross fixed capital formation	X	X	X
Changes in inventories	X	X	X
of which work in progress	X	X	
Net acquisition of land	X	X	
Public financing			
Other non market output	X	X	
Subsidies	X	X	X
Investment grants	X	X	X
Other transfers	X	X	X
Supplementary data			
Labour inputs	X	X	X
Net fixed capital stock	X	X	X
Inventories of work in progress	X	X	
Land area	X	X	

This table is to be drawn up yearly, on the basis of a functional analysis of the forestry and logging industry transactions, as they are recorded in national accounts and/or Eurostat EAF. Natural growth of cultivated timber is to be added to the output (of forestry). Stumpage value of the timber withdrawn by logging from the stock of standing volume is to be added to the intermediate consumption of logging. The value of the "changes in inventories (work in progress)" is given by the difference between the value of natural growth of cultivated timber and the stumpage value of the cultivated timber withdrawn from forest by logging.

For the compilation of harvesting costs and rate of return for forestry, two imputed transactions are introduced: unpaid labour and return to fixed capital.

Table 4a Supply-Use physical table: use

Products (units)	Intermediate consumption of industries							Total	Final consumption	Capital formation	Exports	Total
	Forestry & logging	Manufacture of wood products	Pulp	Paper	Printing	Recycling	Other					
Standing timber (1 000 m ³ over bark)	X							X	-	X	-	X
Saw logs (1 000 m ³)		X						X			X	X
Fuel wood (1 000 m ³)								X	X		X	X
Pulp wood (1 000 m ³)			X					X			X	X
Wood and wood products (1 000 m ³)								X	X	X	X	X
Paper pulp (1 000 t)				X				X			X	X
Paper (1 000 t)					X			X	X		X	X
Books, newspapers (1 000 t)								X	X		X	X
Wood waste as a product (1 000 t)		X	X					X			X	X
Paper waste as a product (1 000 t)			X				X	X			X	X

Note on the table

The table is the standard "use" table of national accounts but in physical units.

Final consumption is net, i.e. that physical quantities corresponding to sales of existing products by households are deducted.

For a given product, the total of uses should be equal to the total of supply as recorded in Table 4b.

Only wood waste and paper waste which are accounted for in the intermediate consumption of industries, i.e. that give rise to transactions, are recorded in the table.

Classifications
Products

Standing timber (1 000 m ³ over bark)	02.015
Saw logs (1 000 m ³ without bark)	02.01.11 to 02.01.13
Fuel wood (1 000 m ³)	02.01.14
Pulp wood (1 000 m ³)	02.01.15
Wood and wood products (1 000 m ³)	20.1 to 20.5 (except 20.10.4 & 20.52)
Paper pulp (1 000 t)	21.11
Paper (1 000 t)	21.12 except 21.12.6
Books, newspapers (1 000 t)	22 except 21.14, 22.24 & 22.3
Wood waste as a product (1 000 t)	20.10.4
Paper waste as a product (1 000 t)	21.12.6

CPA
Industries

Forestry and logging
Manufacture of wood products
Manufacture of pulp
Manufacture of paper
Printing
Recycling and waste management
Other

NACE rev.1

02
20.01 to 20.5
21.11
21.12 & 21.2
22
37.2 & 90 part
All other positions of NACE rev.1

Table 4b Supply-Use physical table: supply

Products (units)	Output of industries						Total	Imports	Total
	Forestry & logging	Manufacture of wood products	Pulp	Paper	Printing	Recycling			
Standing timber (1 000 m ³ over bark)	X						X		X
Saw logs (1 000 m ³)	X						X	X	X
Fuel wood (1 000 m ³)	X						X	X	X
Pulp wood (1 000 m ³)	X						X	X	X
Wood and wood products (1 000 m ³)		X					X	X	X
Paper pulp (1 000 t)			X				X	X	X
Paper (1 000 t)				X			X	X	X
Books, newspapers (1 000 t)					X		X	X	X
Wood waste as a product (1 000 t)		X					X	X	X
Paper waste as a product (1 000 t)				X	X	X	X	X	X

Notes on the table

The table is the standard "supply" table of national accounts, however in physical units.

It describes the supply of products by industries and imports.

Only wood waste and paper waste which are accounted for as output of industries, i.e. that give rise to transactions, are recorded in the table.

For a given product total supply should be equal to the total uses as recorded in Table 4a.

Summary supply-use table

	Intermediate consumption	Final consumption	Capital formation	Exports	Total use = Total supply	Output	Imports
Standing timber (1 000 m ³ over bark)							
Saw logs (1 000 m ³)							
Fuel wood (1 000 m ³)							
Pulp wood (1 000 m ³)							
Wood and wood products (1 000 m ³)							
Paper pulp (1 000 t)							
Paper (1 000 t)							
Books, newspapers (1 000 t)							
Wood waste as a product (1 000 t)							
Paper waste as a product (1 000 t)							

Table 5a Supply-Use monetary table: use

	Intermediate consumption by industries						Total	Final consumption	Capital formation	Exports	Total use
	Forestry & logging	Manufacture of wood products	Manufacture of pulp	Manufacture of paper	Printing	Recycling					
Standing timber	X						X		X		X
Saw logs		X					X			X	X
Fuel wood							X	X			X
Pulp wood			X				X			X	X
Sawn wood, etc.							X	X	X	X	X
Paper pulp				X			X				X
Paper					X		X	X		X	X
Books, newspapers							X	X		X	X
Waste wood											
Waste paper											
Other	X	X	X	X	X	X	X	X	X	X	X
Total intermediate consumption	X										
Gross Value added											
Consumption of fixed capital											
Net value added											
Compensation of employees											
Other taxes less subsidies											
NOS/mixed income											
Output (basic prices)	X										

Notes on the table

The monetary use table records the intermediate consumption of specified products by industries, as well as final uses (final consumption, capital formation and exports). This table is merely the specification for forest-related products of the ESA/SNA use table.

Final consumption and capital formation are net of sales of existing goods. Thus sales of existing goods are not accounted for in the supply table.

Classifications of products and industries are the same as in Table 4 except that a row for other products has been added. Totals in rows and columns are thus equal to the corresponding totals for the whole economy.

Uses are recorded at purchasers' prices.

Final consumption may be separated into durable and non-durable.

Total uses by products must correspond to total supply (Table 5b). Output by industry must correspond to the supply by industry (Table 5b).

A cross (X) indicates the (main) relevant uses.

Table 5b Supply-Use monetary table: supply

	Output of industries						Total (basic prices)	Imports	Net taxes on products	Trade and transport margins	Total (purchaser's prices)
	Forestry & logging	Manufacture of wood products	Manufacture of pulp	Manufacture of paper	Printing	Recycling					
Standing timber	X										X
Saw logs	X							X			X
Fuel wood	X							X			X
Pulp wood	X							X			X
Sawn wood, etc.		X						X			X
Pulp			X					X			X
Paper				X				X			X
Books, newspapers ...					X			X			X
Wood waste (product)								X			X
Paper waste (product)											X
Other products	X	X	X	X	X	X	X	X	X	X	X
Total	X	X	X	X	X	X	X	X	X	X	X

Notes on the table

The monetary supply table records the output (at basic prices) of industries in specified products, as well as imports. This table is merely the specification for forest-related products and industries of the ESA supply table.

Columns for net taxes on products and trade and transport margins allow calculating the supply at purchasers' prices.

Classifications of products and industries are the same as in Table 5a.

Summary supply-use monetary table

	SUPPLY					USE				
	Total output (basic prices)	Imports	Net taxes on products	Trade and transport margins	Total supply (purchaser's prices)	Intermediate consumption	Final consumption	Capital formation	Exports	Total use
Standing timber										
Saw logs										
Fuel wood										
Pulp wood										
Sawn wood, etc.										
Pulp										
Paper										
Books, newspapers ...										
Wood waste (product)										
Paper waste (product)										
Other products										
Total										

Table 6a Material balance (physical): use table

	Intermediate consumption of industries					
	Forestry & logging	Manufacture of wood products	Manufacture of pulp	Manufacture of paper	Printing	Recycling, waste management
Standing timber	X					
Saw logs		X				
Fuel wood						
Pulp wood			X			
Wood and wood products						
Paper pulp				X		
Paper				X	X	
Books, newspapers						
Wood waste as a product			X			
Paper waste as a product				X		X
Other products						
Wood content of intermediate consumption	X	X	X	X	X	X
Of which used as fuel	X	X	X	X		X

Notes on the table

The table records the wood content (in tonnes of dry matter) of the uses by industries of selected wood products.

The total in columns by industry indicates the total content in wood of the products used as intermediate consumption by industries (including that part of wood and paper waste which is accounted for in intermediate consumption).

Table 6b Material balance (physical): make table

	Output of industries					
	Forestry & logging	Manufacture of wood products	Manufacture of pulp	Manufacture of paper	Printing	Recycling
Standing timber	X					
Saw logs	X	X				
Fuel wood	X	X				
Pulp wood	X	X	X			
Wood and wood products						
Paper pulp				X		
Paper				X		
Books, newspapers					X	
Wood waste as a product	X	X				
Paper waste as a product						X
Other						
Wood content of total output	X	X	X	X	X	X

Notes on the table

The table records the wood content (in 1000 tonnes of dry matter) of the output of selected products of selected industries.
Totals in columns by industry indicate the total content in wood of the products produced by the industries and recorded in the output.

Complementary tables: residuals

A set of complementary tables allows recording those residuals (wood waste, paper waste and other residuals containing wood, like black liquors) which are not accounted for in the intermediate use of industries, but are either internally "used" (used as fuel, internally stored) or are treated by external waste treatment activities, recovered or exported.

Table 7a Origin and destination of waste containing wood

	Production of waste wood by industry							Total	Final consumption	Capital formation	Imports	Total
	Forestry & logging	Manufacture of wood products	Pulp	Paper	Printing	Recycling	Other					
Internal as fuel												
Internally stored												
External (incineration)												
External (landfills)												
External (recycling)												
External (exports)												
Release into media (outside forests)												

Table 7b Origin and destination of waste containing paper

	Production of waste paper by industry							Total	Final consumption	Capital formation	Imports	Total
	Forestry & logging	Manufacture of wood products	Pulp	Paper	Printing	Recycling	Other					
External (incineration)												
External (landfills)												
External (recycling)												
External (exports)												
Release into media												

Table 7c Origin and destination of black liquors

	Production of black liquors by industry							Total	Final consumption	Capital formation	Imports	Total
	Forestry & logging	Manufacture of wood products	Pulp	Paper	Printing	Recycling	Other					
Internal as fuel												
Internally stored												
External (incineration)												
External (landfills)												
Release into media												

Complementary tables: wood content of flows of residuals

The following tables record the wood content of the flows described in Tables 7a, 7b and 7c.

Table 8a Wood content of flows of waste containing wood

	Production of waste wood by industry							Total	Final consumption	Capital formation	Imports	Total
	Forestry & logging	Manufacture of wood products	Pulp	Paper	Printing	Recycling	Other					
Internal as fuel												
Internally stored												
External (incineration)												
External (landfills)												
External (recycling)												
External (exports)												
Release into media (outside forests)												

Table 8b Wood content of flows of waste containing paper

	Production of waste paper by industry							Total	Final consumption	Capital formation	Imports	Total
	Forestry & logging	Manufacture of wood products	Pulp	Paper	Printing	Recycling	Other					
External (incineration)												
External (landfills)												
External (recycling)												
External (exports)												
Release into media												

Table 8c Wood content of flows of black liquors

	Production of black liquors by industry							Total	Final consumption	Capital formation	Imports	Total
	Forestry & logging	Manufacture of wood products	Manufacture of pulp	Manufacture of paper	Printing	Recycling	Other					
Internal as fuel												
Internally stored												
External (incineration)												
External (landfills)												
Release into media												

Synthesis table: wood content

	Industries							Total	Final consumption	Capital formation	Rest of the world	Nature	Total
	Forestry & logging	Manufacture of wood products	Manufacture of pulp	Manufacture of paper	Printing	Recycling	Waste treatment						
Entries													
In intermediate consumption													
In final consumption (durables: net change)													
In capital formation net of discards													
Exit													
In products supplied													
Natural growth													
Used as fuel													
Final consumption													
Intermediate consumption													
In waste external treatment													
Incineration													
Landfills													
Recycling													
Other													
In waste internally used as fuel													
In waste internally stored													
Released into media													

Relation between the IEEAF and the issues listed by the Helsinki Conference

	Indicators and criteria	Possibility of integration
1	maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycle	good
1.1	area of forest and other wooded land and changes	good , through forest balances (areas) table 1a
1.2.a	changes in total volume of standing timber	good , through forest balances (m3) table 2a
1.2.b	mean volume of growing stock	
1.2.c	age structure	good , age structure may be introduced in classifications
1.3.	total carbon storage and changes	good , through forest balances and material flow accounts for wood and wood products
2.	maintenance of forest ecosystem health and vitality	Partial
2.1.	depositions of pollutants	no direct integration
2.2	changes in defoliation	good , table 2c
2.3.a	insects and diseases damages	good when losses are described in detail
2.3.b	burnt area	good when losses are described in detail
2.3.c	storm damages	good when losses are described in detail
2.3.d	damages by game	no direct integration
2.4	nutrient balances and acidity	no direct integration
3.	productive functions of forests	partial
3.1.	Balance of growth and removals (wood)	good through physical accounting (standing timber), EAF Rev.1 and balance sheets
3.2.	managed forests	no integration , unless a classification of forest by management regimes is introduced in classifications
3.3.	non-wood forest products	good tables 3a and 3b.
4	maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems	no integration : data on expenditure for maintenance, conservation and enhancement of biological diversity in forest ecosystems through EPEA and FRMA
4.1.a	changes in area of natural, ancient semi-natural forests	good
4.1.b	changes in area of strictly protected forest	good
4.1.c	changes in area of forest protected by special regimes	good
4.2	changes in number of threatened species	In physical units
4.3.	changes in gene reserve forests, etc.	No at present stage
4.4.	changes in the proportion of mixed stands	May be according to classifications used in the balance sheets
4.5.	proportions of annual area of natural regeneration	Yes
5.	protective functions	In physical description only
5.1.	management for soil protection	
5.2.	management for water protection	
6.	other socio-economic functions	good
6.1.	share in GDP	good
6.2.	provision of recreation	no direct integration ; physical data
6.3.	rate of employment	good

EAF Rev.1: Eurostat Economic Accounts for Forestry Rev.1

FRMA: Forest Resource Management Account

EPEA: Environmental Protection Expenditure Account

Annex 1: Not all “land with trees” is wooded land

The French Ministry of Agriculture makes an annual land survey (TERUTI) which cross classifies land according to cover and use.

In the **land cover classification**, forest is defined as land with tree crown cover of more than 10 % and area of more than 0.5 ha. Other wooded land is defined as land with tree cover of more than 10 % and area of less than 0.5 ha; it includes scattered trees and groves of areas of 0.05 to 0.5 ha. Wooded land is the sum of forest land plus other wooded land. Poplar groves are separately accounted for.

Hedgerows (even with scattered trees) and trees alongside roads, etc. are not included in wooded land; like moors, they constitute a separate item of the classification; moors include scrub land, bush, an unknown part of which is wooded (with a crown cover of less than 10 %).

In the **land use classification**, a separate item is the area for wood production (15.2 millions ha in 1994). Other categories of uses may be grouped according to SNA classification: land underlying buildings and structures, land under cultivation (agriculture), recreational land, and other land (e.g. wooded land for protection and without use).

Distribution of wooded land, as an item of land cover classification, among uses (France 1994) (Areas in ha)

Wood production	14 447 000
Without use	872 000
Agricultural production	212 000
Underlying buildings and structures	171 000
Recreational	31 000
Actual environmental protection	< 5 000
Total	15 738 000

Cross-classification of land cover and land use (France 1994) (Areas in ha)

Land cover	Land use (1994)		
	Wood production	Other uses	Total
Forest	13 765 000	956 000	14 721 000
Other wooded	682 000	334 000	1 016 000
Wooded land	14 447 000	1 290 000	15 737 000
Poplars	238 000	7 000	245 000
Hedgerows, etc.	411 000	448 000	859 000
Other land cover	99 000	p.m.	99 000
Total land with trees	15 195 000	1 745 000	16 940 000

"Other land cover" refers to land not classified as wooded land, poplars, hedgerows, etc. but whose use is, according to the land use classification, wood production. It consists in moors and other categories of land cover. Orchards' area (not included in the preceding table) is 303 000 ha.

According to these data, land with trees is almost 17 million ha, while wooded land (inc. poplar groves) is 16 million ha and the difference is 6%.

Although definitions are similar in the TERUTI survey and the French National Forest Inventory, due to differences in methodology, data slightly differ. According to the NFI, forest area for wood production is only 13.5 million ha, and forest area for other uses is 611 000 ha. Total forest area is thus 14.1 million ha, to compare with the result of the TERUTI survey (14.7 million ha)

In order to obtain a full picture of "land with trees", one should add orchards and that (unknown) part of moors (scrubs and bushes) whose crown cover is less than 10%. No indication is given about the classification of trees in city parks.

Cross-classification of land cover and land use - detailed data (France 1994)
(in ha)

Land cover	Land use					Total
	wood production 04	underlying buildings and structures 01, 06-20, 21-23	under cultivation 02, 03, 05	recreation 20	other: protection, without uses 24, 99	
Wooded	14 446 757	170 683	211 841	30 608	877 244	15 737 133
Forest	13 764 962	71 700	118 071	19 552	746 824	14 721 109
Broad-leaved (18)	8 705 114	47 543	78 236	12 945	291 186	9 135 024
Resinous (19)	3 698 470	11 532	24 690	2 052	256 393	3 993 137
Loose afforestation (20)	263 222	2 369	13 081	2 160	64 516	345 348
Mixed (21)	1 098 156	10 256	2 064	2 395	130 420	1 247 600
Other wooded land	681 795	98 983	93 770	11 056	130 420	1 016 024
Groves (22)	509 560	31 972	36 031	4 258	54 663	636 484
Scattered trees (23)	172 235	67 011	57 739	6 798	75 757	379 540
Other land	747 699	3 713 531	30 849 015	334 649	3 537 166	39 182 060
Poplars	237 570	4 376	699	498	1 830	244 973
Hedgerows	383 178	29 066	131 648	1 486	59 336	604 712
Other land with trees (80 & 82)	28 335	173 677	35 675	8 700	8 273	254 660
Moors (70)	63 182	104 281	212 578	14 495	1 492 819	1 887 355
Other land	35 434	3 402 131	30 468 417	309 470	1 974 908	36 190 360
Of which orchards	n.a.	n.a.	n.a.	n.a.	n.a.	(303 000)
Of which agricultural land	1 094	232 972	29 521 250	5 312	10 612	29 771 240
Of which other	34 340	3 169 159	947 167	304 158	1 964 296	6 419 120
Total	15 194 456	3 884 214	31 060 856	365 257	4 414 410	54 919 193

Source: TERUTI results for 1994, areas in ha.

Categories of land use and land cover refer to TERUTI classification; other land with trees (80 & 82) refers to land under tree cover.

Annex 2: Classification of assets in ESA/SNA and SEEA

ESA/SNA classification of selected non-financial assets

NON-FINANCIAL ASSETS		Comments and/or definitions
Produced assets	AN.1	
fixed assets	AN.11	
tangible fixed assets	AN.111	
<i>other buildings and structures,</i>	AN.1112	includes other buildings and structures used for forest-related activities
<i>machinery and equipment</i>	AN.1113	includes machinery and equipment used for forest-related activities
<i>cultivated assets</i>	AN.1114	animals and plants yielding repeat products that are under the direct control, responsibility and management of institutional units
<i>vineyards, orchards and other plantations</i>	AN.1114	Trees (including vines and shrubs) cultivated for products they yield year after year, including those cultivated for fruits and nuts, for sap and resin and for bark and leaf products
<i>of trees yielding repeat products</i>	2	
inventories	AN.12	
work in progress	AN.122	
<i>work in progress on cultivated assets</i>	AN.1221	e.g. trees and other vegetation yielding once-only products, and immature cultivated assets yielding repeat products
Non-produced assets	AN.2	
tangible non-produced assets	AN.21	
land	AN.211	
<i>land underlying buildings and structure</i>	AN.2111	
<i>land under cultivation</i>	AN.2112	includes land under plantations, orchards and vineyards
<i>recreational land & associated surface water</i>	AN.2113	parklands, etc.
<i>other land & associated surface water</i>	AN.2119	land n.e.c. inc. communal grazing land
non-cultivated biological resources	AN.213	Animals and plants for which natural growth and/or regeneration is not under the direct control, responsibility and management of institutional units: e.g. virgins forests, wild fauna and flora. Only those resources that are currently or are likely soon to be exploitable for economic purposes should be included.

SEEA classification of selected non-financial tangible assets (CNFA)

CNFA	Classification of Non-Financial Assets in SEEA	SNA
1	Produced assets	
1.1	Man-made assets	
1.2	Cultivated natural growth assets (living biota)	
1.2.1	cultivated fixed natural growth assets	AN.1114
...	...	
1.2.1.2	<i>vineyards, orchards and other plantations of trees yielding repeat products</i>	AN.11142
...	...	
1.2.2	work in progress on natural growth products	AN.1221
...	...	
1.2.2.2	<i>crops and plants of cultivated forests</i>	
1.2.2.2.1	<i>crops and other produced plants not yet harvested (work in progress)</i>	
1.2.2.2.2	<i>trees of timber tracts</i>	
1.2.2.2.3	<i>other plants of cultivated forests</i>	
2	Non-produced assets	
2.1	Non-produced natural assets	
2.1.1	wild biota	AN.213
2.1.1.1	<i>wild animals</i>	
...	...	
2.1.1.4	<i>trees and other plants of uncultivated forest</i>	
...	...	
2.1.3	land (with ecosystems and soil)	AN.211
2.1.3.1	<i>soils</i>	
2.1.3.2	<i>cultivated (economically used) land areas</i>	
2.1.3.2.1	<i>land underlying buildings and works</i>	AN.2111
2.1.3.2.2	<i>agricultural land</i>	AN.2112
2.1.3.2.3	<i>forests (timber tracts) and other wooded land</i>	
2.1.3.2.4	<i>recreational & other open land for economic purposes</i>	AN.2113 part
...	...	
2.1.3.3	<i>uncultivated land areas (with connected eco-systems)</i>	AN.2113-part & AN.2119-part
2.1.3.3.2	<i>dry open land with vegetation cover</i>	
2.1.3.3.3	<i>open land without or with insignificant vegetation cover</i>	
...	...	

Annex 3: Valuation methods

Valuation methods may be divided into two main categories, each with several variants.

- Transaction value methods: they apply a price derived from observed transactions during the period to the whole stock of an asset.
- Net present value methods: they calculate the value (or change in value) of an asset by the present value of future net returns.

When the value of land and timber are separately assessed, whatever the method, except the hedonic approach, it is worth comparing the sum of these values with the transaction value of forest real estates.

Transaction value methods

A price per unit is derived from observed transactions to value the whole stock or change in stock.

The method may be applied to forest real estates (i.e. to the combined asset formed by the land and the standing timber), to bare forest land or to standing timber. In the first case, the value of the combined asset has to be divided between land and standing timber in a second stage to establish separate balance sheets for land and standing timber.

Transaction value method applied to forest real estates

When applied to forest real estates, the simplest way is to take the average price of one hectare of forest and to apply it to the whole forest area. Average prices may be taken from a fiscal database or similar registers of transactions. This is a rough method, which does not take into account the various characteristics of forest real estates: productivity of land, age and species of the timber stock, actual conditions of the timber exploitation, etc.

As forests are not homogeneous, it is preferable to classify forests according to their characteristics, to calculate a price for each category of forests and to apply this price to the corresponding stock. A variant is the Lancaster approach (hedonic pricing). Starting from recorded transactions and given the characteristics of the transacted forest real estates one identifies through a regression analysis the factors that determine the transaction price. The resulting equation is then applied to the whole stock, which is described according to the same characteristics. This method was applied to the German forests (see Bergen et al 1998) and the result was that the price of a forest real estate was a function of the area, of the stock of growing timber and of the timber species. The method also allows separating the value of land from the value of timber.

Transaction value method applied to bare land

When the hedonic pricing method cannot be applied (e.g. because the characteristics of the transacted real estates are not available) one has to assess the value of bare land and the value of timber separately. In some countries (e.g. France) the price of transacted bare forest land is available. The price of bare forest land may also be approximated by the price of comparable land, e.g. starting from prices of marginal agricultural land. However, often the value of land is either estimated as a ratio of the price of real estates or based on recommended (administrative) values.

Transaction value method applied to standing timber

The price per cubic meter of timber is generally observed, although it may be at different stages: the stumpage price for standing timber or the roadside pick-up price, when timber is already felled, transported to the road side and stacked. When stumpage prices are not available, it is necessary to derive them from the roadside pick-up prices by deducting the felling, transporting and stacking costs. This may be a rather complex operation, in particular if one wants to calculate costs according to different conditions of the logging activity such as slope, species, use of timber, etc. In general an average cost is estimated, which allows assessing the stumpage prices from the roadside pick-up prices.

This stumpage price is then applied to the stocks or flows. There are two variants, called the “stumpage value” method and the “consumption value” method.

The “stumpage value” method

In its simplest variant, an average stumpage price for the total harvest is calculated and applied to the whole stock or flow. This method is rather simple: the stumpage value of the felled timber is divided by its volume, measured over bark. The resulting price is multiplied by e.g. the stock of standing timber. Physical data are generally available from forestry statistics and forest inventories and the main difficulty is the calculation of the stumpage price. More detailed variants apply average stumpage prices e.g. per species to the volume of standing timber (or the natural growth) per species.

The “consumption value” method

In this variant, different stumpage prices are used for the various categories of timber in terms of both species and age or diameter classes. These prices may be directly available, or have to be calculated starting from the prices of the various assortments of felled timber (log prices by diameter class, pulp wood prices, fuel wood prices, etc. by species). These stumpage prices are applied to the respective stocks (per species and per age or diameter class), as given by the forest inventories.

The difference between the two methods is that, in the stumpage value method, the average stumpage prices of the fellings are applied to the stock or flow, irrespective of the age/diameter structure and related characteristics of the stock or flow, whereas in the consumption value method the age/diameter structure of the stock is taken into account, irrespective of the structure of actual fellings. When the structure of the fellings is the same as the structure of the stock, the two variants give the same result.

Hence, one could argue that the stumpage value method assumes that the stock (or change in stock) will be used (harvested) according to the present pattern of fellings. The consumption value method assumes that the whole stock is cut in its present state and composition. However, in forest management, although young trees are cut (e.g. due to thinnings), a part is left growing until its normal age of harvesting. With the consumption value method the value of young stands is very low, as both the volumes are low and the prices for low diameters are well below the prices the stands will receive when actually harvested.

Which of the above ‘assumptions’ is more realistic depends on the current structure of the stock and the fellings. For example, when the stock is ‘young’, the thinnings may dominate and the structure of the fellings may differ from the structure corresponding to a ‘steady state’ or ‘overmature’ forest.

Both the stumpage value and the consumption value methods may be seen as a simplification of the net present value method (see below). The rationale would be that the future increase in the volume of standing timber due to natural growth offsets the need for discounting the future returns. For the consumption value method, this ‘implicit discounting’ is higher and corresponds to both the future natural growth and the future increase in quality, e.g. due to the fact that higher diameters may receive higher prices per cubic meter.

Summary on transaction value methods

Forest real estates	price per hectare x forest area
	Price as a function of forest real estate characteristics applied to the whole forest according to its characteristics (hedonic pricing)
Land	price per hectare x forest area
	price of land as a function of land characteristics applied to the whole area according to its characteristics
Standing timber	average stumpage price per felled cubic metre and per species x total stock of standing timber
	stumpage price by species and diameter applied to the stock according to its species and diameter composition

Net present value methods

These methods calculate the value of the forest assets by the present value of future net economic benefits. Basically they need:

- a model of future receipts and costs,
- a discount rate

General expression of the net present value is:

$V = \sum (R_t - C_t)/(1+r)^t$, where V is the value of the forest, R_t is the receipt in year t , C_t is the forestry cost in year t , r is the discount rate, the summation ($\sum = \text{Sum}$) being over the life of the forest.

The net present value may be applied to the forest real estate, the land and the standing timber.

Application of the net present value methods to the standing timber

In this approach the value of land is neglected. According to the complexity of the modelling and the way the rate of discount is fixed, there are several variants.

In the simplest variant, the rate of discount is fixed exogenously (e.g. from consultation of forest experts; it is generally agreed that an admissible range for the rate of discount for forest assets in Europe is between 1 and 2,5%). On the basis of forest inventories, the forest stock is distributed by age classes (e.g. twenty years classes). A harvesting age and a final volume of standing timber per hectare at the harvesting age are fixed. Future receipts are calculated multiplying the present price of mature timber by the volume that will be harvested. Costs are neglected. The present value is calculated discounting future receipts.

Let T be the harvesting age, Q_T the volume per hectare at the harvesting age, p the stumpage price of mature timber (i.e. the price at the harvesting age), A_t the area of the forest of age t , the net present value of the standing timber is given by:

$$V = \sum pQ_T A_t / (1+r)^{T-t}$$

As far as yields, prices and harvesting age are not the same by species, this method should be applied separately to the main species.

In a more realistic variant, an average management cost is introduced. It may be calculated e.g. by dividing actual forestry costs by the forest area, or assessed from the consultation of forest experts, analysis of the accounts of forest firms, etc. Let C_t be the total capitalised management cost, between t and T , for one hectare of timber of age t , the net present value of the standing timber is given by:

$$V = \sum (pQ_T - C_t) A_t / (1+r)^{T-t}$$

Finally, it is possible to model all receipts, including e.g. receipts from thinnings, and costs. Modelling of receipts is in general rather complex as soon as the assumption of a clear cutting at a given harvesting age is not made. One has to take into account the actual exploitation, i.e. the decrease of the number of trees by hectare for the various age classes.

In the general method, the rate of discount is not fixed but derived as the internal rate of return that equalises receipts and costs (including plantation costs and cost of land) over the life of the forest, the price of land being given.

As the age of final harvesting and the final volume are different across species, all these variants are generally applied to the different species.

Methods derived from the net present value method

In the "age constant method" the forest is distributed by age classes; for each age class the value of the respective timber stock is obtained by multiplying the "expected felling value" (the same as above in the net present value method) by an « age factor ». For younger stands the « age constant » value does not take into account the volume of standing timber but the cost of establishment of the stands. For the intermediate age

stands, the expected felling value is discounted. In the Austrian application of this method the implicit rate of discount embodied in the age constant method is around 1%.

The consumption value method and the stumpage value method could be interpreted as variants of the net present value method. The rationale would be that the future increase in the volume of standing timber offsets the need for discounting future returns. For the consumption value method, this 'implicit discounting' may be higher due to both the natural growth and an increase in quality (e.g. higher diameter classes may receive higher prices per cubic meter).

Let V_t be the volume of standing timber at age t , the consumption value method gives this timber the value $V_t p_t$ where p_t is the stumpage price of the timber at age t . The stumpage price method gives this timber the value $V_t p$, where p is the average stumpage price of fellings (for young timber, $p_t < p < p_T$).

In $T-t$ years the volume of this timber will be $V_T = V_t(1+g)^{T-t}$ (where g is the average growth rate of the timber over the period t to T). The receipts will be $V_T p_T$, therefore, neglecting the management costs, the present value is $(V_T p_T)/(1+r)^{T-t}$.

The consumption value is a good proxy of the (simplified) net present value if $(1+g)^{T-t} = (1+r)^{T-t} p_t/p_T$. The stumpage value will be a good proxy of the (simplified) net present value if $(1+g)^{T-t} = (1+r)^{T-t} p/p_T$.

These conditions do not appear unrealistic but cannot be verified for all age classes at the same time. The result would be a variation in the rate of discount over the life of a forest. However, as management costs and receipts from thinnings are not taken into account (which may also be unevenly spread over the lifetime of a forest) it is not easy to draw a general conclusion.

Application of the net present value to land

The net present value can also be applied to the valuation of land; in this case, the value of the land is given by:

$L = [pQ - C_T - C(1+r)^T]/[(1+r)^T - 1]$, where C_T is the capitalised management cost over the rotation of the timber, C is the plantation cost and pQ is the receipt from harvesting the timber at maturity.

When the value of the rent on land, R , is known, $L = R/r$

Summary of net present value methods applied to standing timber

Simplified NPV	$V = pQ \sum A_t/(1+r)^{T-t}$, with Q = volume per hectare of standing timber at harvesting age, A_t = area of forest of age t ; T harvesting age; p the stumpage price per cubic metre of timber
Taking into account management costs	$V = \sum (pQ - C_t)A_t/(1+r)^{T-t}$, with C_t being the capitalised management costs per hectare for the area of age t , between t and T
Full method	$V = \sum \sum A_t(r_{t+i} - c_{t+i})/(1+r)^i$, with r_{t+i} and c_{t+i} being the receipts and costs in period $t+i$, for one hectare of age t , and r (the discount rate) being taken as the value that equalises receipts and costs, the value of land and cost of plantations being known
Age constant	$V = \sum p c_t Q A_t$, with c_t (age factor) being given by experts or tables

Value of standing timber – illustration of results of different methods (ECU/m³)

	Transaction value			Net present value	
	Hedonic	Consumption	Stumpage	Pure NPV	Age constant
Germany (1995)	46.5	19.7	41.5		
Austria (1995)		21.4	23.5	29.9 (simplified)	29.7
France (1996)		32.1	22.6	39.5	

Source: Eurostat

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