CREEA - Compiling and Refining Environmental and Economic Accounts

Deliverable 5.1- Revision of the proposed SEEA methodology for forests

Authors:
Elsa Varela (EFIMED)
Robert Mavsar (EFIMED)
Viveka Palm (SCB)
Annica Carlsson (SCB)
Sebastian Constantino (SCB)

CREEA is a Collaborative project funded by the EU's
Seventh Framework Program – Theme ENV.2010.4.2.2-1
Grant agreement no: 265134

Deliverable number:	**D5.1**
Revision number:	
Date of current draft:	
Due date of deliverable:	
Actual submission date:	
Dissemination level:	**RE (Consortium)**

CREEA

Compiling and Refining Environmental and Economic Accounts
Funded by the EU's Seventh Framework Program – Theme ENV.2010.4.2.2-1
Collaborative project
Grant agreement no: 265134
Start date of the project: 1 April 2011, Duration: 36 Months

About CREEA

The main goal of CREEA is to refine and elaborate economic and environmental accounting principles as discussed in the London Group and consolidated in the future SEEA 2012, to test them in practical data gathering, to troubleshoot and refine approaches, and show added value of having such harmonized data available via case studies. This will be done in priority areas mentioned in the call, i.e. waste and resources, water, forest and climate change / Kyoto accounting. In this, the project will include work and experiences from major previous projects focused on developing harmonized data sets for integrated economic and environmental accounting (most notably EXIOPOL, FORWAST and a series of EUROSTAT projects in Environmental Accounting). Most data gathered in CREEA will be consolidated in the form of Environmentally Extended Supply and Use tables (EE SUT) and update and expand the EXIOPOL database. In this way, CREEA will produce a global Multi-Regional EE SUT with a unique detail of 130 sectors and products, 30 emissions, 80 resources, and 43 countries plus a rest of world. A unique contribution of CREEA is that also SUT in physical terms will be created. Partners are:

1. Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek (TNO), Netherlands (co-ordinator)
2. JRC -Joint Research Centre- European Commission (DG JRC IPTS), Belgium /Spain
3. Universiteit Leiden (Unileiden), Netherlands
4. Centraal Bureau voor de Statistiek (CBS), Netherlands
5. Norges Teknisk-Naturvitenskapelige Universitet (NTNU), Norway
6. Statistiska Centralbyran (SCB), Sweden
7. Universiteit Twente (TU Twente), Netherlands
8. Eidgenössische Technische Hochschule Zürich (ETH) Switzerland
9. 2.-0 LCA Consultants Aps (2.-0 LCA), Denmark
10. Wuppertal Institut Fur Klima, Umwelt, Energie Gmbh. (WI), Germany
11. SERI - Nachhaltigkeitsforschungs Und –Kommunikations Gmbh (SERI) Austria
12. European Forest Institute (EFI), Finland / Spain

For more information contact the co-ordinator at: arnold.tukker@tno.nl

TABLE OF CONTENTS

1 Introduction

1.1 CREEA project

In 2003, a system of satellite accounts for environmental accounting was proposed, known under the name of System of Environmental and Economic Accounting – in short: SEEA 2003 (UN et al., 2003). This accounting system gives guidelines for setting up environmental accounts which are compatible with the system of national accounts. A revised and extended SEEA is planned to be published in 2012 (in short: SEEA 2012). The UNCEEA (UN Commission of Experts on Environmental and Economic Accounting) is responsible for this work, with most of the operational work being executed in the so-called 'London Group' (LG), a group of experts from statistical offices globally.

The CREEA project on Compiling and Refining Environmental and Economic Accounts has as a main idea to elaborate economic and environmental accounting principles, building upon decisions and discussions in the London Group, to test them in practical data gathering, and show added value of having such harmonized data available via case studies.

In conclusion, it is expected that the project will set up along the following lines and will make major contributions to SEEA 2012, and above all, its practical implementation:

1. Take the existing guidance developed by the London Group for SEEA 2012 as a starting point.
2. Focus on the key areas of relevance for sustainability policy making, and where there is a need for further methodological refinement, demonstration of how to implement practical data gathering, and showcasing the added value in policy making. As confirmed by London Group members contacted and/or part of our consortium, this concerns the following areas also mentioned in the Work item:
    a. Water accounts
    b. Waste accounts in relation to material flow accounts (including stocks)
    c. Forest accounts
    d. Climate change related issues
3. Elaborate where still needed the methodologies currently proposed by the London Group, and test practical data gathering according to these approaches. Do trouble shooting and suggest adaptations of methodologies to make them most effective and efficient with regard to data gathering.
4. Showcase the added value of this more complete accounting system by application in practical policy cases.

In short, such a program fills in remaining gaps in SEEA 2012, gives guidance into the most effective ways of practical implementation (particularly data gathering), and can build a case showing the added value of practically implementing SEEA 2012.

1.2 Forest accounts work package

The Work Package 5 is devoted to forest accounts and its objectives are:

- Revising, refining and testing the methodology for forest accounts as suggested in the existing draft of the SEEA 2012
- Develop a procedure for incorporating UNECE/FAO data and national forest statistics into the SEEA 2012 integrated economic and environmental accounts system

- Investigate the usefulness of the SEEA 2012 forest related indicators for the development of forest policies at the EU and national level
- Providing a dataset of SEEA 2012 indicators for two test regions.
- In short, such a program fills in remaining gaps in SEEA 2012, gives guidance into the most effective ways of practical implementation (particularly data gathering), and can build a case showing the added value of practically implementing SEEA 2012.

Harmonised data collection on forests allow quantifying some of the factors which are relevant for developing forest management strategies and steering forest related policies. They can help to identify risks of forest overexploitation, to develop forest regeneration policies, and to monitor the consumption of wood and other market forest products.

Standard forest accounts aim to bring forest sector information in contact with other type of statistics, allowing for a more generalised analysis that can be used on different levels. However, the forest accounts have not been a major priority in the EU environmental accounts so far. Furthermore, the information about forests deducible from standard national accounting is essentially limited to those forest resources that are exchanged on the market or that are the object of market transactions and, therefore, produce economic benefit and are associated with ownership right. However, we should recognise that forests provide a number of goods and services that are not traded on markets and have no established market prices. These goods and services contribute significantly to the human wellbeing.

The main aim of the first task corresponding to the present deliverable is to revise the proposed SEEA 2012 forestry tables. This revision will be focused on the following aspects:

- Review the proposed changes in the SEEA 2012, with regards to the previous version of the tables (SEEA 2003), and comment on the usefulness of these changes;
- Evaluate the completeness of the SEEA 2012 forestry tables, with regards to the stock and flow of all forest goods and services, including non-market goods and services, and propose options for improvements;
- Estimate the feasibility of the implementation of the SEEA 2012 in the EU Member States (MS). This aspect will be conducted in collaboration with EU Member States' statistical offices and/or other agencies responsible for the provision of national data on forests and forestry. The involvement of national agencies will be achieved through questionnaires and interviews (if needed for clarification of responses to questionnaires).
- Estimate the usefulness of the SEEA 2012 data for the development of forest policies or strategies at the national and EU level, and what potential improvements could be introduced. A reference group with potential users from national agencies responsible for the development of forest related policies and strategies will be formed, to obtain their opinion and gather suggestions about possible improvements. The stakeholder group will be contacted through questionnaires and interviews.

1.3 Structure of the report

The structure of this deliverable is as follows: Chapter 2 introduces the concept of environmental accounting and explains the differences in the way forests are recorded in standard and environmental accounting. Chapter 3 revises the SEEA 2003 and 2012 versions, identifying the sections were forests are accounted for, establishing comparisons across both versions. Chapter 4 presents three of environmental accounting frameworks that have being set up in the EU and have a particular focus on forest accounts: the Economic Accounts for Forestry (EAF), the Integrated Environmental and Economic Accounting for Forests (IEEAF) and the Economy Wide material Flow Accounts (EW-MFA). Chapter 5 presents a couple of reports dealing specifically with the assessment of forest resources, that is, the FAO Forest resources Assessment (FRA) (which is the most important data source in terms of classifications for the SEEA sections on forests) and the State Of Europe's Forests (SoEF) set of criteria and indicators. Finally, Chapter 6 is devoted to discussion and conclusions.

The deliverable main sources of information have been the official reports on the different accounting frameworks, but also scientific papers discussing the role and challanges faced when setting a forest accounting framework. The practitioner view will be collected in a questionnaire that has been designed as part of this WP. The main findings regarding the questionnaire will be shown in the CREEA deliverable 5.2.

2 Forest accounts

2.1 Standard and Environmental accounting

The System of National Accounts (SNA) is an international standard system for the compilation of economic statistics and derivation of economic indicators in monetary terms. Among these, the Gross Domestic Product (GDP) is the most established and important. SNA (UN, 1993) is particularly important because it constitutes the primary source of information about the economy and is widely used for assessment of economic performance, policy analysis and decision-making (Lange, 2004).

The European System of Integrated Economic Accounts (ESA) is the compulsory framework for national accounting in the European Union (Commission of the European Communities, 1996). It can be considered as the European version of the SNA that was proposed for general application by the United Nations in 1993.

However, it is recognised that the SNA has had a number of shortcomings regarding the treatment of the environment (Lange, 2004). One of them is that it fails to reflect the short-run and long-run economic impacts of environmental degradation and natural resource depletion (Vincent, 1999). Furthermore, natural resources comprised within the SNA framework are mainly those under private property and linked to a well established market, while the non cultivated areas designated as conservation areas preservation and hence not subject to a productive activity, are not reflected in the National Accounts.

To overcome this shortcomings, satellite accounts on environment were developed to provide a framework that is linked to the central accounts and enables to represent the environment, and its relation with the economy. The motivation for establishment of environmental accounts has been the widespread adoption of the notion of sustainable development, coupled with the understanding that economic activities and appropriate economic incentives play a central role in determining whether development is sustainable or not (Lange, 2003).

Economic sustainability can be defined as strong or weak, depending on the degree to which one form of capital can substitute another. Weak sustainability requires that the combined value of all assets remain constant, which indicates that is possible to substitute one form of capital for another. In this case, natural capital can be depleted or the environment degraded as long as there are compensating investments in other types of capital: manufactured, human, or other type of natural capital.

On the contrary, strong sustainability is based on the concept that natural capital is a complement to manufactured capital, rather than a substitute (Lange, 2003). Hence, renewable resources such as forests can be exploited only at the natural rate of net growth. The indicator of sustainability requires that all natural capital is measured in physical units.

A less demanding version of the strong sustainability concept, accepts some degree of substitutability among assets, but recognizes that there are some “critical” assets which are irreplaceable. The corresponding measure of sustainability would be partly monetary

(for those assets, manufactured and natural, which are not critical and for which substitution is allowed) and partly physical, for critical natural assets (Lange, 2003).

Environmental accounts may typically have four components (Lange, 2003):

- Natural resource asset accounts, which deal mainly with stocks of natural resources and focus on revising the Balance Sheets of the System of National Accounts (SNA)
- Pollutant and material (energy and resources) flow accounts, which provide information at the industry level about the use of energy and materials as inputs to production and final demand, and the generation of pollutants and solid waste. These accounts are linked to the Supply and Use Tables of the SNA, which are used to construct input-output (IO) tables.
- Environmental protection and resource management expenditures, which identifies expenditures in the conventional SNA incurred by industry, government and households to protect the environment or manage resources.
- Environmentally-adjusted macroeconomic aggregates, which include indicators of sustainability such as environmentally adjusted Net Domestic Product (NDP). Hence, sustainability requires non-decreasing levels of capital stock over time, or, at the level of the individual, non-decreasing per capita capital stock.

In the European experience, the second and the third of these components have been identified as to have most potential for developing environmentally relevant statistics.

The first and the fourth are more aimed at giving a more complete account of the resources available from a rather economic accounts point of view. Ideally, the asset accounts, such as the forest accounts, may provide a way of linking biodiversity issues into the SEEA, through indicators that are already established in the forest statistics.

2.2 Forests and accounting

2.2.1 Forests and forestry in standard accounts

Forestry is a specific part of the national economy, defined by the production of wood in the rough and other forest-related products (Sekot, 2007).

In standard accounting, forests are not considered as a single entity. They appear as two distinct elements that are evaluated separately (Goio et al., 2008): i. Land and ii. Biological goods (timber mainly).

Furthermore, as far as economical exploitation is concerned, SNA is subdivided as follows (Goio et al., 2008):
1. Cultivated land, or forest land on which a forestry activity (silviculture) is carried out, aimed at timber production;
2. Non cultivated land, or forest land where no forestry activity (silviculture) is undertaken, though there may be natural growth.

For the first category, SNA records both production and changes in the forest stock so that the consequences of depletion or re-afforestation are accounted for. For the second category, SNA records only the timber at the moment it enters the economy, i.e. the income from logging, but does not account for changes in natural forest stocks.

The key differentiation between cultivated/non cultivated areas refers to the production boundary and it is based on the existence of economic activity linked to the area. The term ‘‘production’’ usually indicates an activity, carried out under the responsibility, control and management of an institutional unit, that uses inputs of labour, capital and goods and services to produce outputs of other goods and services (UN, 2001). Hence, in the first case (cultivated land), standing timber is defined as productive activity and the added value, corresponding to timber growth, is included in the GDP. In the second case (no cultivated land), growing of standing timber is considered non productive activity, and their added value is included in the GDP only when the timber is harvested. This can result in misleading economic signals about changes in a natural forest: income from over-exploitation would be recorded as part of GDP, but the corresponding depletion of the forest stocks would not be recorded (Lange, 2004). Thus, the information about forests in standard national accounting is limited to these forest resources that produce economic benefit (i.e. are exchanged on the market or are the object of market transactions) and have defined ownership rights (Goio et al., 2008).

As a consequence, because the SNA framework accounts exclusively for market traded goods and services, only a limited amount of forest-economy interactions are recorded in the national accounts. The goods or services that are either traded in informal markets or not traded, are not included in the SNA. Therefore, in the accounting jargon, the non-market forest functions are defined as non-SNA functions. By using this expression, Eurostat stresses that functions other than productive ones are not registered or taken into account by the national accounting system (Goio et al., 2008). However, numerous evidences exists that non-productive forest functions may be of even higher value than their strictly productive functions (Merlo & Croitoru, 2005; Lange, 2004). These functions are not included in the SNA because they are noth within the ‘‘production boundary’’ of the SNA (Vincent & Hartwick, 1998; Haripriya, 2001), when referring to the total range of economic sectors.

This obviously leads to an underestimation of the full value of forest resources. Thus, forests and forest sector are commonly classified as a marginal element of the economy in a number of countries when evaluated under the GDP framework. This is especially problematic in areas with a very limited timber production potential (e.g., Mediterranean region).

Finally, the ecological and social significance of forest resources and their utilization also have considerable effects on other parts of the economy and public welfare, and are of great political concern (Sekot, 2007). Vincent (1999) shows that frequently the value added, as conventionally defined for both industry and agriculture, is overstated from a social standpoint, because a portion of each sector’s operating surplus can be attributed to services provided by forests. For example, forests provide intermediate inputs to other sectors, such as livestock grazing or tourism, but the value of these inputs is not recognised (Lange, 2004). Thus, not only the total benefits from sustainable forestry are underestimated, but other economy sectors are not aware of their dependence on healthy forests (Lange, 2004).

Vincent (1999) proposes that the value of forest services (e.g., pollution disposal services) should be subtracted from value added industry, and included as value added in the forest management account. This change would not affect the overall GDP, as these

would be only a reallocation, but would give a clearer picture of the contribution of the forest sector to national economy.

2.2.2 Forests and forestry in environmental accounts

These limited accounts for forests in SNA are in contrast with the many ways forests interact with economy (Vincent, 1999):

1. Source of renewable, but potentially depletable, timber harvested by logging companies and used as a production input by wood-processing industries.
2. Source of tangible non-timber products collected and consumed by households but not necessarily traded in markets (e.g. fuel wood, forest fruits, game).
3. Source of non tangible non-timber products collected and consumed by households (e.g. existence values associated with biodiversity)
4. Source of environmental services that benefit other productive sectors (e.g., watershed protection benefiting downstream agriculture, forest-based recreation and tourism);
5. Disposal for air pollutants that might negatively affect forest health (e.g., acid rain deposition):
6. Sink and source of carbon dioxide (CO2), which potentially damages other economic sectors through global climate change
7. Through deforestation, forests are a source for land for other purposes (e.g., agriculture, infrastructure); and
8. Forest management as an activity involving the use of variable inputs (labor, materials) and fixed factors (human-made capital).

Hence, expanding forest accounts is potentially useful to gain knowledge about the economic and ecological interactions between the forestry sector and society; to obtain more accurate values (in monetary terms) for forest goods and services, which is important for more efficient management decisions, and environmental and economic policy development (Kriström and Skånberg, 2001).

As Lange (2004) points out, setting an accurate forest account framework paves the way for establishing a value closest to the true socio-economic value of forests in relation to the rest of the economy. The total economic contribution of forest to the national economy could be calculated, as well as identified the potential losses from changes in forest use. Furthermore, the beneficiaries and their distinct nature (direct/indirect, local/downstream) could be identified. This information is necessary for optimizing forest management that will enable to achieve economic and social objectives (e.g., local community preservation, increased equity). In addition, forest accounts provide detailed statistics that may be used in economy-wide models to anticipate impacts of non-forestry policies and design strategies for economic development that take into account all the goods and services, market and non-market, provided to all stakeholders.

This way, forest accounts would ideally address the total economic value of forests, which encompasses all the goods and services provided by forest ecosystems. In recognition of the peculiarities of forestry, special rules have been established and specific accounting schemes were developed for dealing adequately with forestry in the context of national accounting (Sekot, 2007). Nevertheless, the literature on expanded forest accounting is still in a formative stage and there are many theoretical and practical issues that remain unsolved (Kriström and Skånberg, 2001).

The difficulties existing in setting up forest accountings are similar to those when developing environmental accounting framework as a whole. These include, the specific characteristics of forest goods and services, but also the gaps between environmental statistics and accounting frameworks, and the lack of binding agreements that would support the gathering and refinement of forest related data. Despite that many countries conduct periodical forest inventories, these data are not necessarily in accordance with the accounting framework and hence, may not be suitable for accounting purposes. Furthermore, as Smith (2007) states, even in developed countries with mature statistical systems, environmental statistics can suffer from severe quality constraints and most importantly, environmental statistics are often incomplete. These gaps prevent complete understanding of trends in the state of the environment and of the human activities linked to these trends. Most of these are due to the fact that while standard accounts are mandatory (in the European Union countries must report their national accounts to Eurostat), the collection of data for forest accounting relies heavily on "gentlemen's" agreement.

In addition, the long time horizons considered in forestry pose difficulties to measurements as it implies making assumptions on the evolution of the forests and the prices for different goods and services.

Thereby, typically, national forest accounts are only limited to timber asset accounts in physical and monetary terms. In these accounts, forests are disaggregated into cultivated and natural forests, and according to the major tree species (e.g., conifers, broadleaved). Regarding the non-timber goods and services, carbon storage is commonly included. In contrast, when it comes to environmental services such as water and soil protection these are mainly omitted. Regional or site-specific studies exist that account for these services, but broadening these values to the national scale is rare. Collecting data on these aspects on a broad scale requires task demanding studies, because of site-specific features of their provision and economic value.

Forests hold a vast array of use values and non-use values. Wherever possible, all these values should be represented in both physical (forestland in hectares, timber harvested in cubic metres) and monetary units in the accounting framework. Direct use values include market or near-market goods whose physical volume and monetary value can be measured. Many of these goods either have market prices (e.g. commercial timber) or have prices that can be readily estimated by closely related market goods and services (e.g. own-account fuelwood, edible plants and game). In principle, these goods should be included in SNA; although in practice the estimation of non-market goods and services may be rather limited (Lange, 2004).

Indirect use of forest services, such as biodiversity protection and hydrologic function, are often represented only qualitatively through physical indicators, because of monetary valuation is difficult. One exception might be carbon storage, which is relatively easy to measure in physical terms and there is some international consensus on valuation. In the economics literature, a range of economic techniques has been developed to estimate these values. However, these values are still rather experimental and their expansion to national level is very demanding.

Daly and Farley (Daly and Farley 2004, mentioned by Walker & Pearson, 2007) distinguish stock flow resources and fund-service resources. The first are materially

transformed into products in the production process; while, a fund-service resource does not become embodied in the product. Ecosystem services (water purification, pollination, soil regeneration) they mostly categorise as fund-service resources. In this sense, we should also understand that forests sometimes act at the same time as a fund-service (like water purification) and as a stock-flow (timber production) resource, which makes the accounting even more complex and prone to double counting (Walker & Pearson, 2007).

Forests are a renewable resource, subject to depletion and degradation if the use or extraction of goods and services is above the sustainable yield. Resilience is a broader concept for the capacity of an ecosystem to buffer disturbance. It is measured as the capacity of the resource to undergo changes, while still maintaining the same structure, functions and feedbacks (Walker & Pearson, 2007). Thus, a challenge in environmental and forest accounting is considering the system resilience to be able to monitor and predict the resilience of the ecosystems and the thresholds that would determine an irreversible loss of the goods and services they provide. Currently, it is believed that species diversity is the best proxyfor assessing response diversity in ecosystems that have not been intensively studied (Walker & Pearson, 2007).

3 The System of Integrated Environmental and Economic Accounts (SEEA)

3.1 Introduction to SEEA

3.1.1 Introduction

The latest version of SEEA was launched in 2003 but its very first version dates from 1993. It showed the international community was serious about the need to better integrate environment into the national accounts (Smith 2007). Its appearance did not, as one might expect, have an immediate effect on most national environmental accounting efforts. Countries did not necessarily adjust their national efforts to align with it as no country was obliged to follow it. This is in contrast with the System of National Accounts which is an international standard that countries must follow if they wish their national accounts to be considered legitimate by the international community.

SEEA is a satellite account to SNA. It means that it has a similar structure to SNA so most categories could be compared across both frameworks. SEEA provides a set of aggregate indicators to monitor environmental-economic performance at the sector and macroeconomic level, as well as a detailed set of statistics to guide resource managers towards policy decisions that will improve environmental-economic performance in the future (Lange, 2004).

In contrast to other environmental databases, the purpose of SEEA is to link environmental data directly to economic accounts. SEEA attempts to integrate environmental data with economic accounts and link the natural resources with the sectors that depend on them. Hence, SEEA stands apart from environmental statistics in important ways, but relies upon them for its implementation (Lange, 2004).

SEEA includes both physical accounts and monetary accounts, e.g. in the form of transfers such as axes and subsidies. However, non-market valuation is generally avoided.

As stated by Lange (2004), for issues such as forest management, the advantage of the SEEA approach is clear. It is not possible to promote sustainable forestry purely from the narrow perspective of managing forests; rather, an economy-wide approach is needed that can identify benefits that forests provide to other sectors as well as threats to forests from non-forestry policies.

This chapter intends to select the areas of SEEA where forests are recorded so as to evaluate the former and the new versions.

The SEEA 2003 comprises four categories of accounts:

1. Flow accounts for pollution, energy and materials (Chapters 3 and 4) within the economy and the economy and the environment. It considers how physical statistics relating to flows of materials and energy can be built into

accounts compatible with the SNA. Two types of accounts are described: exclusively physical accounts constructed according to the structure of the SNA (e.g., physical input–output tables) and "hybrid" accounts combining both physical and economic statistics.

2. Environmental protection and resource management expenditure accounts (Chapters 5 and 6). These accounts identify expenditures incurred by industry, government and households to protect the environment or to manage natural resources. They take those elements of the existing SNA which are relevant to the good management of the environment and show how the environment-related transactions can be made more explicit.
3. Natural resource asset accounts (Chapters 7 and 8). These accounts record stocks and changes in stocks of natural resources such as land, fish, forest, water and minerals. It comprises accounts for environmental assets measured in physical and monetary terms.
4. Valuation of non-market flow and environmentally adjusted aggregates (Chapters 9 and 10). The final category of SEEA 2003 accounts considers how the economic accounts of the SNA might be adjusted to account for the impact of the economy on the environment. Three sorts of adjustments are considered; those relating to depletion, those concerning so-called defensive expenditures and those relating to degradation.

3.1.2 How are forests accounted for

3.1.2.1 Forests: other wooded land and timber

Forests in SEEA are accounted for based on two separate, although linked assets: wooded land and standing timber. The definitions and classifications of forests in SEEA-2003 are based on the UN-ECE/FAO temperate and boreal forest resource assessment 2000 (TBFRA 2000) (UN-ECE/FAO, 2000).

3.1.2.1.1 Wooded land

SEEA-2003 divides wooded land into forests and other wooded land, both excluding land predominantly used for agriculture:

EA.23 Wooded land
- EA.231 Forested land
  - EA.2311 Forests available for wood supply
  - EA.2312 Forests not available for wood supply
- EA.232 Other wooded land

More detail on these classes could be found in Box 1.

3.1.2.1.2 Standing timber

The definition of the volume of standing timber is:

*The volume of standing trees, living or dead, above stump measured over bark to the top. It includes all trees regardless of diameter, tops of stems, large branches and dead trees lying on the ground that can still be used for fibre or fuel. It excludes small branches, twigs and foliage. (*UN et al., 2003, p.346*)*.

Standing timber is classified in the same categories as wooded land: by availability for wood supply, tree species, naturalness, etc. It also includes a category for trees outside wooded land, which includes trees in areas less than 0.5 hectares in size and less than 20 metres in width, such as scattered trees in meadows and pastures, hedgerows, trees along rivers, in urban areas, etc.

3.1.2.2 Forests in the SEEA components

Within the four major components of SEEA, forest related assets are recorded as follows:

- Forest flow accounts include supply and use tables for detailed forest products (wood and non-wood, marketed and non-marketed) by sector, which are linked to the input-output (IO) tables and social accounting matrices (SAMs) used in economic models. Forest flow accounts also include measures of forest ecosystem services, like carbon storage or watershed protection and environmental degradation associated with forest use (e.g. soil erosion from logging)
- Environmental protection and resource management expenditure accounts include forest management expenditures by government, environmental protection expenditures by public and private sectors and user fees and taxes paid by forest users to the government.
- Asset accounts record stocks and changes in stocks of natural resources over time. Forest asset accounts typically include balance accounts for forestland and stocks of standing timber. Accounts to record forest health are also included.
- In theory, environmentally-adjusted macroeconomic aggregates include commonly used indicators of macroeconomic performance that have been adjusted to better reflect sustainability, such as environmentally-adjusted gross domestic product (GDP), net domestic product (NDP), national savings or national wealth. For this component of SEEA, forestry accounts would provide the addition to GDP of unvalued forest goods and services, the subtraction from NDP of the economic cost of deforestation or loss of forest services due to a change in management and the contribution of forest assets to national wealth. In practice, we do not know of any studies that have done this.

Box 1. The classification of wooded land in SEEA 2003

SEEA 2003 relies largely on TBFRA 2000 report from FAO when classifying wooded land. These are relevant as constitute the accounting categories reflected in SEEA 2003.

Forested land is defined as *tree crown cover (or equivalent stocking level) of more than 10 percent and an area of more than 0.5 hectares. The trees should be able to reach a minimum height of 5 metres at maturity in situ.*
Other wooded land is defined as *land with a tree crown cover (or equivalent stocking level) of either 5-10 percent of trees able to reach a height of at least 5 metres at maturity in situ, or a crown cover of more than 10 percent of trees not able to reach a height of 5 metres at maturity in situ and shrub or brush cover*.
Areas with tree, shrub or brush cover of less than 0,5 hectares in size and less than 20 metres in width are excluded and classified as other land (UN et al., 2003 p. 342).

Forested land is further subdivided into:

- **Forests available for wood supply**, even though harvesting may not be occurring at the present time
- **Forests not available for wood supply,** where legal, economic, or environmental restrictions prevent any significant wood production.

Forested land available for wood supply may be further disaggregated by the degree of "naturalness" of the forest, ranging from completely uncultivated to plantation forests. This distinction is relevant as SNA calculates the production of the forest industry differently for cultivated and natural forests:

- **Natural forests** - *forests with natural species and ecological processes and for which there has been continuity of ecological processes over a very long period of time (the time period of continuity is sometimes quoted as being of more than 200 years but this may not be relevant for all types of forest).*
- **Semi-natural managed forests** - *management has substantially altered the structure and ecological processes of the forests but growth is still mainly a natural process with no regular and continuous human intervention*.
- **Plantations** - *forests for intensive fuel or industrial wood production, planted or artificially regenerated and made up of exotic (non-indigenous) species and/or monocultures. (UN et al., 2003, p.343). Forested land not available for wood Manual for environmental and economic accounts for forestry 59 supply may be classified by the degree of restriction (for example, using IUCN categories) and by major tree species.*

In short the classification would like this:

<table>
<tr><td rowspan="4">Forest land</td><td rowspan="3">Forests available for wood supply</td><td>Natural forests</td></tr>
<tr><td>Semi-natural forests</td></tr>
<tr><td>Plantations</td></tr>
<tr><td colspan="2">Forests NOT available for wood supply</td></tr>
<tr><td colspan="3">Other wooded land</td></tr>
</table>

3.1.2.3 General considerations about the forest accounts

SEEA 2003 provides with some general considerations regarding how to account for forests. We add also some general considerations observed in the revision of the reports.

- In accordance with forest inventories, SEEA considers more preferable to make calculations over a multi-year period except for the impact of major catastrophes.
- The scope of environmental assets measured in SEEA may be greater than then scope of environmental assets measured in monetary terms following the SNA definition of economic assets. This is because in SNA the requirement in physical terms is that environmental assets must deliver benefits to an economic owner. Hence, within the SNA scope remote land and timber resources should not be recorded while SEEA would include them within the scope of the environmental assets of a country even if they do not current are not expected to deliver benefits to an economic owner.
- The scope of the asset accounts in general comprises accounts described both in physical and monetary terms. However, because of the eventual difficulties of establishing monetary values for the physical units of the assets some of the assets are accounted for only in physical terms.
- As stated above, the TBFRA-2000 (Temperate and Boreal Forest Resource Assessment) from the United Nations Economic Commission for Europe and Food and Agriculture Organisation of the United Nations (2000), offers a set of normalised definitions which are followed by SEEA. These may differ from country-specific definitions (for example, from those used in forest inventories). One of these is the definition of (standing) volume, which TBFRA defines as measured without a minimum diameter.
- Equally to what is done in SNA, separating produced and non-produced assets, each category of biological resource in the SEEA asset classification is subdivided into cultivated and non cultivated sub-categories. These categories in SEEA are synonyms for the produced-non produced categories of SNA. For more details on the relevancy of such a classification see Box 2.

Box 2. The cultivated/no-cultivated boundary in SEEA 2003

SEEA, differentiates very precisely cultivated and no-cultivated timber resources. The reason for this distinction is they are recorded very differently in the standard economic accounts although the physical processes of biological resources growing and yielding products are similar for cultivated and non-cultivated resources.

For cultivated biological resources: **growth is regarded as output and may enter into stocks as either fixed capital or work in progress. Harvesting and natural death are recorded as negative capital formation.**

For non-cultivated biological assets: **growth, harvest and natural death will be recorded as additions to and deductions from stock levels.**

It needs to be clear that control over the harvesting is not sufficient to establish that a biological asset is cultivated. If it were, any legislation controlling the use of virgin forests would be sufficient to cause a designation of "produced". Differently, the cultivated assets are these yielding repeat products whose natural growth and/or regeneration is under the direct control, responsibility and management of institutional units. Further, it should be understood that the processes involved must constitute production in the SNA sense and not consist of just legislative control. Examples of production are (i) control of regeneration (seeding, planting of saplings); and (ii) regular supervision of the trees to remove weeds, attend to pests. It should be the case that the process of production has to be one that was classified to the corresponding industrial activity (forestry).

In practical terms, this boundary is defined based on the classes of forest defined by FAO with timber resources in primary forests being considered natural and timber resources in other naturally regenerated and planted forests being considered cultivated.

An example on the relevancy of such a boundary: The SEEA includes non-cultivated resources that provide no current use benefit but that may one day do so. In practice, this means that conceptually all non-cultivated biological resources within the national territory fall within the SEEA asset boundary. The inclusion of non-cultivated resources in SEEA may not make a big difference at a EU scale where most forests according to these criteria, could be classified as cultivated and strict legal measures protect these areas intentionally standing apart from management. However, in tropical countries where significant areas of primary non cultivated forests exist, this classification has important implications on the way these resources are considered in the national accounts. While these areas remain untouched, as far as non cultivated resources are not recorded in the standard accounts, these forests would not be recorded in the standard accounts and hence do not contribute to national welfare. In contrast, a hypothetical scenario where these timber resources are extracted and the land devoted to agricultural uses would be recorded in standard accounts as an increase in national welfare as the timber extracted would enter into the production boundary and agricultural land would be recorded as an increment in cultivated land. Hence, scenarios such as forest degradation would be accounted in a "positive" way in standard accounts. The contribution of SEEA is to keep track on the non-cultivated resources and assess their eventual degradation or depletion.

3.2 Forest accounts in SEEA 2003

3.2.1 Physical flow accounts

The objective of this accounting is investigating the extent to which the economy is dependent on particular environmental inputs and the sensitivity of the environment to particular economic activities.

Four types of flows are distinguished in the SEEA 2003, each of them with its own accounting items.

- Natural resources: mineral and energy resources, water and biological resources.
- Ecosystem inputs: such as the water, nutrients or other required by plants and animals for growth.
- Products: goods and services produced within the economic sphere and used within it.
- Residuals: are the undesired outputs from the economy discharged into the environment.

Accounting for the flow of timber and wood products implies following the progress of these resources through the successive stages of its absorption into various products. These data are useful in understanding the implications for industrial activity consequent on the existence of significant forest reserves and harvest, especially when linked to employment and regional data.

These flows are plugged into supply and use tables (SUT). SUT provide detailed account for flows of goods and services and show the origin of different forest products, the processing of raw forest products into other products such as sawnwood and firewood, and the use of each product by every sector of the economy as well as final users (households, government, capital formation and exports).

National accounts provide monetary SUTs for forest products. The forest accounts of SEEA provide the corresponding physical SUTs and, in principle, extend SUTs for non-timber forest products as well. The two tables are linked to each other and the rest of the economy through the use of a common classification for industries and commodities. From these tables, commodity balances for forest products may be constructed, as well as an input-output (IO) table or SAM in which the production of forest products is represented in physical terms (Lange,2004).

3.2.1.1 Natural resources and products (Non Cultivated and Cultivated forests)

The boundary between cultivated and non cultivated assets is relevant in this section as **cultivated biological assets are regarded as products while forests and timber from non cultivated areas are considered as natural biological resources.** Once they are extracted, they appear in the accounts as product flows.
The figures in the flow accounts should of course be consistent with those referring to the volume of harvested timber in the asset accounts. Hence, the non-cultivated timber resources considered here closely correspond to the timber assets from non cultivated forests, excluding these cultivated forest assets.

3.2.2 Economic accounts and environmental transactions

This category of accounts reflects those elements of the existing SNA which are relevant to the good management of the environment and by tracing them makes these environment-related transactions more explicit. We include here these related or that may eventually be related to forests.

3.2.2.1 Economic activities and products related to the environment

This section of SEEA 2003 identifies the expenditures on activities aimed at alleviate or rectify the pressures on the environment.

3.2.2.1.1 Environmental protection activities

These include the activities where the primary purpose is the protection of the environment. SEEA suggests using the Classification of Environmental Protection Activities (CEPA) for organizing environmental protection activities.

3.2.2.1.2 Natural resource management and exploitation activities

Management of forest resources is considered in this section and comprises national forest inventories, research for pest control and regulation. It includes expansion (afforestation) of wooded areas including net acquisitions of land for afforestation, their development for recreational use, inventories and assessment of forest resources, forest-related research, education, training and information activities, forest-related administration and surveillance.

Public financing for forest management may consist of transfers to producers for afforestation or maintenance of wooded areas, or expenditure by general government units engaged in other non-market activities (management, control, regulation of forest and forestry). Because of its importance, SEEA suggests **it may be desirable to establish a Forest Resource Management Account to record separately the transfers intended to pay for forest resource management expenditure** as well as collective consumption of general government.

Exploitation of forest resources comprises silvicultural activities such as harvesting or reforestation.

3.2.2.1.3 Minimization of natural hazards

Little country experience is available so far in natural hazards. Forest fires would be included here. The nature of activities will differ according to the phenomenon covered and may include research, observation and measurement networks, surveillance, administration of hazard warning systems, provisions for fighting the effects of forest fires (equipment, etc.), provisions for the evacuation of the population, structures to prevent hazards, such as fire barriers in forests.

Initially only government expenditure may be covered. The account could conceivably be extended to cover the costs of clean-up and remediation after the events so as to arrive at estimates of the economic damages caused by natural hazards and their evolution over time. SEEA suggests that data from insurance companies and from government budgets could be a useful starting point.

3.2.2.2 Accounting for other environmentally related transactions

This chapter of SEEA is only concerned with those instruments invoked by government in relation to the use of environmental assets or media. It measures the economic instruments which objective is encouraging environmentally friendly behaviour and practices. Environmental taxes fall into this category, as do direct charges for government provided environmental services. Of increasing importance is the role of charging for the use of environmental media. In some countries, government is assumed to be the public guardian of environmental resources and thus controls them on behalf of the public at large. In other countries, environmental resources are mainly held privately but even so, if there is a charge levied by the owner on the user this needs to be recorded in the accounts.

3.2.3 Asset accounts

To understand the idea behind an asset account, initially in physical terms, it is a table that in its simplest form shows how the closing stock of the asset can be calculated from the opening stock by adding and subtracting the changes which have taken place during the accounting period, generally a year. Its objective is to enumerate the causes of change in the level of stocks throughout the year so that the opening and closing stock levels can be reconciled. Figure 1 illustrate a generic asset account for a physical asset from SEEA.

Figure 1. A generic asset account for a physical asset in SEEA 2003.

Table 7.3 A generic asset account for a physical asset

Opening stock levels
Increases in stocks
Due to economic activity
Due to regular natural processes
Decreases in stocks
Due to economic activity
Due to regular natural processes
Due to natural disasters (net decrease)
Changes due to economic reclassification
Closing stock levels
Changes in environmental quality
Due to natural processes
Due to economic activity

Source: SEEA 2003

Natural resource assets are defined as *those elements of the environment that provide use benefits through the provision of raw materials and energy used in economic activity (or that may provide such benefits one day) and that are subject primarily to quantitative depletion through human use*. They are subdivided into four categories: mineral and energy resources, soil resources, water resources and biological resources. The latter include timber resources and forest land.

SEEA regards the environment as a collection of assets of various types. Natural capital falls into three broad categories:

- natural resources
- land
- ecosystems

These categories represent the stocks that provide the many environmental inputs required to support economic activity. Forests could be found in each of these categories of natural capital as could be seen in the boxes below:

E.A. 1 Natural resources
E.A. 14 Biological resources
E.A. 141 Timber resources (cubic meters)
E.A. 1411 Cultivated
E.A. 1412 Non-Cultivated (these not suitable for timber harvesting fall outside SNA)

E.A. 2 Land and Surface Water (hectares)
Of which recreational land
E.A. 23 Wooded land and associated surface water
E.A. 231 Forested land
E.A.2311 Available for wood supply
E.A. 2312 Not available for wood supply
E.A. 232 Other wooded land

E.A. 3 Ecosystems
E.A. 31 Terrestrial ecosystems
E.A. 313 Forest ecosystems

Hence, this section on asset accounts will show both physical and monetary accounts for these above mentioned categories where forests could be found.

As Lange points out (2004), asset accounts for forestland and standing timber are perhaps the easiest component of forest accounts to construct—data are often readily available and there is long experience in measuring these resources for forest management. The major data source for physical accounts is the national forest inventory. These inventories are conducted over a cycle of several years; accounts for intervening years are generally estimated from forest growth models. Additional data may be obtained for cultivated forests from companies managing the forests, which usually have detailed information about species and age class of their stocks. Data for natural forests are often less readily available. Data for changes such as annual felling and removals are often obtained from annual forestry statistics.

The conceptual distinction in SNA and SEEA is that cultivated forests are under the direct control and management of an institution while natural forests are not. However, there is often a continuum of management from intensively managed to totally undisturbed forests, making the distinction somewhat arbitrary.

3.2.3.1 Physical accounts

Natural resources, land and ecosystems may be described in physical quantities using units such as hectares, tonnes or cubic metres. Physical accounts may also be compiled by quality classes. Thereby, forest may be subdivided on the basis of cover species,

ownership, management regimes, naturalness, degrees of defoliation, and so on. Further, it will often be impossible to express a quality change in terms of the same units as other entries. In these cases, the additive asset account is augmented or even replaced by a series of environmental indicators which express the change in terms of some other units. Supplementary assets account can be created for these purposes.

Physical accounts for forests also usually spell out the types of tree species involved, whether broad-leaved trees yielding hardwood or conifers yielding softwood. Other aspects of forests are also regularly documented in physical accounts; for example, the age structure of the forest which determines the time to maturity of the standing timber.

3.2.3.1.1 Timber resources

The timber accounts focus in forests available for wood supply. However, SEEA acknowledges accounts for timber in strictly protected areas and in areas under economic restrictions are also very important and should be shown separately, since the possibility for changes in economic restrictions may affect the availability for wood supply.

The TBFRA-2000 (Temperate and Boreal Forest Resource Assessment) from the United Nations Economic Commission for Europe and Food and Agriculture Organisation of the United Nations (2000), offers a set of normalised definitions which are followed by SEEA and that may differ from country-specific definitions (for example, from those used in forest inventories). One of these is the definition of (standing) volume, which TBFRA defines as measured without a minimum diameter. Previous definitions had defined standing volume as measured to a minimum diameter of 7 centimetres at breast height. For material flow accounting and physical input-output tables, annual removals of timber should be separated from felled timber not removed from the forest. Further, the volume of fellings which is removed from the forest should be divided into saw logs, pulp wood and fuel wood by tree species or main group of tree species of most economic importance.

Trees outside the forest are mentioned in SEEA as this category can be useful when consolidating data on timber stocks and removals from various sources, especially when trees in this category provide an important source of wood.

Furthermore, SEEA recognizes the need of the definition of a sustainable yield of renewable natural resources beyond the traditional extraction level of the resource which does not exceed the growth. Because forests have several functions besides logging (such as, habitat protection, recreation and biodiversity), the sustainable yield has to be defined on the basis of a particular objective. Ideally, the sustainable yield should be determined by forest experts on the basis of modelling, but if no such information is available natural growth can be used as a proxy.

3.2.3.1.2 Wooded land

The standard SEEA asset classification initially divides wooded land into forested land and other wooded land and employs the general classification used for natural resources between cultivated-non cultivated resources:

- Forested land
  - Cultivated
  - Non-cultivated
    - Previously harvested
    - Virgin forested land
- Other wooded land

This initial classification could be expanded by countries when forestry is an important industry and forested land an important type of land cover. Thereby, these accounts could also spell out other features such as: broad-leaved and conifers or the age structure of the forest.

The next stage is to sub-divide forested land according to its availability for wood supply:

- Forested land available for wood supply
  - Natural forests
  - Semi-natural forests
  - Plantations
- Forested land not available for wood supply
  - Strictly protected
  - Under economic restrictions

Forest land available for wood supply covers areas where no significant restrictions hold for the supply of wood. This category could be further divided according to the naturalness of the forest. However, because this is difficult to measure, SEEA 2003 proposes to stick to general cultivated-non cultivated classification used for natural resources.

In this respect, SEEA suggests that the FAO classification of forest as natural, semi-natural or plantations presented above. Because natural forests in the FAO classification are very close to natural forests in the SNA, their timber resources are clearly classified as non-cultivated. On the other side, plantations are cultivated resources, according to the SNA definition. And finally, regarding semi-natural managed forests, the SEEA would classify them as non-cultivated.

SEEA 2003 provides with an example of a hierarchy for classifying forested land, alternative to the standard SEEA classification, shown schematically in Figure 2 (and of course it may be that not all the headings are applicable in a given country).

Finally, the physical accounting entries for forested land consider the changes in forested land may be brought about by:

- increases in the stock (afforestation and natural expansion);
- decreases in the stock (deforestation and degradation); and
- changes in land classification and reassessment of stocks.

Figure 2. Alternative hierarchy for classifying wooded land in SEEA 2003

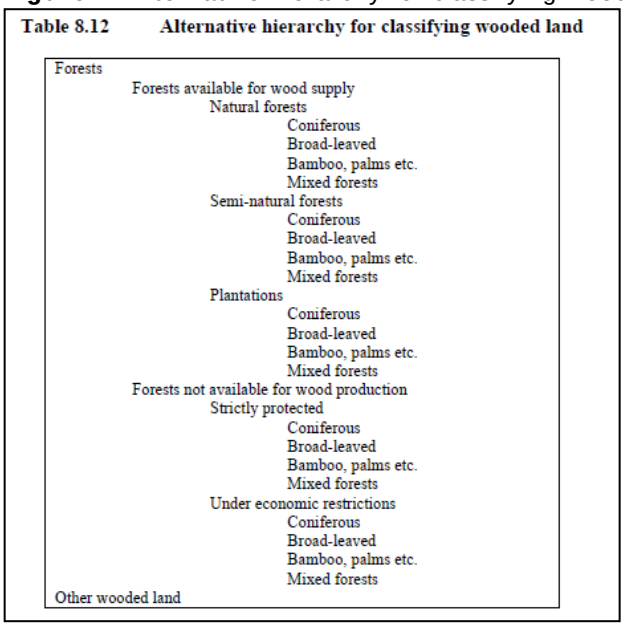

Table 8.12 Alternative hierarchy for classifying wooded land

- Forests
  - Forests available for wood supply
    - Natural forests
      - Coniferous
      - Broad-leaved
      - Bamboo, palms etc.
      - Mixed forests
    - Semi-natural forests
      - Coniferous
      - Broad-leaved
      - Bamboo, palms etc.
      - Mixed forests
    - Plantations
      - Coniferous
      - Broad-leaved
      - Bamboo, palms etc.
      - Mixed forests
  - Forests not available for wood production
    - Strictly protected
      - Coniferous
      - Broad-leaved
      - Bamboo, palms etc.
      - Mixed forests
    - Under economic restrictions
      - Coniferous
      - Broad-leaved
      - Bamboo, palms etc.
      - Mixed forests
- Other wooded land

Source: SEEA 2003

3.2.3.2 Monetary Accounts

When it comes to monetary accounts, establishing a monetary value for forest related assets is not an easy task. SEEA admits that the value of a forest covers the value of standing timber but also the potential to regenerate in the future and the land on which trees stand. In addition, there may be a significant value to be placed on forest products other than timber and on the recreational use provided.

Although the SNA recommends that market prices be used whenever practicable to place a value on an asset, this is not always possible. In such cases, alternative methods of valuation have to be sought. Net present value of future benefits is then preferred, but not always possible to calculate. In this case, the cost of producing the asset may be used as a lower bound on its value.

3.2.3.2.1 Timber resources

A disaggregation of the timber asset account between natural (non-cultivated) and plantation (cultivated) forests is needed since in the SNA natural growth in cultivated forests is treated as production whereas in natural forests only harvested timber is counted as production. In principle, timber stocks from both cultivated and non cultivated forests should be calculated. However, due to the difficulties it represents, the current SNA practice in many countries is to count only harvested timber as production in all forests.

Some alternative methods to the net present value method are shown that represent simplifications of it: the consumption value and stumpage value methods.
SEEA states that natural growth can be valued by any of these methods also. However, there is then a question about whether timber which cannot be harvested should be given the same value as harvestable timber, a zero economic value or some intermediate value.

A disaggregation of the timber asset account between natural (non-cultivated) and plantation (cultivated) forests is needed since in the SNA natural growth in cultivated forests is treated as production whereas in natural forests only harvested timber is counted as production. However, the current SNA practice in many countries is to count only harvested timber as production in all forests.

To calculate the value of timber stocks, the consumption value and stumpage value methods are applicable, as well as the net present value method. These three methods are found in Annex 8.1.

Natural growth can be valued by any of these methods also. However, there is then a question about whether timber which cannot be harvested should be given the same value as harvestable timber, a zero economic value or some intermediate value.

3.2.3.2.2 Forest land

Forest land and standing timber are classified as two separate assets in physical terms. While land is a non-produced asset, standing timber could be a produced asset if the forest is cultivated and a non-produced asset if it is non-cultivated.

In practice it is often difficult to separate the two elements since forested land may not be available for other purposes. Hence, when looking at a forest as an indefinite “going concern”, the value to be given to it clearly covers both the land and the standing timber. This composite asset is called a “forest estate” here to distinguish it from forested land, forests and standing timber.

A range of methods have been developed and tested to value forest estates as well as land and standing timber separately. Some of them are mentioned in this section and none of them is recommended as preferable since it would depend greatly on the data available.

A simple method for valuing forest estates is to calculate the average price of one hectare of forest and to apply it to the whole forest area. Average prices may be calculated from a register of transactions or a fiscal database. Data on transactions exist in many countries but many transactions that do take place may be influenced by hunting rights and questions of inheritance as much as by pure forestry motivations.

As forests are often not homogeneous, if the data are available it is preferable to classify forests according to their characteristics and then to calculate a price for each category and apply this price to the corresponding stock. Relevant classification criteria are the productivity of the land, species and age structure of the standing timber, the existence of hunting rights and so on.

Starting from a sample of recorded transactions, the value of forest estates can also be estimated as a function of these characteristics using a hedonic pricing model.

Another method that can be used to value forest estates is the net present value of the future forest resource rent. Comparing the results of the transactions-based method and the net present value method can give insights into the validity of the assumptions used

in the estimates, such as the discount rate used and the biases in observed transactions prices.

Another possibility is to apply two different valuations to the standing timber on the forested land. The first values the standing timber at a moment in time, assuming that no regeneration will take place as trees mature and die or are felled; in other words, harvesting of timber is restricted to the current rotation cycle of the forest. This puts a value on the existing standing timber. The second valuation is on the basis that harvesting can be sustained indefinitely, so that the value of the asset can be calculated as the discounted present value of an indefinite annual stream of rent generated from harvesting the timber stock. As explained above, this gives a valuation of the timber and land combined as a forest estate. The differences between these two estimates can then be taken as an estimate of the forested land excluding the current standing timber.

3.2.3.2.3 Non-wood forest products

Little attention is devoted to non-wood products in SEEA 2003. These are converted from physical to monetary terms using average market prices for the products concerned. However, because market values include the costs of collection and thus timber and non-wood product, values will not be fully consistent as the value of timber is calculated directly as the product of the stumpage price and the volume of timber harvested without allowing for logging costs.

3.3 SEEA 2012

The System of Environmental-Economic Accounts (SEEA) is currently under revision. This revised SEEA builds upon its predecessors: the SEEA-2003 and the SEEA-1993. It is organized into three main parts: the Central Framework, Experimental Ecosystem Accounts, and Extensions and Applications. The Central Framework, consisting of the internationally agreed standard concepts, definitions, classifications, tables and accounts. Experimental Ecosystem Accounts and Extensions and Applications will not be considered international standards, but will describe best practices. They are scheduled to be completed by February 2013.

The first part of the SEEA 2012 has gone to global consultation. It is written in a more condensed form than SEEA 2003. This implies that the level of detail concerning forest accounting is not so great. The standard discussed main accounting concepts and does not go into the same issues as SEEA 2003.

SEEA 2012 highlights the inherent difficulty in aligning, in complete theoretical terms, a concept of environmental assets from the perspective of ecosystems and also from the perspective of individual components. Hence, the distinction between individual environmental assets and ecosystems has been retained and the relationship between the two perspectives of environmental assets has not been articulated. However, an overarching **definition of environmental assets** covering both perspectives has now been included: *Environmental assets are the naturally occurring living and non-living components of the Earth, together comprising the bio-physical environment that may provide benefits to humanity*.

In the SEEA 2012, environmental assets are considered from two perspectives. In the Central Framework the focus is on individual components of the environment that provide materials and space to all economic activities. This focus reflects the material benefits from the use of environmental assets as natural inputs for the economy but does not consider the non-material from the use of environmental assets. The second perspective on environmental assets is described in SEEA Experimental Ecosystem Accounts The measurement focus on ecosystems *as areas containing a dynamic complex of biotic communities and their non-living environment interacting as a functional unit to provide environmental structures, processes and functions*. Within a given ecosystem, ecosystem accounts consider the capacity of living components within their non-living environment to work together to deliver ecosystem services.

Ecosystem services are the benefits supplied by the functions of ecosystems and received by humanity. Ecosystem services may be grouped into four types (i) provisioning services (such as the provision of timber from forests); (ii) regulatory services (such as when forests act as a sink for carbon); (iii) supporting services (such as in the formation of soils); and (iv) cultural services (such as the enjoyment provided to visitors to a national park). Generally, provisioning services are related to the material benefits of environmental assets, whereas the other types of ecosystem services are related to the non-material benefits of environmental assets.

This section of the report will present these aspects of SEEA 2012 which show significant differences with SEEA 2003. Otherwise, if it is no mentioned, the stated in SEEA 2003 remains valid.

3.3.1 Physical flow accounts

This account is very similar to that spelt out in SEEA 2003 and aligns with the production boundary already set in SEEA 2003.

However, because depletion aspects are given more importance in this version of SEEA, it gives room to account for flows solely within the environment. That would allow for estimating the flow of depletion of renewable resources such as timber resources. It would imply considering the capacity of the resource to regenerate over time, what makes the measurement of depletion challenging.

3.3.2 Monetary flow accounts (activities aimed to preserve the environment)

SEEA 2012 records both the transactions concerning physical flows of natural resources and other natural inputs but also undertake these activities aimed to preserve and protect the environment. These activities follow the same classification as in SEEA 2003:

i. Environmental protection activities (protection of biodiversity and landscape is included here)
ii. Natural resource management activities (management of timber resources are addressed in this class)
iii. Natural resource use activities (use of natural timber resources are recorded under this class)
iv. Minimization of the impact of natural hazards

In addition to the EPEA approach developed in SEEA 2003 to deal with environmental activities, SEEA 2012 provides with the EGSS approach that focuses on the supply of environmental goods and services[1].

3.3.3 Asset accounts

The chapter 5 of SEEA 2012 deals with asset accounting. Several challenges for accounting purposes are described initially: i) obtaining accurate measures of the physical stocks, ii) the measuring of depletion in physical terms and iii) valuation approaches.

SEEA 2012 highlights the idea of ecosystem services and the joint delivery of services by various components of the ecosystem working together. Thereby, there is an explicit consideration of the complexity that must be dealt with when undertaking the asset accounting. However, for the accounting purposes, rather than focusing on ecosystem services, the document assesses the individual living and non-living components that deliver these services.

Similarly to SEEA 2003, forests are considered a form of land cover, but also a category of land use and forests are a type of ecosystem. However, SEEA recalls that timber resources are not found solely in forests; in fact in many countries other types of land cover, such as other wooded land, contain timber resources. As a result of this distinction between forests and timber resources, and given the resource focus for environmental assets in the Central Framework, the classification of environmental assets in Table 5.2.1 follows SEEA 2003 approach and includes forests within the sub-categories of land and distinguishes the timber resources located on this land as a separate environmental asset.

SEEA 2012 highlights the idea of ecosystem services and the joint delivery of services by various components of the ecosystem working together. Thereby, there is an explicit consideration of the complexity that must be dealt with when undertaking the asset accounting. However, for the accounting purposes, rather than focusing on ecosystem services, the document assesses the individual living and non-living components that deliver these services.

Similarly to SEEA 2003, forests are considered a form of land cover, but also a category of land use and forests are a type of ecosystem. However, **SEEA recalls that timber resources are not found solely in forests; in fact in many countries other types of land cover, such as other wooded land, contain timber resources**. As a result of this distinction between forests and timber resources, and given the resource focus for environmental assets in the Central Framework, the classification of environmental assets in Table 5.2.1 follows SEEA 2003 approach and includes forests within the sub-categories of land and distinguishes the timber resources located on this land as a separate environmental asset.

[1] The relevant definitions of environmental goods and services for measurement purposes are separately described for Environmental Protection Expenditure Accounts (EPEA) and statistics on the Environmental Goods and Services Sectors (EGSS).

Box 3. Depletion in SEEA 2012

Depletion, in physical terms, is the decrease in the quantity of the stock of a natural resource over an accounting period that is due to the extraction of the natural resource by economic units occurring at a rate that will not permit the same quantity of resource to be extracted in all future periods. The focus in measuring depletion is on the availability of individual environmental assets in the future and changes in the availability due to extraction and harvest by economic units.

The general definition of depletion requires refinement in the case of renewable natural resources such as timber resources. The ability for them to regenerate naturally means that under certain management and extraction situations, the quantity of resources extracted may be matched by a quantity of resources that are regenerated and there is no overall physical depletion of the environmental asset in this situation.

In SEEA the depletion of natural timber resources is related to the sustainable yield of timber resources from the forest land, other wooded land and other land on which natural timber resources are found. Depletion of natural timber resources, in physical terms, is equal to extractions less sustainable yield. The sustainable yield of timber resources is the quantity of timber that can be harvested at the same rate into the future while ensuring that the productive potential is maintained. The sustainable yield will be a function of the structure of the growing stock and needs to take into account both the expected natural growth and the natural losses of trees. Its estimation is difficult as the natural processes of growth and death, the relationship to other species and the impact of extraction are usually not fully understood in scientific terms.

Finally, a reduction in the quantity of an environmental asset due to unexpected events such as losses due to extreme weather should be recorded as catastrophic losses and not as depletion. Rather, depletion must be seen as a consequence of the extraction of natural resources by economic units.

Overall, the scope of depletion measurement in SEEA is very much on the economic flow of the resources what has evident limitations in assessing the overall sustainability economic processes in guaranteeing the forest resources. The absence of indicators within the scope of depletion that allow assessing issues such as biodiversity levels make the concept very limited and hence not recommended to be linked directly to measures of sustainability.

3.3.3.1 Physical asset accounts

In physical terms, the scope of environmental assets measured in the Central Framework may be greater than the scope of environmental assets measured in monetary terms following the SNA definition of economic assets as this requires including in physical terms only these environmental assets that deliver benefits to an economic owner. Whereas for SEEA, remote land and timber resources should be included within the scope of the environmental assets of a country, even if they are not expected to deliver benefits to an economic owner.

3.3.3.1.1 Timber Resources

The timber resources are recorded even if they are not available for wood supply. In this case, since these timber resources do not have an economic value, they are not recorded in the asset accounts for timber resources in monetary terms. Consequently, the volume of these timber resources in physical terms should be clearly identified such that appropriate alignment can occur between asset accounts in physical and monetary terms.

Within the relevant areas, timber resources are defined, according to FAO by: the volume of trees, living or dead, and **include all trees regardless of diameter**, tops of stems, large branches and dead trees lying on the ground that can still be used for timber or fuel. The volume should be measured as the stem volume over bark at a minimum breast height from the ground level or stump height up to a top. The thresholds for minimum breast height, tops of stem and branches may vary across countries.

On timber definition a range of measurement issues has been clarified compared to SEEA 2003. **This version of SEEA recognizes that the treatment of timber resources as either cultivated or natural depends on the management practices applied to the areas in which timber resources are found**. **The key consideration is that the processes involved in cultivation must constitute a process of economic production**.

This account records the volume of timber resources at the beginning and end of an accounting period and the change in this stock over the accounting period.

A physical asset account for timber could be seen in figure 3. is provided as an example in Table 5.8.2 of SEEA 2012:

Figure 3. A physical asset account for timber resources in SEEA 2012

Table 5.8.2Physical asset account for timber resources (cubic metres over bark)

	Type of timber resource			
	Cultivated		Natural	Total
	Planted	Other naturally regenerated	Primary	
Opening stock of timber resources				
Additions to stock				
Natural growth				
Reclassifications				
Total additions to stock				
Reductions in stock				
Removals				
Natural losses				
Catastrophic losses				
Reclassification				
Total reductions in stock				
Closing stock of timber resources				
Supplementary information				
Fellings				
Felling residues				

Source: SEEA 2012

3.3.3.1.2 Forest and other wooded land

The objective of land accounts in physical terms is to describe the area of land and changes in the area of land over an accounting period.

This version of SEEA because of the above mentioned difficulties in aligning timber resources with forest land**, do not further divide forest land in classes of cultivated-non cultivated,** as it has more to do with the timber resources**. Neither does apply a classification on available/not available for timber supply, but sticks to the basic FAO Forest Resource Assessment 2010 classification.**

Most often the compilation of physical asset accounts for forest and other wooded land are undertaken in conjunction with the compilation of asset accounts for timber resources. However, in principle, accounts for forest and other wooded land are a type of land account.

A key distinction between the physical asset account for forest and other wooded land and the asset account for timber resources is that **the scope of timber resources is not limited to timber from forest and other wooded land.** Another key distinction is that **the asset account for timber resources is focused on the volume of timber resources rather than the area of land covered by forests and other wooded land**.

Thus, the focus of the forest and other wooded land account is on changes in the area of land, for example, due to deforestation and afforestation, rather than on the quantity and value of timber removed from areas of forest and other wooded land.

Notwithstanding these distinctions there are strong connections between asset accounts for timber resources and asset accounts for forest and other wooded land. This is because the majority of timber resources are found in areas of forest and other wooded land.

A physical asset account for forest land is presented in Figure 4 as it is reflected in SEEA 2012:

Figure 4. Physical asset account for forest land according to SEEA 2012.

Table 5.6.6 Physical asset account for forest and other wooded land (hectares)

	Type of forest and other wooded land				
	Primary forest	Other naturally regenerated forest	Planted forest	Other wooded land	Total
Opening stock of forest and other wooded land					
Additions to stock					
Afforestation					
Natural expansion					
Total additions to stock					
Reductions in stock					
Deforestation					
Natural regression					
Total reductions in stock					
Closing stock of forest and other wooded land					

Source: SEEA 2012

3.3.3.2 Monetary accounts

In physical terms the conceptual scope of SEEA is broad extending and surpasses that of the SNA. This is because the requirement in physical terms that environmental assets must deliver benefits to an economic owner. For example, remote land and timber resources should be included within the scope of the environmental assets of a country even if they are not currently expected to deliver benefits to an economic owner. However, in monetary terms the conceptual scope is limited to those individual components that have an economic value based on the market valuation principles of SNA.

3.3.3.2.1 Timber

As in SEEA 2003, the net present value method and its simplifications, stumpage value method and consumption value method, are recommended to value the stocks of timber resources. The cautionary principle is also risen here and it is recommended that the volume of timber resources that cannot be harvested be separately identified and should not form a part of the overall calculations of the value of timber resources.

3.3.3.2.2 Forest land

The Monetary asset account for land differentiates by type of land use and suggests that may also be of interest to estimate the total value of land by institutional sector of ownership. In this case, transactions and reclassifications between sectors are likely to be important accounting entries. When accounting for the value of forest land, separating the value of the location and the value of the physical properties on the land may be difficult. The separation of land under forests should be based on the value of the stock of timber resources.

Box 4. Forest land classification in SEEA 2012

The scope of the forest and other wooded land account in SEEA 2012 is defined consistently with the definitions in FAO Forest Resource Assessment 2010.

Forest land is defined as: **land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ**. Forest land is classified according to different types of forest. The primary distinction is between naturally regenerated forest and planted forest.

Naturally regenerated forest is **forest predominantly composed of trees established through natural regeneration. In this context, predominantly means that the trees established through natural regeneration are expected to constitute more than 50% of the growing stock at maturity**.

Two broad types of naturally regenerated forest are distinguished:

i. **Primary forest** is naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed. Key characteristics of primary forests are that (a) they show natural forest dynamics, such as natural tree species composition, occurrence of dead wood, natural age structure and natural regeneration processes; (b) the area is large enough to maintain its natural characteristics; and (c) there has been no known significant human intervention or the last significant human intervention was long enough ago to have allowed the natural species composition and processes to have become re-established.

ii. **Other naturally regenerated forest** is naturally regenerated forest with clearly visible indications of human activities. These include (a) selectively logged-over areas, areas regenerating following agricultural land use and areas recovering from human-induced fires, etc; (b) forests where it is not possible to distinguish whether they are planted or naturally regenerated; (c) forests with a mix of naturally regenerated trees and planted/seeded trees and where the naturally regenerated trees are expected to constitute more than 50% of the growing stock at stand maturity; (d) coppice from trees established through natural regeneration; and (e) naturally regenerated trees of introduced species.

Planted forests are predominantly composed of trees established through planting and/or deliberate seeding. Planted/seeded trees are expected to constitute more than 50% of the growing stock at maturity, including coppice from trees that were originally planted or seeded. Other wooded land is land not classified as forest land, spanning more than 0.5 hectares; with trees higher than 5 metres and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
Where possible accounts should be compiled using these distinctions between types of forest and other wooded land. In addition, countries may be interested to compile accounts based on the total area of different species of tree.

3.4 Discussion of SEEA 2003 vs. SEEA 2012 and general comments on both systems

This section compares how forests are considered in both versions of SEEA, and which are the main changes, mainly regarding the accounts on timber resources and forest land.

The general impression is that SEEA 2012, differently from SEEA 2003, stays to a longer extent in the realms of the theory and provides less practical indications on how to proceed with the accounts. Furthermore, some ideas that were presented in SEEA 2003 (e.g., including forest management account) were omitted from the SEEA 2012.

On the other hand, some topics (e.g., ecosystem accounts or depletion of natural resources) that were very briefly mentioned in SEEA 2003, are provided much more attention in SEEA 2012. However, also in these cases, the presentation is rather limited to theoretical aspects.

3.4.1.1 Timber resources

The boundary between cultivated and non-cultivated timber resources in SEEA 2003 was based on the forest classes as defined by FAO. Hence, timber in primary forest was classified as natural or non-cultivated resources, while timber resources from other naturally regenerated areas and plantations were classified as cultivated. However, the rules by which different areas of forest land are differentiated may not align neatly with the production boundary of the SEEA or SNA. As an example, SEEA mentions some countries where large areas of planted forests that are not managed directly or where trees are left to grow until ready to harvest. These forests would be considered natural timber resources if following the SEEA production boundary; even though the term “planted forests” may immediately suggest a high level of economic activity. Furthermore, this approach cannot be used in the case of timber resources outside of forests, for example in orchards or in other wooded land (OWL).

SEEA 2012 recognizes that the treatment of timber resources as either cultivated or natural depends on the applied management practices. **The key consideration is that the processes involved in cultivation must constitute a process of economic production**. Thus, given the potential for forestry management practices to vary considerably across countries, SEEA recommends that countries determine the status of their timber resources as being either natural or cultivated, based on application of the production boundary considerations.

This change to a more flexible system allows accounting for timber coming from areas different from forests. Furthermore, it also gives countries the possibility to define a forest as cultivated/- non- cultivated, which better accounts for diverse management situation and reduces misinterpretations.

3.4.1.2 Forest Land

SEEA 2012 removes the classification of forest land in cultivated/non-cultivated and also the division into available/not available for wood supply, which were included in the SEEA

2003. This change is aimed to clearly distinguish the timber account from that regarding land accounting. To clarify these aspects, SEEA 2012 includes some paragraphs to better explain the distinctions between these two accounts.

The reason for removing these categories is to make a clear distinction between forest land and timber resources, emphasizing that forest land is not only a source of timber (and hence shouldn't be classified only according to its availability for supplying timber). This way, the forest land accounts will keep track of changes such as deforestation/afforestation processes, whereas timber accounts would focus on the value of timber resources removed from areas of forest and OWL (but also allowing to account for timber resources outside these areas).

Hence, forest land in SEEA 2012 is classified according to different types of forest. The primary distinction is between naturally regenerated and planted forest. Two broad types of naturally regenerated forest are distinguished: Primary forest and Other naturally regenerated forest. Where possible, accounts should be compiled using this classification of forest and OWL types. In addition, countries could introduce accounts for different tree species.

Box 5. Timber resources in SEEA 2003 and in SEEA 2012

The changes between the two versions of SEEA regarding timber resources, are mainly related to the implementation of a more flexible definition not so strictly related to the FAO definitions.

In SEEA 2003, following strictly FAO classifications may turn out to be problematic in some situations:

1. There are large areas of planted forests that are not managed directly or frequently and the trees are left to grow until ready to harvest. These trees would be considered natural timber resources following the SEEA production boundary even though the term "planted forests" may immediately suggest a high level of economic activity.
2. This approach cannot be used in the case of timber resources found outside of forests for example in orchards or in other wooded land.

Differently, SEEA 2012 allows for:

1. Recording timber growing outside forests.
2. Each country can determine the status of their timber resources as being either natural or cultivated, based on application of the production boundary considerations. Cultivated resources are likely to include activities such as (a) control of regeneration, for example, seeding, planting of saplings, thinning of young stands; and (b) regular and frequent supervision of trees to remove weeds or parasites, or to attend to disease. The level of these types of activity should be significant relative to the value of the timber resources and should be directly connected with the growth of the timber resources in question.

Box 6. Comparison of forest land classification across SEEA 2003 and SEEA 2012

In contrast with the previous version of SEEA where forest land was classified according to its availability for wood supply, SEEA 2012 indirectly acknowledges that forest land should be regarded more broadly, and not only in terms of its availability for wood supply. Furthermore, this latest version of SEEA follows the indications of FRA 2010 where special attention is devoted to timber resources outside the forest. This recognition of timber in other areas provides with additional arguments for a separated accounting (although related to a greater extent) for timber and wooded land.

<table>
<tr><td colspan="6">Forest Land</td></tr>
<tr><td colspan="4">SEEA 2003</td><td colspan="2">SEEA 2012</td></tr>
<tr><td colspan="3">Forest Available for Wood Supply (FAWS)</td><td rowspan="2">Forest Not Available for Wood Supply (FNAWS)</td><td colspan="2">Naturally Regenerated</td><td rowspan="2">Planted forests</td></tr>
<tr><td>Natural</td><td>Semi natural</td><td>Planted</td><td>Primary</td><td>Other Naturally regenerated</td></tr>
</table>

Finally, identical imprecision remains for other wooded land across the two versions of SEEA.

4 Implemented accounting frameworks

4.1 Introduction

Apart from the SEEA framework, a number of accounting reports dealing with forest assessment have been revised to get additional information on accounting frameworks and establish a proper comparison across them so as to evaluate the completeness of SEEA not only in absolute but also in relative terms. This chapter presents very briefly a couple of accounting systems implemented in the EU. More information could be found in the Annexes section.

Similarly to the System of National Accounts (SNA) as proposed for general application by the United Nations, the European System of Integrated Economic Accounts (ESA 95) (Commission of the European Communities, 1996) is the compulsory framework for national accounting in the European Union. It is based on, and closely related to the System of National Accounts (SNA). In contrast with ESA, there is no legal basis for compulsory implementation of the following three systems on environmental accounting for forestry. Thereby, their elaboration is voluntary and hence is only partially provided by a number of countries.

At European level, Eurostat produces data on the member countries using two questionnaires:

- The Joint Forest Sector Questionnaire (JFSQ) on production and trade in wood and wood products. The JFSQ is part of a worldwide exercise in which Eurostat is responsible for the EU and EFTA countries. It includes classical supply balances for wood products.
- The Integrated Environmental and Economic Accounting for Forests (IEEAF); countries are currently providing data on economic accounts for forestry and logging. IEEAF is part of a Eurostat environmental satellite accounts initiative that started in the late 1990s.

In addition, data on wood resources is produced by FAO in the frame of the five-yearly Forest Resources Assessment, FRA, already mentioned. Not only Europe but all countries in the world are asked to report and forecast numbers on topics such as forest area, wood resources and removals. More information on FRA is provided in the next chapter.

Similar five-yearly data is collected by the Ministerial Conference for the Protection of Forests in Europe (MCPFE) that is also provided in the next chapter.

In recognition of the special character of forests and forestry production, two satellite accounts are devoted to forestry: the Economic Accounts for Forestry (EAF) and the European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF). This chapter present these two implemented systems

4.2 EAF

The Economic Accounts for Forestry (EAF) (Statistical Office of the European Communities, 2000) is a satellite account providing additional information and concepts adapted to the particular nature of forest industry. Its main purpose is to analyse the production process and the generated primary income.

However, as the EAF manual argues the implementation this methodology is relatively complex and requires a large amount of data (especially for calculating the output). Thus, although recommended such an approach as the reference principle to be applied when developing the EAF, it is agreed that in 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.

The most important difference between ESA and EAF concerns the measurement of outputs, which implies that the figures for forestry differ between the two concepts. For this purpose bridge-tables were introduced to document these differences.

4.3 IEEAF

The Integrated Environmental and Economic Accounting for Forests (IEEAF) (Statistical Office of the European Communities, 2002) is one of the outputs of Eurostat's Environmental Accounting work that also contributes to the SEEA 2012.
Since 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, the sub-objectives of IEEAF are 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 nonmarket environmental and protective functions of forests, biodiversity, the health status of forests, etc.

Thereby, the proposed framework for 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)
- physical and monetary supply and use tables of wood and wood products.

In the IEEAF no attempt is made to integrate the value of the services and functions the forests provide, or to value their degradation. Nevertheless, the ongoing work for refining the IEEAF is focused 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.

IEEAF follows the definitions provided by the FRA-2000 and makes a revision of the concepts provided regarding forest land, timber and other forest goods and services and functions. Some remarks regarding the considerations made in IEEAF could be of interest when improving forest accounting.

Some results from these data collections can be seen in the publication Environmental statistics and accounts in Europe (Statistical Office of the European Communities, 2010).

4.4 Economy-Wide Material Flow Accounts

The Economy-Wide Material Flow Accounts (EW-MFA) (Eurostat, 2011) is part of the EU regulation on Environmental and Economic Accounts (Regulation of the European Parliament and of the Council covering European Environmental Economic Accounts - European Parliament legislative resolution of 7 June 2011 on the proposal for a regulation of the European Parliament and of the Council on European environmental economic accounts (COM(2010)0132 - C7-0092/2010 - 2010/0073(COD)).

The major aim of EW-MFA is to illustrate the exchange between the environment and the economy. Domestic extraction (DE) represents the domestic extraction of raw materials in the country, Import and Export. It does not include upstream hidden flows related to Imports and Exports of raw materials and products. From 2013 reporting of data on EW-MFA to Eurostat will be obligatory for the EU member states. This data compilation among all on forest and products harvest from forest may also further enhance the possibilities of implementing the forestry accounts of SEEA 2012.

A common compilation guide for EW-MFA by the European Member Countries has been recently developed. The following is how extraction of forestry and forestry precuts is described in the guide; the EW-MFA is closely related to the Integrated System of Environmental and Economic Forestry Accounts (IEEAF). As far as the classification entries for wooded biomass are concerned, the items *timber*, *wood fuel* and other extraction is covered by the forestry statistics. However the remaining part other forest extraction refer to items such as *cork and other forestry products* is only reported in the classification for the IEEAF.

For the purpose of establishing the central EW-MFA indicators, like Domestic Material Consumption, only the harvested timber is regarded as domestic extraction and not the total growth. This is different from the conventions in the IEEAF and ESA 95. There the total natural growth (annual increment) of cultivated timber is always considered to be the economic output of cultivation of trees. In IEEAF the change in inventories if standing timber is regarded as stock change.

The approach of EW-MFA follows the perception that environmental pressures related to the extraction of timber are well represented by the harvest of timber, whereas adding to the stock of standing timber should be regarded as a rather positive effect from an environmental viewpoint. Therefore, for hybrid analysis, like in environmental economic input-output analysis it is necessary to demarcate the monetary and the corresponding flows in a uniform manner. Therefore, EW-MFA reports the change in inventories of standing timber additionally as a memorandum item.

Wood output is reported in cubic meters in forestry statistics. For EW-MFA, cubic metres have to be converted into weight measures using standard conversion factors according toTable 1.

Special care is taken concerning the issue of bark. Significant fraction of bark is subject to further economic use (e.g. energy production). The part of the bark that is used has to be regarded as domestic extraction for the purpose of EW-MFA. All biomass that remain in the forest and is not used (could be branches, root-stock etc) is not accounted as

domestic extraction in EW-MFA. For EW-MFA it is assumed that all harvested wood over bark which is statistically reported is used economically

Table 1
Conversion factor for EW-MFA of wood products, cubic meters into tones.

	Density [t DM/scm]	Density [t at 15% mc/scm]
Coniferous	0.44	0.52
Non-coniferous	0.58	0.68
EU25 average (80% coniferous)	0.47	0.55

**These factors refer to to DM per solid cubic meters (scm) green volume and are based on the IPPC greenhouse gas inventories as by (Perman et al., 2003)*

5 Indicators on Sustainable Forest Management

5.1 Introduction: Sustainable Forest Management, Criteria and Indicators

One of the challenges faced by forest accounts is incorporating mechanisms to assess the quality of forest resources so as to record to what extent these are subject to sustainable/unsustainable management practices. This chapter provides with an overview on the criteria and indicators employed in the assessment of sustainable forest management both at global level, by the FAO FRA report and at European by the SoEF. Finally the work carried out in the development of a questionnaire on forest accounts delivered to experts on the topic is briefly mentioned.

The concept of sustainable forest management (SFM) arises from the notion of sustainable development (Wang, 2004). In contrast with conventional forest management (CFM), this new paradigm shifts the focus of attention from traditionally timber-dominant view to other aspects of forest management.

While still lacking a globally agreed-upon definition, *SFM generally refers to the ways and processes of managing forest resources to meet society's varied needs, today and tomorrow, without compromising the ecological capacity and the renewal potential of the forest resource base* (Wang, 2004).

This new concept reflects the fact that a gradually higher consensus is emerging among forest managers and policy makers that managing forest resources is far broader (and hence, more complex) than dealing with resource extraction or commodity production. In this sense, there has been a growing recognition of the importance of sustaining a number of other significant values of the forest such as its biological diversity, contributions to hydrological cycles, cultural and amenity values. On the other hand, the focus earlier on wood production alone had meant that many other ecological, economic and social values, particularly when they were considered mutually exclusive to wood production, were lost or severely degraded.

Assessing and implementing SFM has been coupled with the development of Criteria and Indicators (C&I). These are perhaps the most important and innovative forest management tools developed in recent decades (Wijewardana, 2008). They are not only a mechanism for systematically implementing sustainable forest management (SFM) procedures, but can also be used to monitor and assess national trends in forest conditions and forest management at a range of scales.

Criteria and Indicators could be defined as (Wijewardana, 2008):

- *A criterion is a category of conditions or processes by which sustainable forest management may be assessed. It is characterized by a set of related indicators that can be monitored periodically to assess change.*

- *An indicator is a measure of an aspect of the criterion. It can be a quantitative or qualitative variable that can be measured or described, and when observed periodically, can demonstrate a trend.*

C&I are typically implemented at three different levels: (1) national, (2) sub-national and (3) forest management unit (FMU) level. Implementation at all levels is important to promote SFM. However, in this accounting framework these relevant mainly relate to the national level. Three international processes have made substantial progress in reporting on how they are managing forests to achieve SFM (Wijer…) and have taken several steps to promote C&I implementation in their member countries. These are:

i) the Ministerial Conference on the Protection of Forests in Europe (MCPFE)
ii) the Montreal Process Criteria and Indicators (MPCI) and
iii) the International Tropical Timber Organization (ITTO).

Finally, the FAO has based its Forest Resources Assessment 2010 on seven thematic areas common to the international and regional C&I processes.

SFM does also has a reflection on forest economics that are adapting some of the techniques and tools developed by environmental economics towards valuing forest good and services as a whole. The number of works applying these techniques to forest environment has grown rapidly in the last few decades. However, the challenge would be to scale up these estimations so as to arrive to regional or even nation-wide estimations of these values attached to forest ecosystems. This is in contrast with traditional forest economics that are mainly focused on the notion of sustained yield in timber production, which is the overarching paradigm in conventional forest economics. It states that the volume of wood harvested should not exceed the volume of growth gained over a given period of time. Furthermore, this vision of forest economics restricts to measure the value of a resource by its market price. Hence, a good which is not traded in the market may not be a resource itself from this narrow economic perspective (Kant, 2007).

This shift in forest economics should ideally have a reflection in the accounting frameworks. Hence, beyond the sustainable yield and the hectares of forest land, accounts should ideally track changes in these other values. For example, despite some of the Montreal criteria and indicators may have a correspondence with SEEA, it does not provide information for the legal and institutional aspects of forest health and provides only partial information about social aspects of forests (Lange, 2004). Hence, a more comprehensive set of forest-related accounts is necessary to inform such indicators.

This section of the report is devoted to:

i) Present the FAO FRA report that is the main source of information for SEEA forest accounts.

ii) Present the SoEF report and the set of C&I most suitable to our understanding to be incorporated in an accounting framework so as to inform the quality of the forest resource as a whole.

iii) Present very briefly the questionnaire submitted to the statistical offices of several countries. It contains shows several SoEF indicators with respect to their degree of suitability for being included in their accounting frameworks.

5.2 FAO Global Forests Resources Assessments (FRA)

This section describes the main aspects of FRA2010 that may be of relevance in understanding its scope and its reflection on the SEEA framework for forest accounts. Therefore, the definitions and information compiled in this section intend to be a critical resume from FRA 2010 (FAO, 2010). For further detailed information we encourage the reader to go through the original document.

The Global Forest Resources Assessment 2010 (FRA 2010) is the most comprehensive assessment of forests and forestry to date - not only in terms of the number of countries and people involved -but also in terms of scope. It examines the current status and recent trends for about 90 variables covering the extent, condition, uses and values of forests and other wooded land, with the aim of assessing all benefits from forest resources. Information has been collated from 233 countries and territories for four points in time: 1990, 2000, 2005 and 2010.

The results are presented according to the seven thematic elements of sustainable forest management:

1. Extent of forest resources
2. Forest biological diversity
3. Forest health and vitality
4. Productive functions of forest resources
5. Protective functions of forest resources
6. Socio-economic functions of forests resources
7. Legal, policy and institutional framework

Each of these elements (criteria) are assessed according to a number of variables (indicators). Therefore, countries had to report a total of 17 National Reporting Tables (see Table 2).

Table 2 National reporting Tables for FRA 2010 (FAO, 2010)

National Reporting Tables for FRA 2010
1. Extent of forest and other wooded land
2. Forest ownership and management rights
3. Forest designation and management
4. Forest characteristics
5. Forest establishment and reforestation
6. Growing stock
7. Biomass stock
8. Carbon stock
9. Forest fires
10. Other disturbances affecting forest health and vitality
11. Wood removals and value of wood removals
12. Non-wood forest products removals and value of removals
13. Employment in forestry
14. Policy and legal framework
15. Institutional framework
16. Education and research
17. Public revenue collection and expenditure
Additional terms

5.2.1 Extent of forest resources

The extent of forest resources is the first measure of sustainable forest management. It relates to the overall goal of maintaining adequate forest resources. Forest area is an easily understood baseline variable, which provides a first indication of the relative importance of forests in a country or region. Estimates of change in forest area over time provide an indication of the demand for land for forestry and other land uses. Therefore, the extent of forest resources has formed the backbone of all global forest resources assessments. The most commonly quoted statistics from the global forest resources assessments continue to be the global rate of deforestation and the net loss of forest area.

However, the significance of forest area as a single indicator of forest development has often been overemphasized. Many other variables must be considered in determining the relevant trends in the extent of forest resources. The net loss of forest area is not in itself sufficient to describe land use dynamics. On its own, the area of forest does not tell us what kinds of forests we have, how healthy they are, what benefits they might provide or how well they are managed.

Hence, the global forest resources assessments have evolved over time and now contain information on a wide variety of aspects related to forests and forestry. The challenge then being, to incorporate them within an accounting perspective.

For FRA 2010, information was sought on the current status and changes over time (1990, 2000, 2005 and 2010) of the following six variables related to the extent of forest resources:

- Area of ‘forest’ and ‘other wooded land’. Countries were also encouraged to provide information on ‘other land with tree cover’.
- Characteristics of forests according to three classes: primary forests, other naturally regenerated forests and planted forests. For the latter two, countries were also asked to provide data on the area of forest composed of introduced species.
- Area of selected forest types: mangroves, bamboo and rubber plantations.
- Standing volume of wood, i.e. the total growing stock in forests and other wooded land, and its composition.
- Forest biomass.
- Carbon stock contained in woody biomass, dead wood, litter and forest soils.

The first classification of forest resources is their division in forest land or other wooded land Furthermore, FRA 20*10 dedicates a special category to ”Trees outside the forest”, underlining their relevancy and also the lack of information about these forest resources.* This areas are included under the class ”Other land with tree cover” sub-category of ”Other Land”. *‘Trees outside forests’ refers to trees found on lands that are not categorized as ‘forest’ nor as ‘other wooded land’. They include trees (isolated, linear and groups or stands of tre*es and tree systems) found in rural landscapes (e.g. on farms, in fields, pastures and various forms of horticulture and agroforestry systems, in hedges, along roads and streams) and in urban settings (e.g. on private or public lands and along streets).

Countries frequently classify their forest area according to forest or vegetation type, age structure or diameter distribution classes. Because of the varying conditions and classification systems among countries and regions, it was not feasible to report on such classifications at the global level. In an attempt to describe this range, countries were asked to characterize their forests according to three classes for FRA 2010:

- Primary forests: *Naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed*.

- Other naturally regenerated forests: *Naturally regenerated forest where there are clearly visible indications of human activities*.

- Planted forests: *Forest predominantly composed of trees established through planting and/or deliberate seeding*.

However, countries were asked to report separately on the areas of mangroves, bamboo and rubber plantations for FRA 2010 as these species groups are well defined and frequently used in countries where they exist.

For FRA 2010 information was also collected on the proportion of broadleaved and coniferous tree species, and on the growing stock of commercial species. A complete time series for growing stock on other wooded land was reported by 111 countries (including those that reported zero). For the remaining countries and areas, FAO developed some estimation.

Forest biomass, expressed in terms of dry weight of living organisms, is an important measure for analysing ecosystem productivity and also for assessing energy potential and the role of forests in the carbon cycle. Although closely correlated to – and often estimated directly from – growing stock it constitutes an important characteristic of the forest ecosystem and has formed part of the global forest resources assessments since FRA 1990. The vast majority of countries have used the conversion factors provided by the IPCC to estimate biomass from growing stock.

5.2.2 Forest biological diversity

Assessing, monitoring and reporting on biological diversity are important activities aimed at guiding sustainable forest management. Monitoring of biological diversity – and the changes caused by forestry and other practices – is important in assessing the effectiveness of management and the cumulative changes brought about by forest use.

However, there are conceptual and practical difficulties in measuring it. Assessments of biological diversity can be made at a range of different scales that require different methodologies. These scales include ecosystems, landscapes, species, populations, individuals and genes. For policy and monitoring purposes, it is the change in biological diversity that is important, which implies identifying the relevant indicators and then monitoring them over time So far this has not been achieved for forest ecosystems on a wide scale (i.e. national or continental). Hence, the variables measured for FRA 2010 with relevance to forest biological diversity include:

- area of primary forests
- forest area designated primarily for conservation of biological diversity
- area of forests in protected areas
- tree species composition of forests

The area of primary forests was already reported in the previous section. However, here they make special emphasis on its role as an indicator of forest biodiversity.

The forest area designated primarily for conservation of biological diversity is not necessarily equivalent to the area of forest in protected areas because some forests in protected areas may be designated for reasons other than the conservation of biological diversity, such as the conservation of soil and water resources or cultural heritage.
Conversely, forest areas may be designated for the conservation of biodiversity without forming part of a protected area network or system.

As part of FRA 2010, countries were asked to provide information on the area of forest contained in protected areas systems.

Information on growing stock composition can be used as a proxy indicator of forest tree species richness and relative abundance. The countries were requested to list the ten most common species in terms of growing stock and document their contribution to total growing stock for 1990, 2000 and 2005. Information was also obtained on the area of planted forests primarily composed of introduced species.

5.2.3 Forest health and vitality

Forests are subject to a variety of disturbances that are themselves strongly influenced by climate. Disturbances such as fire, drought, landslides, species invasions, insect and disease outbreaks, and climatic events such as hurricanes, windstorms and ice storms influence the composition, structure and functions of forests (Dale et al., 2001).

Climate change is expected to affect forests' susceptibility to disturbances, as well as the frequency, intensity, duration and timing of such disturbances.
Data collected for FRA 2010 on forest health and vitality focused on the following, largely quantifiable categories, for which many countries record incidence and extent:

- area of forest significantly affected by insects;
- area of forest significantly affected by diseases;
- area burned (separated into areas of forest, other wooded land and other land);
- number of wildfires (separated into those affecting forests, other wooded lands and other land);
- proportion of wildfires and planned fires;
- area of forest significantly affected by other biotic factors (such as wildlife browsing, grazing and physical damage by animals);
- area of forest significantly affected by abiotic factors (such as air pollution, wind, snow, ice, floods, landslides, tropical storms, drought and tsunami);
- area of forest significantly affected by invasive species (woody species only).

5.2.4 Productive functions of forest resources

The productive function of forest resources is a traditional thematic element and one of the main objectives of forest resources assessments. Earlier assessments were focused on timber supply, but the concept of forest production has since widened to encompass all types of wood and non-wood forest products.

Many products are extracted from forests, ranging from wood for timber and fuelwood to food (berries, mushrooms, edible plants, bushmeat), fodder and other NWFPs. By quantity, industrial roundwood and woodfuel are the most important products; among NWFPs, food and fodder are the most significant.

As part of the FRA 2010 process, information was collected on the following variables related to the productive function of forest resources:

- area of forest designated for production;
- area of planted forests;
- areas of afforestation and reforestation;
- removals of wood products;
- removals of non-wood forest products (NWFPs).

Forest areas that have been designated for productive functions bear no legal, economic or technical restrictions on wood production and serve primarily for the production of various commodities, including roundwood (industrial roundwood and woodfuel) and NWFPs. They have been designated either by legal prescription or by decision of the landowner or manager. In these forests production is reported as the 'primary function', which is considered to be significantly more important than other functions.

Planted forests are established for different purposes and not all of them are designated for production of wood or NWFPs. However, no information was solicited on the area of planted forests designated for productive and protective purposes for FRA 2010.

Afforestation is the act of establishing forests through planting and/or deliberate seeding on land that is not classified as forest, while reforestation refers to the re-establishment of forest through planting and/or deliberate seeding on land classified as forest, for instance after a fire, storm or following clearfelling. No attempt was made to quantify the area of forest regenerated through natural or assisted natural regeneration in FRA 2010.

Afforestation implies an increase in forest area through the conversion of land not bearing forest to forested land, while reforestation does not have an impact on the size of the total area of forest. It should be kept in mind that afforestation and reforestation are not only aimed at establishing planted forests to fulfill productive purposes.

Wood removed from forests and other wooded land constitutes an important component of the productive function.

Information on removals of NWFPs demonstrates their importance, both as commodities for national and international markets, and for the livelihoods of many local and indigenous people who depend on them. This information shows that NWFPs often deserve a higher priority in the development of national poverty alleviation policies, rural

development projects and forest conservation strategies. Countries were asked to report the national output in terms of quantity (and value) by providing the botanical names of the key NWFP species However, 141 countries, representing 21 percent of the global forest area, did not report any data at all, even though it is known that NWFPs play a significant role (for example, in the Central African countries and in Papua New Guinea). Where national statistics do exist, data on removals are often limited to those NWFPs that are (inter-)nationally traded. However, many NWFPs are used and consumed non-commercially, so the figures reported are often a significant underestimate of the full range of NWFPs gathered in the country.

The major categories of NWFP removals about which countries provided the most information are (in descending order of importance):
1. Food
2. Exudates
3. Other plant products
4. Wild honey and beeswax
5. Ornamental plants
6. Raw materials for medicine and aromatic products
7. Wild meat
8. Raw materials for utensils, handicrafts and construction
9. Living animals
10. Hides, skins and trophies

5.2.5 Protective functions of forest resources

In the context of FRA 2010, countries were asked to report on only one variable: the area of forest with 'protection of soil and water as the primary designated function'. The wording 'protective' role or function is thus, in this report, intended to denote forest areas with soil and water conservation as the main function or management objective.

5.2.6 Socio-economic functions of forest resources

To assess the socio-economic functions of forests, the value of wood and NWFP removals is employed as an indicator of the economic benefits of forestry.

Concerning the value of wood and non-wood products removals, many countries responded for industrial roundwood, but far fewer provided information about the value of woodfuel removals. It should be noted that there are a number of problems with assessing the value of NWFP removals. One is that the assessment asked for the value of primary production (i.e. excluding the income from downstream processing outside the forest), but in many cases countries reported figures for the values of semi-processed products (which are often significantly higher to cover transport and labour costs). Another problem is many countries only reported the value of their five to ten most important NWFPs.

Regarding the social functions of forests, two indicators were designated as proxies to evaluate them: employment in forestry and the area of forests designated for social services (an indirect measure of social benefits) respectively.

The level of employment in forestry is an indicator of both the social and economic value of the sector to society. For FRA 2010, employment was defined as: "*Persons who during a specified reference period performed some work for wage or salary (paid employment) or profit or family gain (selfemployment) in cash or in kind*".

However, information was requested only on employment related to the primary production of forest goods and related services (i.e. excluding the processing of wood and NWFPs). Thus the figures cannot be compared with statistics on employment in the forestry sector as a whole. The area of forest designated for social services indicates the extent to which countries and forest managers have identified specific forests areas for recreation, tourism, education, research and for the conservation of cultural or spiritual sites.

Regarding the areas designated for social services, many countries recognize the importance of the social function of forests but have included it under the category of multiple use and/or unknown function when it was not possible to quantify the area. Even among the countries that did report areas designated for social services, there continued to be different interpretations of which areas should be included in this category and figures are, therefore, not always comparable among countries.

In addition, FRA compiles information about forest ownership and management rights (or forest tenure) as one indicator of the socio-economic functions of forests. It is commonly assumed that 'secure tenure' enables or provides incentives for people to invest time and resources in forest management. Access to data on forest tenure (including changes and trends) is therefore a fundamental prerequisite for any country in designing and adopting effective and secure tenure arrangements that can help to reduce deforestation and forest degradation.

In 2005, 80 percent of the global forest area was publicly owned, 18 percent was privately owned and 2 percent was classified as 'other' ownership, including unknown and disputed ownership.

Public ownership was predominant in all regions and subregions. Europe excluding the Russian Federation was the exception to this, where public ownership accounted for less than half (46 percent) of the forest area. Public ownership was also by far the most common form of ownership in many of the countries with high forest cover, such as Brazil, Democratic Republic of the Congo, Indonesia and the Russian Federation. Publicly owned forests may be managed by the state, communities, individuals or the private sector. At the global level, the state retains management responsibilities in about 80 percent of public forests, followed by private corporations and institutions (10 percent), and communities (7 percent).

At the global level, the area of forest under public ownership decreased by 141 million hectares, or about 0.3 percent annually between 1990 and 2005, while the area of forest under private ownership increased by 113 million hectares or almost 1.5 percent per year on average. It is not possible to say how much of the reduction in the area of publicly owned forests is due to changes in ownership itself or to a reduction of the total forest area but the latter seems more likely in many cases.

Finally, the fiscal measures that governments use to provide support to forest management and collect fees and charges from the sector are outlined. This information is important in understanding the changing roles of government and citizens in the sector. In FRA 2010 forest revenue was defined to include all taxes, fees, charges and royalties collected specifically from the domestic production and trade of forest products, but it excluded general taxes collected from all sectors of the economy (e.g. corporation tax and sales tax). Public expenditure included expenditure on forestry activities by all relevant public institutions and was divided into operational expenditure and transfer payments, with each of these types of expenditure divided by source of funding (domestic or external). Countries were also asked to exclude the income and expenditure of publicly-owned businesses in their reports (FAO, 2007).

5.2.7 Legal, policy and institutional framework

The national legal, policy and institutional framework related to forests constitutes the fundamental basis for sustainable forest management. More specifically, for FRA 2010 countries were asked to provide information on the following variables:

- the existence of a national and/or subnational forest law, date of enactment and date of latest amendment;
- the existence of a national and/or subnational forest policy and date of endorsement;
- the existence of a national forest programme, date of commencement and its current status;
- the institutional structure related to forests and forestry;
- human resources in public forestry institutions;
- the number of graduates in forest-related education;
- the number of professional staff in publicly funded forest research centres.

In addition, information was compiled on international conventions and agreements related to forests and the extent to which countries have ratified or adopted these.

5.2.8 Progress towards sustainable forest management

The analysis presented in this chapter focuses first on the status of forest management and then on progress towards sustainable forest management more broadly, by illustrating aggregated findings from FRA 2010 covering all seven thematic elements of sustainable forest management.

Firstly, to assess the status of forest management, countries were asked to report on four additional variables to illustrate the status of forest management:

- The area of forest in protected areas
- The area of permanent forest estate
- The area of forest with management plan
- The area of forest under sustainable forest management

The first of them was already discussed in the section devoted to biological diversity.
The area of permanent forest estate indicates the area of forest designated to be retained as forest. As such, trends in this variable over time are a better indicator of progress towards sustainable forest management than trends in the total forest area in

countries where certain forest areas have been set aside for future conversion to other uses

The area of forest with a management plan provides another indication of progress towards sustainable forest management, although it must be noted that areas without a plan – including inaccessible areas – may also be conserved and sustainably managed, while the mere existence of a plan does not provide assurance that the plan is sound, is being implemented, or has the intended effect. FRA 2010 is the first time countries have been asked to provide an estimate of the area of forest considered to be under sustainable forest management in the FRA process.

Because there is no agreed definition or assessment methodology, this was considered a pilot assessment and countries were also asked to provide the definition, criteria and method used to assess the area under sustainable forest management.

Secondly, to obtain a broad picture of progress towards sustainable forest management, a sub-set of indicators were selected for each of the seven thematic elements of sustainable forest management; it yielded a total of 18 variables. An arbitrary threshold of +/-0.5 percent per year was selected for all variables in order to highlight large changes and to distinguish the cases where the difference between two estimates indicates an actual change from those cases where the difference may not be statistically significant.

Simple, three-coloured 'traffic light' matrices were prepared to visualize change rates in the variables listed under each thematic area for a particular region. These indicate trends in the selected variables over time and the progress they reflect towards sustainable forest management. Trends can thus be positive, negative or with no major change (less than 0.5 percent) for each of the 18 variables. The results of this analysis are presented at global, regional and subregional levels.

5.2.9 Relation between SEEA and FRA

SEEA namely rely on FRA definitions and classifications to build its forest accounts. Hence, the revision of the main chapters of FRA is relevant for gaining understanding on the SEEA framework.

In order to have a more rounded and complete view of ecological sustainability, SEEA itself recommends the use of indicators reflecting ecological conditions to complement the SEEA accounts. However, we consider the challenge for SEEA would be incorporating some of other aspects included in FRA into an accounting perspective.

FRA stresses the fact that on its own the area of forests does not inform about the quality of these forests, how healthy they are what benefits they might provide or how well they are managed. That is why the FRA has evolved and reflects a variety of aspects related to forests and forestry. However, this is in contrast with SEEA framework were forest accounts are mainly represented by timber and forest land area.

However, some efforts have been done in this direction in SEEA 2012 and a taste of this new perspective on SFM could be noticed in SEA. This way, SEEA following FRA 2010 and acknowledges the relevancy of trees outside the forests, allowing for the inclusion of

timber resources from these areas. Because timber could be found also outside the forest and also because forest land provides with a vast array of good s and services, SEEA sets a clear distinction between forest land and timber resources that hopefully in the future will allow for the recognition and inclusion of forest functions in the accounting perspective.

This said, the assessment of SFM made by the FRA report, faces the lack of data on many relevant aspects of the forests such as social values, non timber forest products or global/regional assessment of SFM. This lack of data is reflected in SEEA where these aspects are hardly considered, partly because of the difficulties in incorporating them, but also partly because lacking data makes these indicators not as prominent as they could be. In this sense, the coming efforts pursued by FRA on refining the assessment of SFM or for example in evaluating communities self consumption and dependence on the forest resources will hopefully have a reflection on the accounting frameworks.

To sum up, a further alignment of FRA indicators with these from forest accounting frameworks would be desirable so as to incorporate a wider analysis of the sustainability of forest management within the accounting frameworks. The environmental accounts should ideally learn from what is already reflected in such reports and the assessments of SFM should be produced with a deeper focus on producing indicators suitable to be plugged into an accounting environment..

5.3 State of Europe's Forest (SoEF) indicators

The State of Europe's Forests 2011 (UNECE & FAO, 2011) report covers the 46 signatory countries and the European Union. Countries are grouped into six country groups. The data presented has been provided by individual countries through joint FOREST EUROPE/UNECE/FAO enquiries on quantitative and qualitative indicators and by international data providers.

The State of Europe's Forests 2011 report consists of three substantive parts. The first two parts are structured according to the pan-European criteria and indicators for sustainable forest management, which consist of quantitative and qualitative indicators covering all central aspects of sustainable forest management.

Part I reflects changes in quantitative indicators over time for the six criteria, i.e. forest resources and their contribution to global carbon cycles; forest ecosystem health and vitality; productive functions of forests; biological diversity in forest ecosystems; protective functions in forest management; and other socio-economic functions and conditions.

Part II focuses on qualitative indicators and provides an overview of the policies, institutions and policy instruments for sustainable forest management in the FOREST EUROPE signatory countries and the European Union and presents changes by policy area.

While the first two parts do not specifically address the overall extent to which forest management in Europe is sustainable, Part III of the report is an attempt to address and evaluate the sustainability of forest management. It offers an experimental method to assess sustainability of forest management in Europe, providing preliminary results by

country groups. The intention is that this approach will stimulate widespread discussion on the nature of sustainable forest management. Furthermore, part III presents four future major challenges and opportunities for the forest sector, all highly complex: Contributions by forests and forest management to climate change mitigation, wood for energy, protection of biodiversity and in amplifying a low-carbon, green economy.

In summary, the fulfilment of the criteria can be evaluated through a set of 35 quantitative and 17 qualitative indicators. Because the report attempts to cover trends from the last two decades, most of the indicators provide data for 1990, 2000, 2005 and 2010. However, for some of them, the info provided is narrowed to one or two reference points due to the limited availability of data.

Our aim in revising SoEF indicators was to evaluate the suitability of some of the indicators for their eventual inclusion in an environmental accounting framework for forests in broad sense and in particular in SEEA. Because these indicators were assessed on a pan-European scale and for a national level, could be suitable for their inclusion on an accounting framework such as SEEA that has a nation-wide scope.

For this purpose, quantitative indicators that are addressed in part I were considered suitable to be revised for these objectives. On the other hand, qualitative indicators, which enable monitoring of the status and changes in policies, institutions and instruments, are difficult to accommodate in an accounting framework and do not seem to provide with any contribution that enable the improvement of the topics identified in SEEA 2012.

FRA and SoEF are reports launched by institutions that try to assess the state of the forests and the degree of sustainability achieved in their management from a transnational scope. Therefore, both reports share some similarities in the indicators analysed. However, because FRA has a global view whereas SoEF is focused on a European scale some disparities are also observed between them. SoEF shares a rather similar with FRA and addresses the main seven criteria of SFM considered by FRA. However, some of them are adapted to the reality of the European forests. Furthermore, because the scale is not so broad, it allows SoEF to focus on some specific issues that FRA would be able to address due to its specificity.

The three types of forest characteristics spelt out by FRA (primary/ other naturally regenerated/ planted forests) are considered differently in SoEF that focuses both on regeneration types (natural/aforestation-reforestation/coppice) and on the naturalness of the forests (undisturbed/semi natural/plantations) when drawing the whole picture of the forest stands in Europe. Deadwood arises as an indicator of biodiversity while lacks in FRA as probably would be impossible to collect data for a global scale. SoEF considers a wider array of services that forests provide when compared to FRA: protective and social services, but also amenity services, together with the scope on cultural/spiritual values are reflected. Protective forests are considered not only with a focus on soil, erosion and water, but also with respect to protection of infrastructures and against natural hazards. Finally, we would like o mention that SoEF evaluates the pattern of forest landscapes in Europe, assessing the fragmentation/connectivity of forest patches.

5.4 The questionnaire on forestry accounts

In parallel with the revision of SEEA 2012, a questionnaire was designed and sent to the statistical offices and forest agencies in different countries. The aim of this questionnaire was to collect (i) information on the countries' experience with the implementation of forestry accounts, and (ii) information about the proposed improvements of the SEEA standards, that is including some of the forest Europe indicators in their accounting frameworks and hence in their collecting data process.

The questionnaire consists of two main parts. The first collects information on the forest accounts conducted in each of the respondents' country and asks about the purpose, source of data and methodologies applied. The second part lists some of the SoEF quantitative indicators that were considered to be suitable for improving the forest accounts. Respondents were asked to evaluate their suitability and feasibility of application in their respective national accounting frameworks.

Precise information on the questionnaire structure and results will be provided in CREEA deliverable 5.2

6 Discussion and conclusions

This report corresponds to the first deliverable of the Work Package on forest accounts in CREEA. The aim of the report has been to compare two versions of SEEA (2003 and 2012) regarding the way forest topics are addressed and evaluate their suitability. Furthermore, three EU forest related accounting systems have been analyzed, as practical implementations of accounting frameworks dealing with forests and forestry. Related to these broad implementations, there have been some country experiences for data gathering and national pilot studies in Europe. These have been conducted mainly in countries with the largest forest sector such as Finland, Latvia, Sweden, Norway and Austria. It should be noticed, that regular reporting on forest accounts is hindered, because the forest related data collection is still voluntary (e.g., IEEAF reporting for EUROSTAT).

Furthermore, a couple of reports assessing sustainable forest management (SFM) on a global perspective have been analyzed to explore linkages between the criteria and indicators for SFM and their eventual inclusion in forest accounts. The information found was used to design a questionnaire that was sent to a reference group of statisticians and foresters dealing with forest accounts in different countries.

The standard national accounts (SNA) limits the information about forests to forest resources that are exchanged on the market or are object of market transactions. This can result in misleading economic signals. For example, the over exploitation of forest resources would be recorded as increased GDP contribution of the forestry sector, but the SNA would not record the corresponding depletion of forest stocks . Furthermore, there is a clear danger of substantial underestimation of the value of forest resources. Namely, numerous evidences exist that the non-productive functions of forests may have even higher values than the productive functions.

In contrast, environmental forest accounts would ideally allow accounting forest resources from a wider perspective. For example, it would record resources that do not produce market benefits, but nevertheless, provide important goods and services to the society and to other sectors of the economy. This would simultaneously allow to monitor their eventual depletion or degradation.

In addition, forest goods and services, other than timber, would be recorded, underlining the role forests play for the economy and the society as a whole. Enriching accounts from this perspective would increase the relevancy of the forest sector, which is at the present considered as a relatively marginal sector in the SNA, and thus receives rather low political priority.

The comparison of SEEA 2003 and 2012 shows that the later version relies to a greater extent on theoretical explanations of environmental economic accounting. Furthermore, it is less oriented towards its implementation. Besides, some specific aspects mentioned in SEEA 2003, such as the suitability of establishing a specific account on forest management, were omitted in the latest version.

Despite these shortcomings, SEEA 2012 introduces some improvements, such as an explicit recognition of depletion and ecosystem accounting as relevant aspects for

environmental accounts. However, related to depletion, the classical concept of sustainable yield is used, which is not valid as the sole indicator of sustainability of forest resource management. While the ecosystem accounts will be addressed only in the experimental section of the new SEEA.

Regarding forest accounts, the general impression is that these accounts are still mainly based on the record of timber and forest land area, while other aspects of forests, although mentioned, are rarely considered in the accounting tables.

SEEA 2012 is built on the classifications established in the FAO FRA2010 report. However, SEEA 2012 introduces some changes and slightly differs from SEEA 2003, which was using the FAO TBFRA 2000 definitions. For example, timber resources in SEEA 2012 are no longer so strictly attached to forest land. Rather, it accounts also resources outside of forest land. Still, these resources are divided to natural and cultivated, but this distinction in SEEA 2012 is country specific and better adapted to country's forest management particularities. Related to this shift in the timber classes, the forest land is no longer classified according to its availability for timber supply. These changes could be interpreted as a step forward to a more flexible classification where forests are considered in a broader sense and not only as sources of timber.

During the revision of SEEA 2012 some relevant issues were identified as lacking or to be improved. Developing methods for their inclusion in the accounting frameworks would surely improve the accuracy of the assessment on the contribution of the forest sector to the national economy. These are the following:

- Assessment of the recreational services provided by forests.
- Estimation of self consumption share for certain forest products. It would be relevant for disentangling the distribution of benefits from forests. In this sense, we are aware that the collection of information on the timber and non-timber forest products consumed by household would be rather challenging.
- Depletion of the resources in a broader sense, beyond the evaluation of sustainable yield. The way it is currently addressed is rather limited as it solely focuses on the concept of sustainable yield, which does not provide information about the quality of forest resources.
- Monetization of the resources. Physical accounts typically tend to be broader than monetary accounts, because of the difficulties attached to the estimation of the monetary value.

However, the underpinning objective of SEEA may not be to tackle all these issues, but rather providing general guidance and rising concern on the issues that may be relevant or challenging for future advances in accounting.

Nevertheless, some of the qualitative indicators proposed by SoEF may be appropriate for these purposes as they inform SFM from a nationwide perspective. To sum up, the overall goal would be informing depletion of forest resources more consistently, gauging the quality (and not only the quantity) of the forest resources by broadening the limited view of the sustainable yield concept.

Ideally the overall objective of forest accounts would be to achieve a better alignment between SFM indicators and environmental accounting frameworks, which would enable better monitor and secure the sustainability of forest resources.

7 References

Commission of the European Communities (1996): European System of Accounts – ESA 1995, Office for Official Publications of the European Communities.

Daly, H.E., Farley, J., 2004. Ecological Economics: Principles and Applications. Island Press, Washington DC.

Eurostat, 2011. Economy Wide Material Flow Accounts (EW-MFA): Compilation Guidelines for Eurostat's 2011 EW-MFA questionnaire.

FAO, 2010. Global Forest Resources Assessment 2010. FAO forest paper nº 163. Food and Agriculture Organization of the United Nations. Rome, Italy.

FAO, 2006. Global forest resources assessment 2005—Progress towards sustainable forest management. FAO Forestry paper 147.

Goio, I., Gios, G., Pollini, C., 2008. The development of forest accounting in the province of Trento (Italy). Journal of Forest Economics 14: 177-196.

Haripriya, G.S., 2001. Integrated environmental and economic accounting: an application to the forest resources in India. Environmental Resource Economics 19 (1), 73–95.

Kant, S., 2007. Economic perspectives and analyses of multiple forest values and sustainable forest management. Forest Policy and Economics, 9: 733-740.

Kriström, B.; Skånberg, K., 2001. Monetary forestry accounting including environmental goods and services. Investigación Agraria: Sistemas y Recursos Forestales 1: 7-26. http://www.inia.es/gcontrec/pub/krist_1049452072799.pdf

Lange, G-M., 2003. Policy Applications of Environmental Accounting. The World Bank Environment Department. Washigton, D.C. USA. 74 Pages

Lange, G-M., 2004. Manual for environmental and economic accounts for forestry: a tool for cross-sectoral policy analysis. FAO Forestry Department. Rome, Italy. 116 pages.

Merlo, M. and Croitoru, L. (Eds), 2005. Valuing Mediterranean Forests. Towards a Total Economic Value. CABI Publishing. CAbi iNternational wallingfors, Oxfordshire. UK. 406 pp.

Sekot, W., 2007. European forest accounting: general concepts and Austrian experiences. European Journal of Forest research 126, 4: 481-494.

Smith, R., 2007. Development of the SEEA 2003 and its implementation. Ecological Economics, 61: 592-599.

Statistical Office of the European Communities (ed) (2000) Manual on economic accounts for agriculture and forestry EEA/EAF (rev.1.1), Luxembourg p 179. http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-27-00-782

Statistical Office of the European Communities (ed) (2002) The European framework for integrated environmental and economic accounting for forests – IEEAF,

Luxembourg, p 106. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-BE-02-003/EN/KS-BE-02-003-EN.PDF

Statistical Office of the European Communities, 2010. Environmental statistics and accounts in Europe. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-32-10-283/EN/KS-32-10-283-EN.PDF

United Nations (ed), 2012. Integrated Environmental and Economic Accounts- SEEA 2012, version nº4. Statistical Office of the United Nations. http://unstats.un.org/unsd/envaccounting/seearev/

United Nations, European Commission, International Monetary Fund, Organization for Economic Cooperation and Development and World Bank. 2003. System of Integrated environmental and economic accounting 2003. SEEA 2003. New York. UN.

United Nations, 2001. Glossary of SNA Terms, UN National Account Questionnaire 1993 SNA: Part 2 Supporting Booklet, New York.

UN-ECE and FAO (United Nations Economic Commission for Europe and Food and Agriculture Organization), 2011. FOREST EUROPE: State of Europe's Forests. Status and Trends in Sustainable Forest Management in Europe.

UN-ECE and FAO (United Nations Economic Commission for Europe and Food and Agriculture Organization). 2000. Temperate and Boreal Forest resource Assessment TBFRA-2000. Geneva Timber and Forest Study Papers, N17. United Nations. New York and Geneva, 467 pages

Vincent, J.R., 1999. A framework for Forest Accounting. Forest Science45, 4: 552-561. United Nations. 1993. System of national accounts. New York. UN

Vincent, J.R., Hartwick, J.M., 1998. Accounting for the Benefits of Forests Resources: Concept and Experience. Mimeo report prepared for FAO Forestry Department. 153p.Forestry Department, FAO, Rome.

Walker, B.H:, Pearson, L., 2007. A resilience perspective of the SEEA. Ecological Economics, 61: 708-715.

Wang, S., 2004. One hundred faces of sustainable forest management. Forest Policy and Economics, 6: 205-213.

Wijewardana, D., 2008. Criteria and indicators for sustainable forest management. The road travelled and the way ahead. Ecological Indicators 8: 115-122.

8 Annexes

8.1 Economic valuation methods for calculating the monetary value of timber assets

8.1.1 Present value calculations

The present value method calculations require a lot of data on the age structure and growth rate of the forest, on forest management costs and on the rent on land. When having data on forest inventory, estimates are made of the harvesting age and volume of standing timber per hectare at the harvesting age. These volumes are multiplied by the stumpage price [2]to estimate future receipts, and discounted to estimate a value per hectare for each age class. These values are multiplied by the total area of each age class and added to give the value of the total stock of standing timber.

Because yields, prices and harvesting ages differ by species, this method should be applied to each main species separately. Since it neglects intermediate costs and receipts, as well as the rent on land, the method introduces a bias (of unknown size) in relation to the theoretically correct value. It is most reliable when the costs are relatively small in relation to value; this may be true for many cost elements. In a more realistic variant, an average management cost is introduced. This may be calculated by dividing actual forestry costs by the forest area based on information from forestry experts or based on analysis of the accounts of forest companies.

This method is difficult to apply for standing timber due to being highly data demanding. Hence, alternative methods could be used, such as the discounted future stumpage price and the consumption value method. These simplified methods differ mainly in the complexity of the modelling of revenue and production costs, the data they require and the way the rate of discount is determined.

8.1.2 Stumpage value method

The stumpage method assumes that the rate of discount is equal to the natural growth rate of the forest. This way, there is no need for discounting and the value of the stock is obtained by multiplying the current volumes of standing timber by stumpage prices. This approach could be even simpler by calculating an average stumpage price for the whole stock of standing timber.
Some alternatives are recommended when stumpage prices are not directly available.

8.1.3 The consumption value method

The difference is that in the consumption value method, different stumpage prices are used not only for different species, but also for different age or diameter classes. These prices are applied to the stock of timber, which is generally known by species and age or diameter classes through forest inventories. The consumption value method measures the value of the timber as if it were all cut now; hence its name.

[2] The stumpage price is the price paid by the feller to the owner of the forest for the standing timber.

8.1.4 Basic differences among the different methods

The basic difference between the stumpage value method and the consumption value method is that the former uses the structure of the fellings for weighting the stumpage prices, whereas the latter uses the structure of the stock. These two structures may differ considerably and may also change over time (examples are shown for Germany, Austria and France).

The two methods are special forms of the net present value method (with implicit discounting) and the choice of one or the other depends upon the current structure of the stock and the fellings and their assumed evolution in the future:

- The net present value method is best when the forest is managed optimally according to the principles of forestry economics and for large-scale afforestation, where the structure of the stock and fellings will change over time.
- The stumpage value method gives good results when the current felling structure can be assumed to continue in the future.
- For old growth and overly-mature forest, the consumption value method is a good method.

Chapter 8 od SEEA 2012 also recommends to have, if possible, disaggregated asset accounts by institutional sector (government and private enterprises, for example) if data is available.

8.2 IEAAF accounting framework

This annex describes the three main sections the Integrated Environmental and Economic Accounts for Forestry (IEEAF) is composed of.

8.2.1 A. Flow accounts through a simplified NAM

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, there is a direct link between the two categories.
There are four main parts of this account:

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

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 the intermediate and fixed capital consumptions, and the net added value is the balancing item.

The third group of rows and columns **summarises the income accounts**. Summarises net product taxes, net added value, current transfers between institutional sectors, and current receipts from the rest of the world in rows . The columns record the 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.

The fourth group of rows and columns **summarises the capital account**. Net saving, consumption of fixed capital and capital transfers are reported in rows, while gross capital formation, capital transfers and net capital transfers from the rest of the world are represented in the columns. Net lending/borrowing of the total economy is the balancing item.

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.

8.2.1.1 Monetary flows

The simplified NAM provides with a classification of industries and products according to the NACE classification and specifies how the accounts should be built for them.

8.2.1.1.1 Economic accounts for specified industries

8.2.1.1.1.1 Forestry and logging

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.).
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.

8.2.1.1.1.2 Other industries

For other industries it is necessary to examine how existing information systems allow identifying 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 cover the output related to wooded land by industry, type and institutional sectors.

8.2.1.1.1.3 Development of specific accounts

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 ACCOUNTS: The simplified NAM allows for the description of the transactions covered by the Environmental Protection Expenditure Account (EPEA) of SERIEE.
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". 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. 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): Its objective is to describe, adopting a functional approach, 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
- development of new uses for forest resources,
- recycling, recovery, reuse or savings of forest products and by-products

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).
The FRMA groups together:

a. Current uses 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, 80, 91 and 92 of the NACE rev.1, may be concerned.
c. Net acquisitions of land for afforestation purposes.

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.

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.

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.

8.2.1.2 Material flows and balances

Natural resource accounts 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.

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.

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.

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. This scheme is further extended to the flows of residuals.

Regarding CO2 and carbon balances, 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.

8.2.1.2.1 Sector/commodity balance

The sector/commodity balance is disaggregated in two matrices, corresponding to the supply and use tables of the ESA/SNA system. Units are m^3 or tons according to the type of products.

The use matrix of the sector/commodity balance describes the uses of the products, being uses the intermediate consumption by industries and final uses. Products are those proposed in the classification of products (section 4.38): timber, saw logs, fuel wood and pulp wood, sawn wood and other wood products, 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, 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.

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.

8.2.2 B. Balance sheets

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.
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.
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).

8.2.2.1 Classification of assets

The ESA/SNA classification is rearranged in order to match with forest concerns. Specific disaggregation is made for assets related to forests. Specific categories are introduced for land and for inventories of standing timber. Produced assets and non-produced assets are separated.

8.2.2.1.1 Produced assets

Three columns for fixed assets and two for inventories.

8.2.2.1.1.1 Fixed assets

Fixed assets related to forests: They refer to fixed assets of the forest-related industries, as specified in the industry classification. 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.
Some other types of fixed assets are mentioned, but not included here because of their minor importance.

8.2.2.1.1.2 Inventories

As concerns forests, inventories mainly consist of standing timber.

8.2.2.1.1.3 Cultivated standing timber

Cultivated standing timber corresponds to standing timber on "cultivated forest land available for wood supply". 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. Description of inventories (and changes in inventories) of standing timber is made in physical units (m3 with bark) and in monetary value.

8.2.2.1.2 Non-Produced assets

Land is distinguished from other non-produced assets; non-economic assets that are only described in physical terms are recorded in a specific column.

8.2.2.1.2.1 Land

Basic land classification: 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)

· other land.

Wooded land is further separated into "wooded land available for wood supply" and "wooded land not available for wood supply". Within the first category, a distinction is made between “cultivated” wooded land and “non-cultivated" wooded land.

Within the category “not available for wood supply” a distinction is made between “strictly protected wooded land” and “not strictly protected wooded land”.

8.2.2.1.2.2 Non-cultivated standing timber

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.

These timber stocks are described in physical units (m^3) and in monetary terms. Stocks pertaining to the first category, 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.

8.2.2.1.2.3 Other wild biota

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".

8.2.3 C. Flow of residuals

Residuals are divided into two big categories:

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

These are re-classified into five groups:

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

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.

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

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

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 not reflected here for sake of brevity.