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Manual for Environmental and Economic Accounts for Forestry

A Tool for Assessing Cross-Sectoral Policy Impacts on Forestry

Report to the FAO Forestry Department
Forestry Policy and Information Division
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List of acronyms

CGE	Computable general equilibrium
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GIS	Geographic Information System
IMF	International Monetary Fund
IO	Input-output
IUCN	World Conservation Union
NDP	Net Domestic Product
NSCB	National Statistical Coordination Board
NTFP	Non-timber forest products
OECD	Organization for Economic Cooperation and Development
SAM	Social accounting matrix
SAP	Structural adjustment program
SEEA	System of Environmental and Economic Accounts
SEK	Swedish krona
SNA	System of National Accounts
UN	United Nations

Introduction

Over the past few decades, most countries have come to embrace the notion of sustainable development, popularly expressed by the Brundtland Commission Report, *Our Common Future*, as '…development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' (World Commission on Environment and Development, 1987). The search for ways to operationalise this notion has focused, in part, on national economic accounts: incorporating the role of the environment and natural capital more fully into the conventional system of national accounts (SNA) through a system of satellite accounts for the environment.

The SNA (UN at al., 1993a) is particularly important because it constitutes the primary source of information about the economy and is widely used in all countries for assessment of economic performance, policy analysis and decision-making. However, the SNA has had a number of well-known shortcomings regarding the treatment of the environment.

With regard to forestry, the SNA has treated cultivated forests and natural forests quite differently. For cultivated forests, the SNA records both production and changes in the forest stock so that the consequences of depletion or re/afforestation are accounted for. For natural forests, however, the SNA records only the income from logging, but not changes in natural forest stocks. This can result in quite 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. Similarly, the benefits from afforestation would not be recorded.

More importantly, both cultivated and natural forests provide non-marketed (timber and non-timber) that are often not included in the national accounts, although they may be critical to rural livelihoods in developing countries. In principle, the SNA includes such products, but measurement difficulties have limited implementation in many countries. In addition, many of the non-market services from forests are omitted or wrongly attributed to other sectors of the economy. Forest services provide intermediate inputs to other sectors such as livestock grazing or tourism, but the value of these services is not recognised and hence, is attributed to the using sector, not to forestry. Ecosystem services such as watershed protection and carbon storage may not be represented at all. Thus the total benefits from sustainable forestry are underestimated, and other sectors of the economy are not fully aware of their dependence on healthy forests.

The 1993 revision of the SNA addresses some of these problems, notably by expanding the asset boundary to include a broader range of natural assets such as natural forests. Even with this expanded coverage, significant gaps remain. The *System of Integrated Environmental and Economic Accounts* (SEEA) was developed as a set of satellite accounts to the SNA to address these gaps by the statistical offices of the UN together with other international agencies and national statistical offices (UN et al., 2003b).

Within the SEEA, forest accounts provide a framework for a) linking forest asset (balance) accounts with flow accounts for timber, non-timber forest products (NTFP), and forest ecosystem services in physical and monetary terms; and b) linking forest asset and flow accounts with the SNA. The SEEA provides a measure of forest values that is more comprehensive than the SNA in two respects. First, the SEEA forest accounts include both cultivated and natural forests in the asset accounts. Second, the SEEA forest accounts attempt to include all forest goods and services, both market and non-market, in the flow accounts, which is essential for representing cross-sectoral linkages. A more comprehensive accounting for the role of forests in the national economy and local communities will improve evaluation of the benefits from sustainable forestry.

In terms of some of the data collected, forest accounts overlap considerably with other information systems to promote sustainable forestry, such as National Forest Resource Assessments and various frameworks for forest indicators (such as the Criteria and Indicators approach). The major distinction is the emphasis of the SEEA forest accounts on an economic perspective: forest accounts are integrated with national economic accounts, which allows analysis of cross-sectoral impacts. Forest accounts also provide both indicators and a detailed set of statistics for analysis.

The SEEA provides the basic conceptual framework for all environmental accounts, including forest accounts, but the Handbook does not cover any individual resource or environmental service in great detail, nor does it consider the policy applications of the accounts for a particular resource. To fill this gap, a number of specialized manuals have been compiled such as the manual for fisheries (FAO, forthcoming) and water (UN-Eurostat, forthcoming). The UN and its agencies have not yet developed a manual for forests. Eurostat has done a considerable amount of work on forest accounting, but the focus is on issues that are important to European countries, which may not be the same in other parts of the world.

The overall purpose of the Manual on Environmental and Economic Accounts for Forestry (EEAF) is to contribute to sustainable forest management by providing a tool for better monitoring and evaluation of cross-sectoral linkages, and for integrating forest goods and services into national economic development. The Manual will assist countries in trying to answer questions like:

- How do non-forestry sectors benefit from forests and what are the total economic benefits from sustainable forestry management?
- What are the economic trade-offs among competing sectors and how can forest utilisation be optimized, talking into account all forest benefits, market and non-market, to all stakeholders?
- What is the full economic value of forests? Who are the beneficiaries?
- What is the cost of deforestation? Is economic growth based on the depletion of forests?

- What are the impacts of non-forestry policies on forest use?

The target audience of the Manual includes policy analysts and decision-makers in government ministries (forestry and non-forestry) at the national and local levels, forestland users and owners, universities and research organizations, NGO's and other citizen groups. Such a broad audience requires a presentation that strikes a balance between the technical aspects of forest accounting and a clear explanation of how the forest accounts can be used by each stakeholder in formulating policy.

The first part of the manual provides a review of the policy applications of forest accounts, focusing on cross-sectoral linkages and drawing extensively on examples throughout the world, especially developing countries and countries in transition. Chapter 1 provides an overview of environmental accounts, the structure of the forest accounts and a discussion of the major policy issues that drive compilation of forest accounting. Chapter 2 reviews the policy applications of forest accounts. Chapter 3 addresses an issue of growing importance: construction of accounts for individual forests or regions. While national level forest accounts are useful for some policy applications, much forest management takes place at the level of the region or individual forest. Many national forest accounts are actually derived from regional accounts, so it may not present an insurmountable challenge to disaggregate forest accounts by the appropriate geographic characteristics. Chapter 4 provides guidelines, including worksheets, for using forest accounts as a tool for understanding cross-sectoral policy linkages and building alliances for sustainable forestry.

The second part of the manual provides step-by-step guidance for constructing forest accounts, including the sets of tables to be used, potential data sources, and a discussion of experiences of specific countries in implementing the accounts. Chapter 5 introduces the definitions and classifications used for forests accounts. Chapters 6 and 7 provide a detailed technical discussion of the physical and monetary accounts, respectively. These chapters also discuss how countries have implemented forest accounts. Examples are drawn mostly from the Eurostat Pilot Programme and the SEEA Handbook because these reflect the outcome of an extensive process of testing methodologies for forest accounting and adhere most strictly to the SEEA and SNA framework. Chapter 8 discusses data sources and provides a standard set of tables for constructing forest accounts.

1. Overview of forest accounting

Environmental and natural resource accounting has evolved since the 1970s through the efforts of individual countries and practitioners, each developing their own frameworks and methodologies to represent their environmental priorities. Since the late 1980s, a concerted effort has been underway through the United Nations Statistics Division, Eurostat, the OECD, the World Bank, national statistical offices, and other organizations to standardize the framework and methodologies. The United Nations published an interim handbook on environmental accounting in 1993 and has recently completed a substantial revision, the *System of Integrated Economic and Environmental Accounting 2003* (UN, et al., 2003).

This chapter begins with an overview of environmental accounts and advantages of the SEEA as a tool for environmental economic policy. The structure of forest accounts is then developed, based on a mapping of forest goods and services into the four basic components of environmental accounts. The extent to which each country has implemented each component of the forest accounts is briefly reviewed, and will be examined in greater detail in Chapter 3. The chapter closes with a discussion of the most important policy issues driving forest accounting and how each component of the forest accounts is used to address these issues.

1.1 Structure of forest accounts

As satellite accounts, the SEEA has a similar structure to the SNA. The SEEA consists of stocks and flows of environmental goods and services. It provides a set of aggregate indicators to monitor environmental-economic performance at the sectoral and macroeconomic level, as well as a detailed set of statistics to guide resource managers toward policy decisions that will improve environmental-economic performance in the future. The definition of environmental goods and services in the SEEA is much broader than the SNA, in principle attempting to measure total economic value, not just market transactions.

The SEEA has major four components:

- Asset accounts record stocks and changes in stocks of natural resources over time. Forest asset accounts typically include balance accounts for forest land and stocks of standing timber. Accounts to record forest health are also included.

- Flow or production accounts for materials, energy and pollution 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. 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 identify expenditures undertaken by public and private sectors to manage resources and protect the environment. These are already included in the SNA but are not made explicit because they are combined with all the other expenditures of these institutions. The purpose of this part of the SEEA is to make those expenditures explicit. Forestry accounts include forest management expenditures by government, environmental protection expenditures by public and private sectors, as well as user fees and taxes paid by forest users to the government.

- 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 the SEEA, forestry accounts 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, the contribution of forest assets to national wealth.

The SEEA includes both physical accounts and, to the extent possible, monetary accounts. Valuation of some non-market goods and services can be difficult. However, there are a number of widely used economic valuation techniques that can be applied.

There are two features that distinguish the SEEA from other databases about the environment: 1) integration of environmental data with economic accounts, and 2) comprehensive treatment of all important natural resources, linking them with the economic sectors that rely on them, directly and indirectly, and those sectors that affect them.

In contrast to other environmental databases, the purpose of the SEEA is to link environmental data directly to the economic accounts. The SEEA achieves this by sharing structure, definitions and classifications with the SNA. The advantage of this approach is that it provides a tool to overcome the tendency to divide issues along disciplinary lines, in which analyses of economic issues and of environmental issues are carried out independently of one another.

Regarding the second distinguishing feature, the SEEA includes all the important natural resources, linking them with the economic sectors that rely on them, directly and indirectly, and those sectors that affect them, a feature that makes it ideal for addressing cross-sectoral issues, such as forestry management. The SEEA includes forest accounts as well as all other critical environmental stocks and flows related to forestry, such as land and ecosystem accounts, energy accounts, pollution and material flow accounts, etc.

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 and threats to forests from non-forestry policies. The SEEA makes possible joint analysis of economic policies and their impact on all relevant environmental variables.

For all resources, policy analysis and decision-making take place on three relatively distinct levels: the local or company level, the sectoral or industry level, and the macroeconomic (national) or regional level. The contribution of SEEA to policy analysis has been primarily at the sectoral and macroeconomic levels. At the macroeconomic level, the SEEA is useful as a planning tool to coordinate policies across different line ministries and assess cross-sectoral impacts, weighing alternatives and tradeoffs among sectors. National forest accounts are often constructed from accounts for individual regions or forests. The regional or forest-level accounts provide additional opportunities for forestry management at the regional level, an issue discussed in Chapter 5.

The SEEA accounts for the value of non-marketed goods and ecosystem services of forests, which show how many non-forestry sectors benefit from forest ecosystems. This information is critical in developing cross-sectoral policy, as well as the cross-sectoral institutions and alliances necessary for implementing sustainable forestry. Such institutions would involve stakeholders from all sectors that benefit from forestry, such as rural development, tourism, agriculture, fisheries, municipal water supply, and others. Even though agriculture is a main competitor with forests for land use in many countries, agriculture also relies on forest ecosystems in ways that are not often included in policy analysis, such as watershed protection. Systematic accounting for forest inputs to agriculture will show what agriculture and others have to gain from forest conservation.

1.2 Policy uses of forest accounts

The forest accounts provide both improved forestry indicators as well as detailed statistics that can be used for improved management of forestry. Management applications include, for example, the assessment of trade-offs among competing forest users, the design of economic policy instruments (e.g., property rights, taxes and subsidies, creation of markets for non-market forest services, etc.), and modelling the economy-wide impact of non-forestry policies.

For cross-sectoral policy, forest managers need to establish the socio-economic contributions of forests in relation to the rest of the economy, and to evaluate the impact of non-forestry policies on forests. While data collected about the contribution of forests are important in their own right, they are also often necessary for the cost-benefit analyses and modelling required for evaluating changes in non-forestry policy. The forest accounts help address issues such as:

A. Establish the true socio-economic value of forests in relation to the rest of the economy

1. *What is the total economic contribution of forests and what are the benefits from sustainable forest management?*
   Forest accounts ensure that all forest benefits, market and non-market, are accounted for in a manner consistent with national accounts. By identifying all forest contributions, the potential losses from changes in forest use can be identified.

2. *What is the distribution of forest benefits among different groups in society?*
   The accounts indicate the benefits that accrue to commercial (large scale and artisanal) and subsistence forest users, direct and indirect beneficiaries. They can also distinguish local benefits from those that accrue to 'downstream,' non-local communities, including other beneficiaries in a watershed (e.g., hydroelectric power, municipalities, fisheries) and the global community (e.g., biodiversity and carbon storage). This information is necessary for optimizing forest management to achieve economic as well as social objectives (such as local community preservation or increased equity).

3. *Is economic growth sustainable or is it based on the depletion of forests?*
   Forest accounts provide improved indicators of sustainability that include the full value of forest assets and the net cost of deforestation and land use change

B. Evaluate the impact of non-forestry policies

4. *What are the trade-offs among competing users and how can forest utilization be optimised?*
   Optimisation of infrastructure development, forest land use, assessment of trade-offs among competing users, and the design of policy instruments can take into account total economic value of forests, market and non-market, including linkages to non-forestry sectors and impacts on all stakeholders.

5. *What are the impacts of non-forestry policies on forest use?*
   Forest accounts provide detailed statistics that can be used in economy-wide models to anticipate impacts of non-forestry policies and to design strategies for economic development that take into account all the goods and services, market and non-market, provided to all stakeholders.

These policy applications are discussed for national level accounts in the next chapter. Chapter 3 describes these applications at the regional and local levels.

PART I. USING FOREST ACCOUNTS FOR CROSS-SECTORAL POLICY ANALYSIS

2. Cross-sectoral policy applications of forest accounts

This chapter shows how the forest accounts have been implemented and used for policy analysis. Country experiences at the national level are discussed in relation to how they address each of the main policy applications of forest accounts identified in Chapter 1:

A. Establish the true socio-economic value of forests in relation to the rest of the economy

1. What is the total economic contribution of forests and what are the benefits from sustainable forest management?
2. What is the distribution of forest benefits among different groups in society?
3. Is economic growth sustainable or is it based on the depletion of forests?

B. Evaluate the impact of non-forestry policies

4. What are the trade-offs among competing users and how can forest utilization be optimized?
5. What are the impacts of non-forestry policies on forest use?

The national forest accounts assess the total economic value of forests and link forestry values to the use of other resources and to the broader economy, integrating forestry policy with national development, and monitoring interactions and feedback across different industries. Thus, the forestry accounts can be useful for two sets of resource managers and stakeholders: forestry managers and stakeholders responsible for sustainable management of the forest sector, and managers and stakeholders concerned with the macro-economy.

Forestry managers may already have information about the total economic value of forest resources, including the inputs provided to sectors not part of the traditional forestry sector. What they gain from the forest accounts is the ability to put that information within the context of the national economy. This helps them to identify and address threats to forest resources that originate outside the forestry sector, which can improve their ability to protect this resource.

Policy-makers and other stakeholders outside the forestry sector benefit from the forest accounts in several ways: more accurate GDP that reflects all the contributions of forests, better indicators of sustainable economic development that include forestry and forestland resources, a tool for comparing policies across different natural resources including the extent to which the ‘user pays’ principle is applied, but perhaps most importantly, a method to integrate forestry into macro-economic policy and planning tools. By identifying the extent of other sectors’ dependence on forests, it is possible to build strategic alliances with stakeholders in other sectors, such as agriculture, tourism, and electric power.

Sustainable economic development requires anticipating the interaction and feedback from one part of the economy to another, weighing alternative development strategies in a manner that anticipates the full (direct + indirect) costs and benefits incurred throughout the economy. In the past, sectoral policies may have been designed with relatively little emphasis on economy-wide impacts. Agricultural policy, for example, may have been formulated with little concern for impact on forestry, even though it may have had a major impact, indirectly, through changes in land use. The forest accounts provides a tool for coordinating policies across the economy, anticipating cross-sectoral policy impacts and designing more effective national development policies.

This chapter begins by listing the countries with formal forest accounting programmes, and the components of the forest accounts and related environmental accounts that they have constructed. Examples of the policy applications of forest accounts are drawn from a range of countries—beginning with Sweden, South Africa, and Romania—to illustrate how the forest accounts are implemented and applied under widely varying circumstances. Additional examples will be provided by accounts for other countries such as Swaziland and Spain, and forest valuation case studies.

2.1 Countries implementing forest accounts

Table 2.1 shows countries that have constructed forest accounts and the type of forest goods and services included in the accounts. This table is limited to those countries with formal accounting programs sponsored by government agencies or by non-governmental agencies in cooperation with governments. Forestry accounts are more common in developed countries than developing countries. Eurostat has had an ongoing program to develop forest resource accounts since 1995 and many of the participating countries have developed extensive accounts. There are also many additional academic studies and one-off studies by governments or international agencies that are not shown here; some of these will be discussed later in the section on policy analysis. For an exhaustive review of all forest accounting efforts through 1997, see (Vincent and Hartwick, 1997).

The forest accounts for all countries include timber asset accounts in physical and monetary terms. Forests are disaggregated in different ways depending on the policy issues and characteristics of forests in each country. Virtually all forest accounts distinguish cultivated and natural forests, and disaggregate forests by major tree species. Many developing countries limit the timber accounts to commercial timber production, but are beginning to add non-commercial timber production and use of non-wood products as data become available. Among the developing countries, only Swaziland has constructed supply and use tables (SUT). SUTs are only constructed for timber and wood products at this time.

The non-timber benefit most commonly included in forest resource accounts is carbon storage. Virtually all developed countries include carbon accounts. This practice is less widespread in developing countries but is likely to increase with growing potential for markets in forest carbon mitigation. In most countries forest accounts have been constructed as part of a broader environmental accounting effort that includes other natural resources.

Table 2.1 Forest accounts constructed by selected countries

	FOREST ACCOUNTS				FOREST-RELATED ACCOUNTS			
	Timber		Non-timber goods and services					
	Asset accounts	Supply and use table	Carbon storage	Other goods and services	Land	Energy	Water	Pollution and Env. Degradation
Developing countries								
Brazil	X							
Chile	X							
Costa Rica	X							
Indonesia	X		X					
Mexico	X				X	X		X
Philippines	X		X	X	X	X		X
Thailand	X							
South Africa	X		X	X			X	
Swaziland	X	X	X	X				
Developed countries								
Under Eurostat pilot program:								
Austria	X	X	X	X	X	X		X
Finland	X	X	X	X	X	X		X
Denmark	X	X	X	X	X	X	X	X
France	X	X	X	X	X	X	X	X
Norway	X	X	X	X	X	X		X
Sweden	X	X	X	X	X	X	X	X
Spain	X	X	X	X	X	X		X
Germany	X	X	X	X	X	X	X	X
Italy	X	X	X	X	X	X		X
Other developed countries:								
Canada	X	X	X	X	X	X	X	X
Australia	X	X	X	X	X	X	X	X
New Zealand	X	X	X	X	X	X		X

Note: Countries included here have on-going accounting programs by government agencies, or by non-governmental agencies in cooperation with governments. There have been many additional academic studies and one-time studies by governments or international agencies. See Vincent and Hartwick (1997) for a review of these studies.

2.2 Total economic contribution of forests and the benefits from sustainable forest management

Forest management, especially in developing countries, has often been based on a limited range of economic values, mostly commercial values. Decisions about forestland use, for example, often compare the value of land under commercial timber production and the value of land under commercial agriculture, omitting other forest benefits, especially the use of forest products by local communities. Better understanding of the full range of goods and services supplied by forests is essential for optimal utilization of forests, and may provide an economic rationale for sustainable forestry. This section uses data from Sweden, South Africa, and Romania to show the importance of accounting for total forests values, and the share of forest values that are either wrongly attributed to other sectors, or not counted at all in national economic accounts. Sweden and South Africa have constructed forest accounts. Romania has not constructed forest accounts but has carried out an extensive forest valuation study, which includes much of the same information that forest accounts would provide.

2.2.1 Structure of forest accounts for Sweden, South Africa, and Romania[1]

Sweden's forest accounts are part of a well established and comprehensive government program of environmental accounting that includes all components of forest accounts, as well as many other resources including water, pollution, energy, and detailed land and ecosystem accounts (Eurostat 2002a, 2002b; Norman et al., 2001). The asset accounts are disaggregated by the categories recommended in the Eurostat project, but flow accounts for forest goods and services are not disaggregated by type of forest. The Swedish forest accounts are generally quite comprehensive, but do not attempt to include forest environmental services other than carbon storage

South Africa's forest accounts are part of an environmental accounting initiative by Statistics South Africa with support from the University of Pretoria and other agencies (Hassan, 2002, 2003). In addition to forests, accounts have been constructed for water accounts and minerals. South African forests are classified by three major types: cultivated forest plantations that provide most of the country's commercial timber and tree products, natural forests and woodlands that are used by rural communities, and fynbos woodlands, which is a unique biome in South Africa, the Cape Floral Kingdom.

Complete stock and flow accounts have been constructed only for cultivated forests, including impact on hydrological flow services. Flow accounts for timber and non-timber goods have been constructed for natural forests and fynbos woodland; this information is especially useful because many of these values are not included in the national accounts of South Africa. Indeed, a primary motivation for the forest accounts was to provide a better estimate of the total economic value of forestry in the national economy. Forest environmental services are represented mainly by carbon storage.

There are two major gaps in the South African forest accounts: stock accounts for natural forests have not been constructed, and forest accounts for national parks and protected areas have not yet been included in the accounts. Most of the forest-based international and domestic tourism is based on the system of national parks. The omission of forests in national parks and protected areas results in a significant underestimation of the recreation and tourism value of South Africa's forests.

Romania's forest valuation study was undertaken by a research consortium as a review of forest management in cooperation with the World Bank (Fortech Dames & Moore, 1999).

[1] Romania has not constructed forest accounts, but has undertaken an extensive forest valuation study.

From 1948 until 1991, most of Romania's forests were owned and managed by the state, and forests were managed sustainably. In 1991 a policy of restitution to private owners was instituted but since that time 31% of privatized land was clearcut or seriously degraded. The government is considering returning more of state-owned forests to private owners. There is support for return of forests to private owners, but in a manner that encourages sustainable management. Accounting for the full economic value of forests is an important element in these policy discussions.

Forest values for Romania include timber stock and flows of non-timber forest products. There is also an estimate of the combined value of social and environmental services provided by forests. As described below, this value is more than an order of magnitude greater than all other forest values combined, but the methodologies and data used for this figure is not discussed in the report so it is not possible to evaluate it.

The structure of each country's forest accounts is described in Table 2.2, which shows the classification of forests, and the detailed NTFP and environmental services included in each country's accounts. All countries provide physical and monetary accounts for timber, forest land, non-timber forest goods, and carbon storage. Specific non-timber forest products vary by country. The countries differ in the forest services that are represented: recreational benefits are most often included, but for South Africa, much of the tourism value is missing because of the omission of national parks from the forest accounts. South Africa also includes services to agriculture: livestock grazing and pollination of commercial agriculture in the western part of the country.

In the Swedish and South African accounts, there is relatively little representation of protective environmental services provided by forests, other than carbon storage. South Africa includes an estimate of the (negative) impact of cultivated forest plantations on water flow. Sweden records the land area that provides protection from noise. The Romanian report covers a wide range of forest environmental services, but provides no explanation of how these were calculated.

2.2.2 Forest values for Sweden, South Africa, and Romania

The estimated forest values for Sweden, South Africa, and Romania (Tables 2.3, 2.4, and 2.5) indicate that non-timber values can be greater than the value of commercial timber harvest. Both Sweden and Romania report values at the national level, not providing information about values by type of forest. South African forest accounts disaggregate values for three categories of forests: cultivated, natural and fynbos woodlands. A short time series of forest values is available for Sweden (1993-1999) and Romania (1994-1997), and only one year's values are available for South Africa, so it is not possible to assess what may be happening to forest values over time.

Table 2.2 Structure of forest accounts for South Africa, Sweden and Romania[1]

	South Africa	Sweden	Romania
1. Asset accounts for standing timber and forest land			
Standing timber (m3 and value)	Timber in cultivated forests classified by Major species and age class Standing timber in natural forests is not estimated	Classified by Type of forest (cultivated, natural, other), Availability for wood supply, Protection status, Major species and age class	Classified by Major species, Site class and Age class
Forest land	Classified by 3 types of forest: cultivated, natural, and fynbos woodlands Land area (ha) only	Classified by Type of forest (cultivated, natural, other), Availability for wood supply, Protection status Land area and value	
2. Flow accounts for forest products			
Commercial timber and tree products (m3 and value)	Timber from cultivated forests by major species, Rattan	Timber by species	Timber by species, Wickerwork
Non-market timber (m3 and value)	Timber for construction, fuelwood, crafts, etc.	Timber for fuelwood	NAV
NTFP, (volume and value)	Wild plants, game, medicines, honey, tea, flowers	Wild plants, game	Wild plants, game, honey, fish
Forest services	Livestock grazing (livestock days, value) Pollination services of wild bees (number of farms, value) Recreation and tourism (value) Carbon storage (tons C, value) Impact on water flow from cultivated forests (volume, value)	Recreation (number of visitors, value) Carbon storage (tons C, value) Biodiversity protection (land area, species count) Noise protection services (land area and value)	Single value for combined carbon storage, soil and water protection, and social value of forest
3. Expenditures for forest management and protection			
	NAV	Costs of forest management and protection	Costs of forest management
4. Macroeconomic indicators			
	GDP adjusted for omitted non-market forest products Forest appreciation-depreciation/depletion	NDP, Forest appreciation-depreciation/depletion	NAV

[1] Information for Romania is from a forest valuation study not forest accounts, but much of the information is compatible with forest accounts.
NAV: Not available

Sources: South Africa (Hassan, 2002, 2003); Sweden (Eurostat 2002a, 2002b; Norman et al., 2001); Romania (Fortech Dames & Moore, 1999)

There are similarities and differences among the forest values of these three countries, in part reflecting different forest uses and in part reflecting the different coverage of the forest accounts. Notably absent from South Africa and Romania's forest values are comprehensive figures for recreational services.

Recreational use of Swedish forests is the single most important forest value, greater than the value of timber harvest. The value of carbon storage is roughly half the value of timber[2]. Non-timber goods are less than 5% of the total value of forests, and the forest protective services for soils and noise abatement are negligible. Of course, there are some forest services that could not be valued (See Table 2.2), but these accounts provide a reasonable estimate of the magnitude of non-timber forest values.

Table 2.3 Value of forest goods and services in Sweden, 1993 to 1999
(millions of Euros)

	1993	1995	1999
Timber harvest	2080	2540	2370
Non-timber goods	273	233	225
Forest services			
Recreation	2370	2370	2370
Protection from noise	20	20	20
Carbon storage	1050	630	810
Subtotal	3440	3020	3200
Total output of forests	**5793**	**5793**	**5795**

Source: Norman et al. (2001).

In South Africa, commercial timber harvest accounts less than a third of forest value. The largest single forest value is non-market goods from natural forests, which are used mainly by traditional rural communities. Combined with livestock grazing, the goods and services in natural forests account for over half of total forest value. In contrast to Sweden, recreational use of forests is very small and limited to fynbos woodlands; tourism in cultivated forests and natural woodlands is negligible. Natural forests provide also cultural and aesthetic values to traditional communities, but there has been no estimate of this value.

The recreational value of forests in national parks and protected areas, which are major domestic and international tourism sites, have not yet been included in the forest accounts. Environmental damage, in the form of a water abstraction externality by

[2] Several methods were used to value carbon storage (See Chapter 7). The value reported here is one of the lower values and is the one preferred by the authors.

cultivated forests of alien species, accounts for about 12% of the value of commercial timber harvest. In South Africa, this externality is being treated quite seriously. The new South African water policy has proposed charging forest plantations for this water abstraction externality.

Table 2.4 Value of forest goods and services in South Africa, 1998
(millions of rands)

	Cultivated forests	Natural forests	Fynbos woodlands	Total
Commercial timber harvest	1856	NA	NA	1856
Non-market timber & non-timber goods	NA	2613	79	2692
Forest services				
Recreation	NA	NA	29	29
Livestock grazing	NA	1021	NA	1021
Pollination services	NA	NA	786	786
Reduction of rainfall runoff	-225	NA	NA	-225
Carbon storage	120	360	NAV	480
Subtotal	-105	1381	815	2091
Total value of forests	**1751**	**3994**	**894**	**6639**

NA: not applicable
NAV: not available
Source: (Hassan, 2002)

Table 2.5 Value of forest goods and services in Romania, 1994 to 1997
(millions of US$ in constant 1997 prices)

	1994	1995	1996	1997
Timber production	89.2	110.9	120.7	104.2
Wickerwork	7.7	7.6	7.3	5.4
Forest fruits and mushrooms	9.0	11.4	8.9	7.6
Hunting	21.2	21.8	19.2	15.3
Fish and apiculture	1.3	1.6	1.5	1.6
Tourism and recreation	not valued			
Total	**130.3**	**173.3**	**159.7**	**136.1**
Forest environmental services (carbon storage, soil and water protection, etc.)	**Average annual value: 3,096.0**			

Source: Adapted from (Fortech Dames & Moore, 1999)

The Romanian forest valuation study reports timber, and non-timber products, recreational services, and forest environmental services. Figures are not reported for different categories of forest. The underlying physical data and valuation methodologies are reported only for timber and non-timber products. Insufficient data were available for valuing recreational services. A single value is reported for environmental services that combines carbon storage, soil and water protection and social values, but no information about the value of each service and how this figure was obtained. The estimated value of environmental services is more than an order of magnitude greater than the total for timber and non-timber products. Without further documentation it is hard to assess this value; in any case, it is likely that forest environmental services are substantial.

2.2.3 How do forest accounts improve the national economic accounts?

With respect to the main objective of this policy application, providing a better understanding of total economic value of forests than conventional national accounts provide, the benefit of the accounts can be summarized in Table 2.6. In all countries, the values directly attributed to forests in the national accounts greatly underestimate the true value of forests. The share attributed to forestry ranges from a high of 45% in Sweden to a low of 4% in Romania. A large part of forest services benefit other sectors and are attributed to these sectors, mainly recreation and agriculture, which account for 41% of forest output in Sweden and 24% in South Africa. Given the omission of many forest environmental services from the forest accounts, these values should be considered a lower bound. It is not possible to determine the share of Romanian forest values wrongly attributed to other sectors and the share not counted at all.

Table 2.6 Forest values included in the national accounts of Sweden, South Africa, and Romania

	Sweden, 1999		**South Africa, 1998**		**Romania, 1997**	
	(million euros)	% of total	(million rands)	% of total	(million US$)	% of total
Included in national accounts as forest values	2595 (timber, non-timber goods)	45%	1856 (commercial timber)	28%	136	4%
Included but attributed to other sectors	2370 (recreational services)	41%	1611 (grazing, recreation, pollination, reduced rainfall runoff)	24%	Part of 3,096 (forest environment services)	Part of 96%
Not included in national accounts	830 (noise protection + carbon storage)	14%	3172 (non-market timber, non-timber forest goods, carbon storage)	48%	Part of 3096 (forest environment services)	Part of 96%
Total	5795	100%	6639	100%	3235	100%

2.3 Who benefits from the goods and services provided by forests?

The question of who benefits from forests is increasingly important for development policy. This issue has two dimensions, an inter-generational one and an intra-generational one. Inter-generational equity concerns the forest wealth left to future generations —whether society is liquidating its natural capital to pay for current consumption or using it sustainably. This is discussed in section 2.4.

Intra-generational equity concerns the distribution of benefits among different social groups in the present generation. Forest accounts have not been used to address systematically the issues of equity and poverty, but this use of the accounts is likely to become important in future work (e.g., Lange and Hassan, 2002). Identifying the different social groups that benefit from forest goods and services is an essential first step in forest land use planning, infrastructure development, and in assessing trade-offs among competing forest uses.

There are several ways in which the distribution of forest benefits can be evaluated, which are each useful for policy purposes. Some of the characteristics to consider include:

- Scale or purpose of use. Forest users may be large-scale commercial operators, artisanal users who operate commercially but on a much smaller scale, and subsistence forest users.

  Policy relevance: important for assessing impact of policy changes on vulnerable social groups and designing mitigation strategies to compensate for losses

- Distance from forest: local and downstream beneficiaries. Local beneficiaries live in close proximity to a forest and are usually aware of the direct benefits they receive from forest utilization. Non-local communities within the region or country benefit from forest goods and services directly for recreation, or indirectly for environmental services such as watershed protection. They typically do not own the forest and may not be fully aware of the value of the indirect benefits they receive. Global beneficiaries may live far from the forest, benefiting from services such as carbon storage and biodiversity protection.

  Policy relevance: important to promote sustainable forestry by identifying non-forestry beneficiaries and for designing policy instruments that compensate forest users/owners for services they provide

- Geographic region within a country. Forest benefits may vary considerably by region, and even when the forest cover is similar, the forest benefits that accrue to each household may vary due to population density and other factors.

  Policy relevance: useful for identifying regions experiencing greatest stress on forests relative to population needs, and for designing management strategies appropriate to each region.

In identifying forest beneficiaries, it may be useful to combine two or more of these dimensions, and to further disaggregate households by income class, or other relevant characteristics. This section will address the first two approaches to evaluating the distribution of forest benefits, scale of forest user and distance from forest. Distribution by geographic distribution within a country will be discussed in Chapter 5, where the construction of accounts for regions or individual forests is addressed.

2.3.1 Scale of forest utilization: distribution of benefits to commercial, artisanal and subsistence users

Commercial logging mainly benefits large-scale commercial and artisanal timber producers, and until recently, these values were often the only ones considered in forest management. The beneficiaries from other forest products varies by country. In many developing countries, subsistence forest users benefit from non-marketed goods and services such as livestock grazing. These forest products may be critical to the livelihoods of local communities and, thus, have a high social value even when the economic value of such products is low relative to commercial timber.

Shackleton and Shackleton (2002) document the importance of NTFP to rural livelihoods in South Africa based on extensive surveys of the use of NTFP throughout rural South Africa.   All rural households make use of NTFP to some extent. The authors distinguish two types of use: daily or regular subsistence use of NTFP which saves scarce cash to be used for other household needs, and the emergency safety net use of NTFP, which is the additional use or trade in NTFP in response to unexpected household difficulties (drought, illness, etc.). The authors find that in times of hardship the poorer rural household increasingly rely on collecting NTFP for sale in informal markets. Thus, NTFP are important not only for daily subsistence, but also as part of a coping strategy to diversify livelihoods and reduce vulnerability to hardships.

Recreational services primarily benefit households. In developing countries, forest recreational services may be enjoyed mainly by foreign visitors but also provide employment to local communities. In some instances, recreational services are provided free of charge, or at a cost that does not reflect its value to the beneficiary. This often occurs for use of natural parks, protected areas, and natural forests. Thus the recreational services of forests are undervalued and do not send an appropriate signal for sustainable forest management. In developing countries, this may result in transfer of benefits from the host country to relatively well-off foreigners. Services, which provide indirect benefits of a public goods nature, such as watershed protection and carbon storage, accrue to multiple beneficiaries.

While no forest accounts have been compiled with the idea of representing these distributional aspects, some observations can be made on the basis of the Swedish and South African forest accounts (Table 2.7). In both sets of accounts, artisanal producers are not distinguished from large-scale commercial operators, but it is possible to distinguish commercial operators, household forest users, and multiple beneficiaries. In South Africa, poor rural households depend on forests for subsistence livelihoods and accounts for the single largest forest value. In Sweden, households are also the major beneficiaries, but mainly in the form of recreational services.

2.3.2 Distance from forest: distribution of local, regional and global benefits

When major benefits do not accrue to land owners/users, the incentive for sustainable forestry declines, even though the social benefits from sustainable forestry may outweigh the benefits from land use conversion. Beneficiaries can be categorized as local forest owners/users, regional beneficiaries, and global beneficiaries. Two examples are shown from the forest accounts for Swaziland and Spain to illustrate the forms these divisions may take (Table 2.8); these accounts are discussed in greater detail in the next chapter.

Table 2.7 Distribution of forest benefits by purpose or scale of forest use

	Sweden, 1999 (million euros)	South Africa (million rands)
Private commercial operators	**2370 (41%)**	**2721 (29%)**
Commercial logging and forest products	2370	1935
Commercial agriculture (pollination in South Africa)	NA	786
Households	**2595 (45%)**	**3663 (55%)**
Non-market timber and other NTFP (Subsistence production in South Africa)	225	3634
Recreation (value to visitors)	2370	29
Multiple beneficiaries	**820 (14%)**	**255 (16%)**
Carbon storage	810	480
Other environmental services including negative impacts	20	-225
Total	**5795**	**6639**

NA: not available
Source: Tables 4.3 and 4.4

Local users/owners in both countries receive the largest share of forest benefits: 55% and 47% in Swaziland and Spain, respectively. These include benefits from commercial logging and household harvest of non-market timber and NTFP. In Spain, commercial logging is operated by local companies, but in Swaziland, most of the logging operations are foreign owned. It is useful to distinguish the foreign operators as their interests may differ from local operators. There are no non-local, regional benefits identified in Swaziland's forest accounts. In Spain, the proximity of the forest to Madrid makes it an attractive recreational site for city-dwellers. Recreational services accruing to regional beneficiaries account for 42% of the forest's total economic value, but visitors typically do not pay for the use of forests. Finally, the global community benefits from forest services such as international tourism, carbon storage, biodiversity protection, which account for 32% and 12% of forest values in Swaziland and Spain, respectively.

Table 2.8 Distribution of forest benefits between land owners/users and others in Swaziland and Spain
(percent of total forest value)

Swaziland (national forest accounts)		**Spain (accounts for Guadarrama Forest)**	
Local beneficiaries	68%	**Local beneficiaries** (commercial logging and NTFP)	47%
Subsistence household (non-market timber and NTFP)	55%		
Foreign-owned local beneficiaries (commercial logging)	13%		
		Non-local regional beneficiaries (recreation)	42%
Global beneficiaries (carbon storage, international tourism)	32%	**Global beneficiaries** (carbon storage, biodiversity protection)	12%

Source: Adapted from (Mbuli, 2003 and Capparos, 2001). See chapter 5 for more detailed figures and discussion of sources.

2.4 Is economic growth based on the depletion of forests and other renewable resources?

In the past, loss of cultivated forest was included in the national accounts but loss of natural forest was not. Forest accounts were constructed to adjust the commonly used measures of macroeconomic performance, GDP and NDP, for depletion of natural forests and it was hoped that these environmentally adjusted measures of GDP and NDP would provide more accurate indicators of sustainable development. This type of application was typical of early work in developing countries, and some of the results are shown in Table 2.9. In some instances, Indonesia and Costa Rica, the cost of deforestation was quite high. In Sweden, this value is quite small.

The World Bank includes a rough estimate of forest depletion (timber value only) in its indicator of sustainable development, Genuine Savings (Kunte et al., 1998). Genuine Savings attempts to adjust conventional Net Domestic Savings for environmental depletion and for investment in human capital. It subtracts from Net Domestic Savings an estimate of depletion of forest and minerals, adds expenditures on education (viewed as investment in human capital) and subtracts a notional damage charge for carbon emissions. In the World Bank estimates, forest depletion reduced Net Domestic Savings by 20% in low-income countries, mostly in Asia (Hamilton, 2001).

Table 2.9 Costs of forest depletion and degradation in selected countries

Country	*Change in GDP/NDP*
Indonesia, 1971-1984	-5.4% of GDP
Costa Rica, 1970-1989	-5.2% of GDP
Philippines, 1988-1992	-3.0% of GDP
Malaysia, 1970-1990	-0.3% of GDP
Sweden, 1998	-0.03% of NDP
Swaziland	-0.83 % of GDP

Sources: Indonesia: (Repetto et al. 1987); Costa Rica: (Repetto et al. 1989); Philippines: (NSCB, 1998; Delos Angelos and Peskin, 1998; Domingo, 1998); Malaysia: estimated from (Vincent, 1997); Sweden: (Ahlroth, 2000a); Swaziland: Mbuli, 2003).

There is increasing interest in measures of changes in total wealth (produced capital plus natural capital and human capital) as an indicator of sustainable development (see for example, Dasgupta and Maler, 2000). Some countries, such as Australia and Canada are beginning to publish figures for total national wealth that include non-produced assets such as natural forests. In Australia and Canada, the total economic value of natural capital has been quite small, and the share of natural forests, valued for timber only, was extremely small (Lange, 2001a, 2001b). However, in some developing countries, such as Malaysia (Vincent, 1997) and the Philippines (NSCB, 1998; Lange, 2000) the asset value of forests can be significant.

2.5 Forest valuation and trade-offs among competing uses of forests

Improved understanding of the value of forests can be useful in cost-benefit analyses to determine the optimal use of forests among competing users, often providing a strong economic argument for forest conservation, or at least lessening the incentive for deforestation. In one example, Shahwahid et al. (1999) analyzed the trade-offs among three alternative uses of forestland in the four catchments that make up Hulu Langat Forest Reserve in Malaysia. The Forest Reserve is currently used for catchment protection, providing soil protection and water to a dam for hydroelectric power and water regulation downstream. The alternative uses are two different methods of logging: conventional logging, which provides the most timber but results in high levels of soil erosion that reduce dam capacity, and restricted-impact logging, which provides less timber than conventional logging but also less soil disturbance. The study found that the economic returns to timber alone, under either logging method, were not as great as the economic value of forests from catchment protection. Further analysis showed that a combination of restricted-impact logging and reduced catchment protection provided the greatest economic value. The relatively small reduction of forest catchment protection services from logging was compensated for by the timber value of logging, as long as the restricted-impact method was used.

Some important additional forest benefits were omitted from the analysis—recreation and tourism, biodiversity, non-timber forest products, and other protective services for downstream activities. The provision of these additional benefits is compatible with catchment protection, but would be reduced by logging; if they had been included, the optimal use of forestland might not have included even restricted-impact logging. A similar study of alternative uses of Tongass National Forest, an old-growth, temperate rainforest in Alaska, compared the economic values of logging, tourism and protective services for the fishing industry (maintaining the water quality of rivers used as spawning grounds by fish). Studies showed that the value of forest services to recreation and fishing exceeded the timber value of forests (Alaska Rainforest Campaign, no date).

Although the Malaysian and Alaskan forest studies, and many other similar studies, did not use of SEEA forest accounting framework, they are examples of the kind of policy analysis that the forest accounts can support. The forest accounts provide a framework for assessing the total value of forests, not just direct commercial value from extractive activities, but the goods and services (or loss of these services) provided to other industries as well.

The assessment of tradeoffs among competing users can be estimated in a partial equilibrium cost-benefit analysis, such as the study mentioned above, or in a larger, economy-wide general equilibrium modeling framework. The next section discusses such a modeling approach, which is used for capturing the full cross-sectoral impacts on forestry. But this modeling approach can also be used for evaluating alternative forestland use.

2.6 Modelling the economy-wide impact of non-forestry policies

Assessment of trade-offs in a partial equilibrium framework is a first step toward understanding the cross-sectoral policy impacts on forestry. But understanding the impact of broader changes, such as trade liberalization, population growth, agricultural policy, etc. often requires an economy-wide environmental-economic model. Economic simulation models have been widely used to understand cross-sectoral impacts on forests. Forest accounts are quite useful in this type of analysis because they are an extension of, and consistent with, the national economic accounts. Several versions of simulation modeling are reviewed, from relatively simple forestry multiplier analysis to more complex general equilibrium analysis based on hybrid forestry IO/SAM models.

2.6.1 Forestry multiplier and impact analysis

There is a long history in regional and forestry economics of applying input-output (IO) or social accounting matrix (SAM) multiplier analysis to evaluate the employment and income effects of forestry on a local economy[3]. For example, the US Forest Service has developed an IO multiplier model that can be applied for every county in the country (Alward and Palmer, 1983; Loomis, 1993). This method is used to analyze the dependence of a local economy on forestry and to answer questions, such as, how will changes in forestland management affect the local economy? Will the loss of jobs in one

[3] Analysis also uses, where available, social accounting matrix models, which are IO models expanded to include more detailed information about the generation and spending of incomes among different categories of households.

sector (e.g., logging, saw milling) be offset by job gains in other sectors (e.g. tourism)? What are the effects on employment and income in other sectors of the economy?

IO models represent the transactions among all sectors of the economy in a double-entry bookkeeping framework, where each transaction is recorded simultaneously as a sale and a purchase between two sectors. This allows the calculation of 'upstream' and 'downstream' linkages from one sector to all others in the economy. The upstream linkages for logging, for example, include the direct inputs purchased by the logging sector such as fuel and materials, plus the indirect inputs needed to produce the direct inputs to logging. One can trace the impacts of logging on the economy by traveling downstream as well: the use of timber as input to sawmills, the use of sawn wood by other wood processing sectors, the use of these wood products further downstream, etc. At each stage, upstream and downstream, employment and income is generated. A small change in logging creates multiplier effects throughout the economy, affecting upstream and downstream industries and the employment and income associated with them.

Virtually all industrialized countries use these IO multiplier models, or more complex general equilibrium models based on a Social Accounting Matrix (an IO table extended to trace the flows of income), for forestry impact assessments (e.g., Ashton and Pickens, 1992; British Columbia Ministry of Forestry, 1999; Macaulay Land Use Research Institute, 1999). Multiplier analysis is also used in developing countries where IO tables are constructed, such as China, India, Indonesia, the Philippines, Korea, Mexico, South Africa, etc. Simple forestry impact models are derived from national accounts and usually represent only the monetary transactions in an economy. Analysis has traditionally focused on income and employment impacts of forestry or changes in forest management, but not on the broader environmental impacts, or the impact of non-forestry policies on forests.

To include impacts on the environment, hybrid IO tables have been constructed, which extend the standard IO tables for environmental data represented in physical units. 'Hybrid' refers to the mix of monetary and physical units in the table. Hybrid accounts have been used extensively for energy analysis (e.g., Miller and Blair, 1985; Pearson, 1989; UN, 1999). There has been some use of forestry IO tables in conventional multiplier analysis, but such analyses usually include only the use and supply of wood products in physical units.

The forest accounts allow construction of a hybrid forestry IO table that includes non-market forest goods and services as well. For more extensive analysis, such as will be described in the next section, extended forest-related accounts are required. Forest related accounts would include forest goods and services plus accounts for land, and other environmental factors that may affect forests in a given area: energy, water, pollution, soil erosion, etc soil erosion, water, pollution, and energy, where relevant to the analysis. The model thus includes physical and monetary data about all the forestry-related resources needed for sustainable forestry management and for assessing cross-sectoral impacts on forestry. The framework for such a hybrid IO table is shown in Table 2.10.

Table 2.10 Hybrid input-output table for forest and forest-related resources

A. Inter-industry table (in monetary units)

	Intermediate consumption by ISIC code							Final Users	
	1	2	3	4	5	6	7	Consumption (public + private)	Imports
1. Agriculture									
2. Forestry									
3. Mining									
4. Manuf. of wood products									
5. Other manufacturing									
6. Utilities and trade									
7. Services									
Value-added									
Employment									

B. Extension for Hybrid Forestry IO Table (in physical units)

Wood products									
Non-wood products									
Land									
Energy									
Water									
Pollution, soil erosion, other environmental impacts									

2.6.2. Forestry simulation models and forest accounts

There are several examples of hybrid simulation models for forestry based on environmental accounts. The first two studies reviewed here are relatively limited in scope—a study of fuelwood use in Tanzania, and the potential demand for forests as a carbon sink. The next two studies address the issue of deforestation in a much broader context—the impact of structural adjustment programs in the Philippines and the impact of Indonesia's Second Long-term Development Plan on forests. The latter two studies are good examples of the attempts to fully understand the complex linkages between macroeconomic policy and deforestation.

Peskin et al. (1992) undertook a study of factors influencing deforestation in Tanzania using environmental accounts for forestry and energy. They found that use of fuelwood was a major contributing factor to deforestation; fuelwood is not only widely used by households, but is also widely used for processing agricultural products, notably tobacco curing. Peskin found that fuelwood use was strongly influenced by energy pricing policy and macroeconomic policies that affected the foreign exchange rate. Deterioration of the exchange rate created incentives to substitute fuelwood for imported commercial fuels. In addition, a decline in the exchange rate increased demand for products like tobacco, requiring more fuelwood and increasing pressure on forests. A more complete set of accounts would have included stock accounts for forests and land use, tying the demand for fuelwood directly to the supply, but this information was not available.

A new interest in forest and land accounts has emerged from international efforts to compensate for greenhouse gas emissions by creating carbon sinks in tropical forests. A growing number of studies have analyzed the potential value of forestland as a carbon sink compared to its value under alternative uses. Peck and Descargues (1997) reviewed a range of energy policies that could be considered in Europe and their potential impact on forests. The authors found that energy policy would not, by itself, have a major impact on forests. However, when policies to mitigate carbon emissions from fossil fuel were considered, they found a positive impact on forests. This study did not make use of forest accounts, but represents the kind of study that could make use of the accounts.

One of the major applications of the SEEA in Europe has been in analysing green taxes—especially carbon taxes, but also taxes on other air pollutants. These models, usually multi-sectoral CGE models, use the energy and pollution accounts of the SEEA. Typically, these models assess how high carbon taxes would have to be to achieve a target level of emissions. However, policy-makers can also consider other carbon mitigation measures, such as purchase of tradable carbon emission permits, or carbon storage by forests. Tropical forests can offer attractive options for carbon storage.

A Swedish study (Nilsson and Huhtala, 2000) analyzed the advantages to Sweden of purchasing carbon-trading permits as an alternative to implementing measures to reduce domestic levels of carbon emissions in order to meet Sweden's carbon target under the Kyoto Protocol. The analysis estimated a 'reservation price' indicating the maximum amount a country would be willing to pay for carbon storage in tropical forests. Analysis of forest and land accounts in tropical countries have estimated corresponding reservation prices—the minimum payment the country would be willing to accept to use forestland for carbon storage rather than other purposes. A study by Castro and Cordero (2001) estimated the reservation prices in 8 regions of Costa Rica (which have different opportunity costs and carbon productivity) for 27 different agricultural activities. The reservation prices were lowest for livestock and rice, and highest for export crops like coffee and pineapples.

The environmental accounts have been used in developed countries, especially Europe, mainly to analyze issues related to pollution and environmental taxes. Economy-wide studies of forestry are largely restricted to traditional multiplier analyses that show the employment and income generated by forestry. Two studies in developing countries have explicitly combined environmental accounts with economic models to address cross-sectoral policy linkages to forestry, one for the Philippines and one for Indonesia.

The Philippines: environmental-economic modeling and forestry

In the early 1980s the Philippines experienced a debt crisis and the World Bank and IMF stepped in with stabilization and structural adjustment programs. Stabilization programs are short-term program to address macroeconomic imbalances such as unmanageable balance of payments deficits. They usually reduce government expenditures considerably, shift resources into the production of internationally tradable goods, and introduce measures to refinance debt. Structural adjustment programs (SAP) have a longer-term objective of restoring sustainable economic development, often through the promotion of economic liberalization that targets exchange rate and trade policies, the size and composition of government expenditures, and the extent of government control over the economy. The discussion of underlying causes of deforestation in section 2 noted that such programs might create incentives for more intensive, unsustainable exploitation of forests and other natural resources, which would be exported in order to pay off the debt, or at least interest on the debt.

There have been many analyses of the economic impacts of stabilization and structural adjustment programs, but a purely economic model cannot inform policy-makers about the impact on the environment. Similarly, there have been numerous studies of the changing condition of the Philippines' forests, but they have not been linked to the impacts of macroeconomic policy changes throughout the economy.

Cruz and Repetto (1992) examined the impacts of structural adjustment in the Philippines using an environmental-economic model to simulate the impact of the actual policies of the SAP and alternative policies, which could have been undertaken by the SAP. The authors constructed a multi-sectoral CGE model of the economy, and combined it with environmental accounts and a population migration model. They point out the need to link the CGE model of the economy with environmental accounts in order to analyze how the economic changes result in changes in forestry and land use, energy use, generation of pollution, and demand for other natural resources. The forest and land accounts were disaggregated by geographic area as well as ecological characteristics such as type of forest and agricultural potential. This was one of the first attempts in developing countries to create a framework that made use of both economic accounts and the environmental accounts for policy analysis.

Their analysis provided quite detailed results regarding the impact of SAP on the environment. Regarding forests, there was initially concern that SAP would encourage increased exploitation of forests; in fact, output from forests declined, partly due to the collapse of the domestic economy and domestic demand for forest products, but also in response to falling world market prices. Despite declining timber production, deforestation increased because of land clearing by impoverished households. While migration of poor people to forest lands as shifting cultivators trying to earn a subsistence livelihood was already occurring, the increased unemployment and poverty that resulted from SAP accelerated migration and the resulting deforestation. The environmental-economic model also showed that the negative impact of SAP could have been reduced if environmental concerns had been incorporated in the SAP and safeguards had been put in place to protect forests and other resources. While their results may be disputed, the researchers did demonstrate the usefulness of such a model to understand this complex issue.

Indonesia: environmental-economic modeling and forestry

To assess the environmental implications of Indonesia's Second Long-Term Development Plan (1994-2018), an environmental-economic model was constructed by integrating environmental accounts (land, forests, water, energy, pollution) with a multi-sector, dynamic input-output model (Hamilton, 1997; Lange, 1997). Land and forest accounts were disaggregated by geographic region and agricultural potential. Conflict over resource use and the deterioration of the environment required evaluations of tradeoffs between economic growth and potentially serious degradation of the natural resource base, especially forests. The study assessed the demands of the country's development plans on the natural resource base and identified the kinds of technological and policy changes that might make it possible to achieve the development objectives given the environmental constraints.

In the late 1980s and early 1990s, much of the concern over deforestation in Indonesia had focused on excessive logging of natural forests for timber exports, and to a lesser extent, the clearing of forests by slash-and-burn cultivators. However, analysis revealed that a large and growing share of timber products was used domestically in manufacturing and construction. Promotion of rapid macroeconomic growth combined with plans to develop a large paper and pulp would increase demand for wood products and decimate Indonesia’s forests, even with strict controls over timber exports. At the same time, the plan to maintain food self-sufficiency would require substantial increases in land for farming, which could further increase pressure on forests.

The analysis found that development objectives could be met only if there were substantial changes both in the forest sector and other sectors of the economy, as well as careful land use planning. The required changes included increased efficiency of timber harvesting and wood processing, increased efficiency of wood use in the construction industry, pricing policy reforms, but most importantly, an expansion of land under forest plantations to reduce pressure on natural forests. This last requirement brought the needs of sustainable forestry in conflict with agriculture. Detailed land accounts indicated that if forest plantations expanded only in degraded areas not suitable for agriculture, it would still be possible to meet many agricultural objectives.

2.7 Summary and comments

This section has reviewed how the forestry accounts have been implemented in different countries and how they have been used. In most countries, the forest accounts have mainly been used to assess forest asset values and the value of forest goods and services, providing a better indication of the benefit of sustainable forestry and what would be lost from deforestation. In particular, the accounts were able to identify the forest values that are attributed to other sectors (like agriculture and tourism) or totally omitted from conventional national economic accounts. This information can be useful in cost-benefit analyses to assess the economic benefits and trade-offs from alternative uses of forests.

However, from the examples reviewed here, coverage of forest values is incomplete and varies widely among countries. The most comprehensive forest accounts have been constructed under the Eurostat pilot programme, but even these did not attempt to measure the value of forest environmental services, except for carbon storage. There is still a great deal of work to be done.

Few countries have taken full advantage of the opportunities provided by the forest accounts for analysis of the linkages between forestry and other sectors of the economy, or macroeconomic policies. Part of the problem is one of information. Detailed information is needed about the flows of forests goods and services to each sector of the economy, as well as the use of land and other resources by each sector of the economy. As seen in Table 2.1, only developed countries compiled such detailed accounts on a regular basis. The developed countries have used parts of their environmental accounts for policy modeling, and supply and use tables for timber ad wood products are used in modeling. But the broader forest accounts supply and use tables have not been used much.

Two countries, the Philippines and Indonesia, have used environmental accounts to examine cross-sectoral policy impacts on forestry. Although events have largely overtaken both these countries since the time of the studies, they illustrate the kind of analytical framework that can be developed from the forest accounts and the broader accounts of the SEEA.

3. Forest accounts at the regional level and for individual forests

Most forest accounts have been constructed at the national level, yet countries often have separate forests or regions with distinct characteristics, which have very different forest economic values. While accounting for the total economic value of forests at the national level is indispensable, forest management also requires a relatively localized or regional approach, which reflects local forest characteristics. In order to better represent regional differences, some forest accounts have been constructed at the regional level or for individual forests.

Chapter 1 identified three levels at which for policy formulation and resource management: the macroeconomic (national) level, the sectoral or industry-wide level, and the local community/regional or company level. This chapter explores the relationship between forest accounting at the national level and the regional/forest level. Two issues are considered: how spatial disaggregation of national accounts to the regional level can improve the policy usefulness of national forest accounts, and how the accounting framework can assist stakeholders at the regional or even local level in forest management. Case studies from Swaziland and Spain are used to help explore these issues. In Swaziland, national forest accounts were constructed from comprehensive regional accounts defined on the basis of ecological zones and type of forest. In Spain, forest accounts were constructed for a single forest, but were not related to national forest accounts.

3.1 Spatial disaggregation of national forest accounts

In designing forest policy at the macroeconomic level, an overview of the role of forestry in the economy is needed, which national level forest accounts provide. Many of the policy issues discussed in the previous chapter require analysis at the national level. Also, the total dependence of other sectors on forestry services, summed across all regions and forests, can help foresters in their negotiations over national budget priorities and coordination of forestry and non-forestry policies at the national level. National forest accounts provide the basis for designing policy to address international concerns such as participation in carbon markets.

A strong argument can be made, however, for some regional differentiation of the accounts even in addressing sectoral and national level policy issues. At the sectoral level for example, setting priorities for investment in forests and forest management is an issue that requires both the overview of all forests provided by national forest accounts as well as accounts for each region or forest in which investment will take place. At the local level, the best investments for a specific forest can be identified; at the national level, priorities are set among the regions for investment. Decisions can be made only by ranking the socio-economic costs and benefits in each region.

At the national level, the value of forest benefits may constitute a relatively small share of GDP, even when all the non-market benefits are accounted for. However, forest benefits may be very high for some regions within a country, or for specific communities within a region. Even assessments of macroeconomic policies on forestry would benefit from some regional disaggregation of forest accounts. The previous chapter described case studies for the Philippines and Indonesia of the impacts of macroeconomic policies on forestry based on national forest accounts. Both of these countries are vast, with forests and forest utilization that vary significantly from region to region. In order to represent the geographic variation, the national forest accounts were disaggregated by geographic and ecological characteristics. The national-level framework of the forest accounts then became a strength rather than a weakness, because it provided a framework for consistent and comprehensive treatment of all land and forests, which in turn allowed aggregation of localized impacts to determine the cumulative impacts for the national economy.

3.2 Regional forest accounts and accounts for individual forests

It is increasingly common to build national forest accounts from accounts for more detailed sub-national regions or for specific forests. For example, Mbuli (2003) constructed forest accounts for Swaziland based on separate accounts for each of the four major ecological regions. Campos (2000) provides a collection of six case studies of forest accounts compiled for individual forests in Spain, the USA, and Colombia, and Haripriya (2000) constructed forest accounts for the Indian state of Maharashtra. Other forest accounts, including most of those from developed countries listed in Table 3.1 as well as South Africa, the Philippines and others, were constructed from regional accounts, although the regional detail may not be reported in the forest accounts.

In this section, two forest accounts are presented as examples of two different approaches to spatial disaggregation. The first is an account for a single forest in Spain, while the second example is the forest accounts for Swaziland disaggregated by ecological region.

3.2.1 Accounts for the Guadarrama silvestris pinewood forest in Spain

Capparós et al. (2001) constructed accounts for a forest in the Guadarrama Mountains, which is one of the best areas for commercial *Pinus silvestris* and also a very popular recreational area because it is only 100 kilometres from Madrid. These compete with additional uses of the forest for livestock grazing and local harvesting of mushrooms, as well as the global benefits from carbon storage and biodiversity conservation. The purpose of this study was to account for the economic value of all uses, and to determine the distribution of forest benefits to different stakeholders.

Commercial logging is the only market activity in the forest: recreation, hunting, and mushroom picking all take place free of charge. Livestock grazing is also mainly a market activity, but there is no charge for grazing in the forest. For most activities, the value can be estimated on the basis of similar products or close substitutes that are marketed. Recreation, carbon storage and biodiversity conservation were estimated using other methods described in Chapter 2. Table 3.1 shows the value of each forest product and the valuation method used. For comparison, the authors estimate the net income from production of forest goods and services and, in the case of logging, the distribution of income between landowners and forest workers. Most other activities have few or no intermediate inputs.

Local beneficiaries are the largest beneficiaries, receiving 46% of the value of forest goods and services, followed by regional communities who receive 42%. Commercial logging is the single most valuable activity, accounting for 40% of forest goods and services, split between land owners (35%) and forest workers (5%). Additional benefits from livestock grazing, hunting and local mushroom picking account for another 6%. Recreational activities, split between mushroom picking and other recreational activities, account for 42% of the forest benefits and accrue to regional communities, many from nearby Madrid. Global beneficiaries from carbon storage and biodiversity conservation receive 12% of net benefits.

Table 3.1 Value of forest goods and services in Guadarrama sylvestris pinewood forest in Spain, 1998

	Net income/benefit		
	(euros/ha)	**Percent of total**	**Valuation method**
1. Local beneficiaries (47%)			
Timber	134	40%	Market value of timber
Land owners	118	35%	
Forest workers	16	5%	
Grazing of livestock	10	3%	Market rental cost of similar grazing area
Hunting	2	1%	Market value of commercial game meat
Mushroom picking, local	11	3%	Market value of commercial mushrooms
2. Non-local, regional beneficiaries (42%)			
Mushroom picking, recreational	9	3%	Market value of commercial mushrooms
Recreation (except mushroom picking)	132	40%	Travel cost method
3. Global beneficiaries: local, regional, international (12%)			
Carbon	7	2%	Damage averted method
Biodiversity conservation	33	10%	Contingent valuation method (only of people in the region)
Total value	**341**	**100%**	

Note: figures reported per hectare only, not for total area
Values are reported net of intermediate inputs
Figures do not sum to total due to rounding

Source: Adapted from Capparós et al. (2001) Tables 2 and 7

3.2.2 Forest accounting by ecological region in Swaziland

The national forest accounts of Swaziland were constructed as a joint project of the Department of Forestry and the Central Statistics Office from accounts compiled at the regional level utilizing information collected under the Swaziland Forest Resource Assessment (Mbuli, 2003). Regions were classified by the major ecological zones described in Table 3.2. Accounts were also partly reported for 13 major types of vegetation in natural forests, woodlands and bushlands, and cultivated forests (Table 3.3). The forest accounts do not fully cross-tabulate the two sets of criteria for classification, although they could be compiled in that manner.

Table 3.2 Ecological zones of Swaziland

Ecological zone	Characteristics of ecological zone	% of country	Population in 1999 (millions)
Highveld	Average altitude 1300 metres, Average annual rainfall 1000-1500mm Semi-humid climate with short grassland forest patches	33%	0.29
Middleveld	Average altitude 500 metres, Annual rainfall 600-750mm Tall grassland with scattered trees and shrubs High rates of soil erosion	28%	0.37
Lowveld	Average altitude 200 metres, Annual rainfall 600-750mm Near tropical climate Mixed and acacia savannah	31%	0.21
Lubombo plateau	Average altitude 600 metres Hillside bush and plateau savannah	8%	0.05
Total land area and population		**1.7 million hectares**	**0.92 million people**

Source: Mbuli, 2003

Table 3.3 Distribution of forests and woodlands in Swaziland by type of vegetation, 1999

Vegetation Types	Area (ha)	% of total
Natural forest	36,556	4.6%
Dense montane highland	10,510	1.3%
Open montane highland	839	0.1%
Riverine forest	25,207	3.2%
Natural woodlands	382,261	48.5%
Mixed woodlands, dense	52,971	6.7%
Mixed woodlands, open	116,649	14.8%
Acacia, dense	10,293	1.3%
Acacia, open	168,020	21.3%
Dry acacia woodland, dense	1,482	0.2%
Dry acacia woodland, open	32,846	4.2%
Bushland	232,954	29.5%
Dense bushland	55,683	7.1%

Open bushland	177,271	22.5%
Cultivated forests	136,662	17.3%
Pine and gum	110,222	14.0%
Wattle	26,440	3.4%
Total	788,433	100.0%

Source: Adapted from (Hassan et al. p. 5, Table 1)

Swaziland has a large commercial forestry sector with cultivated forests, and significant non-market use of forest products from natural forests, mainly by rural households. Forestry companies provided information for the commercial sector. Information for the non-market sector was provided largely from the Swaziland Forest Resource Assessment (FRA) carried out by the Department of Forestry (DANCED, 1999, 2000). Under the FRA and a subsequent survey of household utilization of forest products, a survey of 119 rural households collected information about the volume and prices of forest products used in each ecological zone. Although most products are collected for own use, there is a substantial informal market in forest products as well. Neither is these uses are included in the national accounts.

From the survey, per capita resource use was calculated for each ecological zone and applied to the total rural population in that zone. Surveys of urban population, which accounted for 23% of the population in 1999, were not carried out. For the forest accounts, it was assumed that their per capita use of firewood was half that of the rural population; the use of other forest products in relation to rural use is much lower, ranging from 2% for craft wood to 28% for timber for home construction.

The value of commercial timber, the only economic contribution of forests reported in the national economic accounts, is emlangeni (E) 40.4 million in 1999, while the value from natural forests to local communities of non-market timber and NTFP is more than four times as great, E 170.4 (Table 3.4). Estimated tourism benefits are extremely low, but additional benefits from carbon storage in commercial plantation forests are substantial, more than twice the value of commercial logging.

The most important non-market forest product item in each region is timber, accounting for over 90% of the total value of forest products. The Swaziland accounts further disaggregate this product into firewood, construction of homes, construction of fences, and construction of cattle enclosures. Firewood accounts for most wood use in all regions, but the relative importance of each wood product varies by region. Thatch and weaving grasses are next in importance in all regions except Lubombo, where livestock grazing is more important. Unfortunately, the study did not cross-tabulate forest benefits by region and forest cover in order to calculate benefits per hectare of forest.

Table 3.4 Production of forest goods and services in Swaziland by ecological zone, 1999 (million emlangeni)

Cultivated	Natural forests and woodlands	Total

	forests (mainly highveld)	High-veld	Middle-veld	Low-veld	Lubombo	Sub-total	
1. Commercial timber	40.7						40.7
2. Forest products for own-use, mainly non-market							
Timber		56.9	44.3	38.1	15.7	155.0	155.0
Edible plants		0.4	0.2	0.5	0.1	1.2	1.2
Medicines		0.1	0.4	0.1	0.0	0.7	0.7
Thatch, weaving grass		3.1	3.0	2.7	0.1	9.0	9.0
Livestock grazing		1.5	1.6	1.1	0.3	4.6	4.6
Sub-total		62.0	49.6	42.6	16.2	170.4	170.4
3. International tourism						0.1	0.1
4. Carbon storage	91.3	Carbon values for natural forests and woodlands not distributed by ecological region				7.9	99.2
Total							**310.4**
GDP, 1999							**8,410.0**
Forest values omitted from GDP:							
Forest products for own use (except livestock)*							165.8
Carbon storage							99.2
Subtotal							264.0

*assumes virtually the entire production value of non-market forest goods is value-added (labor cost), so the production value and contribution to GDP are the same. (See discussion in Chapter 2)

Note: The currency of Swaziland, the emlangeni, is equivalent to the South African rand and was worth 0.154 euros in 1999.

Source: Adapted from Hassan, Mbuli, Dlamini, 2002 p.40 table 11 and author's calculations.

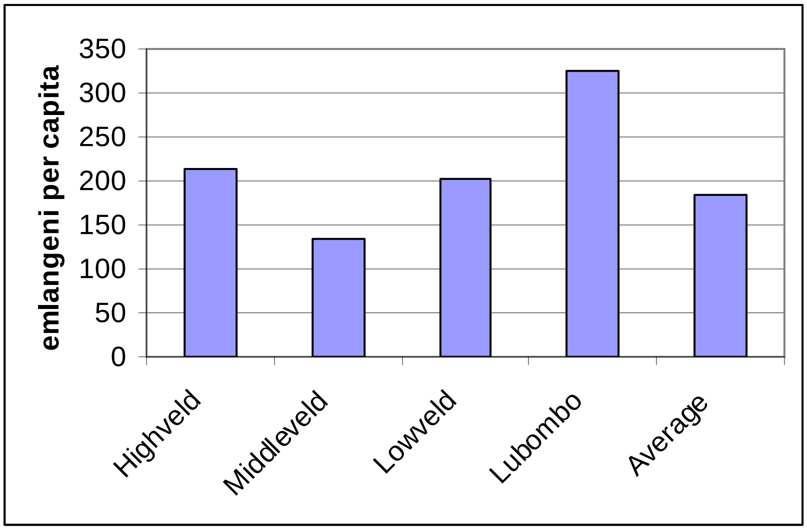
Local, foreign and global beneficiaries of forest goods and services

The forest benefits in the Swaziland accounts can be divided largely into local benefits and foreign/global benefits, as described in Chapter 4. Local benefits accrue from employment in the commercial forest and tourism industries and from harvest of forest products for own use. Profits from commercial logging accrue to foreign owners, and carbon storage benefits the global community. There is no estimate in the forest accounts of forest services such as watershed protection, which would benefit regional, non-local communities.

Distribution of local forest benefits by region

The Swaziland regional accounts have been used so far only to construct a national picture of the forestry sector. The socio-economic role of forestry in livelihoods in different regions has not been analyzed yet. But the use of the regional surveys and the systematic construction of national accounts from regional surveys provide some insight into the dependence of rural households on forests. The average per capita benefit of local communities from non-market forest products is E 185, but this ranges a great deal among different regions, from a high of E 324 in Lubombo to a low of E 134 in the Middleveld.

Figure 3.1 Distribution of forest benefits by region in Swaziland, 1999



Source: Calculated from data in (Mbuli, 2003)

Further understanding of the dependence of households on forests is provided by information about which household members have responsibility for gathering forest products (Table 3.4) and proximity to forest resources (Table 3.5). The responsibility for collection forest products falls largely on women and children, a result of the traditional division of labor as well as fewer employment opportunities for women in rural areas. Men primarily collect wood used for construction purposes. Many households find forest resources close at hand, but close proximity to forest resources varies greatly by region: only 14% of households in Lubombo region compared to 57% in the highveld region.

Table 3.4 Responsibility for collection of NTFP by gender and region in Swaziland, 1999
(in percent)

	Highveld	Middleveld	Lowveld	Lubombo	Average
Wife	39	22	27	24	28.9
Wife & children	13	34	23	29	25.4
Children	14	10	20	0	11.2
Husband	17	9	14	12	13.1
Husband & children	17	10	9	29	16.3
Men as hired labor	0	6.4	5.9	5.9	4.6
Men as community project	0	1.8	0	0	0.5
Total	100	100	100	100	100

Source: Adapted from (Hassan et al. 2002, p. 63) and (Mbuli, 2003, Table 1.3, p. 67)

Table 3.5 Distance to forest product source by ecological region in Swaziland, 1999
(percent of households)

	Highveld	Middleveld	Lowveld	Lubombo	Average
very near	57%	31%	42%	14%	40%
2-3 hours	27%	39%	26%	43%	31%
3-5 hours	0%	6%	11%	14%	7%
whole day	17%	24%	21%	29%	22%
Total	100%	100%	100%	100%	100%

Source: Adapted from (Mbuli, 2003, Tale 4.5, p. 68)

3.3 Challenges for regional and local forest accounting

These two case studies for Swaziland and Spain are fairly typical examples of forest accounting at the regional or forest level. How useful are they for addressing regional or local forest management issues?

3.3.1 Distribution of forest benefits and trade-offs among competing forest users

Both case studies identify market and non-market forest values, providing stakeholders with a more comprehensive picture of the economic benefits from sustainable forest management and what stands to be lost from deforestation. The accounts also identify the beneficiaries of forest services, which is very useful in identifying obstacles to sustainable forestry. When major benefits do not accrue to land owners/users, the incentive for sustainable forestry declines, even though the social benefits from sustainable forestry may outweigh the benefits from land use conversion. By identifying forest beneficiaries, forest accounts provide a basis for negotiations over payments for environmental services.

Like national forest accounts, the non-market forest benefits that are easiest and most often incorporated in regional or forest-level accounts are

1. Non-market wood and NTFP that primarily benefit local communities
2. recreation and tourism services which, in developing countries like Swaziland, benefit mainly foreigners or in developed countries like Spain, may benefit regional communities
3. the value of carbon storage, which mainly benefits the global community.

The accounts for the Guadarrama forest in Spain indicate the importance of recreational services to "downstream" beneficiaries. At present, beneficiaries do not pay landowners for this service and the private benefits from logging appear sufficient to ensure sustainable forest management. But if there is pressure on forests in the future, it may be appropriate to devise a system for users to pay for this service. In Swaziland, the regional forest accounts can be used by stakeholders to demonstrate the rural livelihoods that would be lost, and would need to be replaced, if more forest land were converted to forest plantations or to large-scale commercial agriculture.

These examples show how regional or forest-level accounts may be helpful to stakeholders where non-market forest products to local communities have not been systematically taken into account in forestland use decisions. In both case studies, estimates of forest services like watershed protection, which mainly benefit downstream communities, were not estimated. It is not possible to determine *a priori* how economically significant these services are, but their inclusion is most likely to increase the total benefits from sustainable forestry.

The surveys used to construct forest accounts for Swaziland provide considerable amount of information about the use of forest resources and how this varies by region. Additional information that, for example, differentiates forest resource use by type of household in each region, that cross-tabulates resource use by region and forest cover, and that includes information about household income would provide a powerful tool for forest managers. Extensive work in South Africa by many researchers and summarized in (Shackleton and Shackleton, 2002) indicates that within a rural community, dependence on forest resources varies enormously.

Regional forest accounts, linked to additional demographic and socio-economic data, would provide forest managers and local stakeholders with a tool to determine, for example, what local areas are under greatest stress relative to population needs, the importance of forest products in livelihoods, and to design management strategies appropriate to each region. For example, the regional forest accounts can be used by stakeholders to demonstrate the rural livelihoods that would be lost, and would need to be replaced, if more forest land were converted to forest plantations or to large-scale commercial agriculture.

3.3.2 Regional forestry-economic modeling

More extensive policy analysis at the regional level, comparable to the economic modeling at the national level that was discussed in the previous chapter, could measure the impact on employment and the regional economy of major land use changes or macroeconomic policy impacts. Such analysis may be important when the national or international benefits from some forest uses are important. For example, commercial forestry may support downstream processing and wood product industries outside the local region, which generate significant employment and foreign exchange earnings. These activities may also generate downstream pollution and environmental damage, which would not be represented in regional forest accounts.

Integrated forestry-economic modeling at the regional level requires combining regional forest accounts with corresponding economic accounts for the region. Compilation of national economic accounts is virtually universal, so linking national forest accounts to a national economic model is relatively straightforward. But the development of regional economic accounts is much more limited. Regional forest accounts will have more limited use for regional forest management unless they can be integrated with corresponding regional economic accounts.

Regional economic accounts are regularly compiled only in developed countries and some large developing countries such as China, India, Indonesia, and the Philippines. Few developing countries compile regional economic accounts on a regular basis. Even where regional economic accounts are available, they may not correspond well with regional forest accounts. Economic accounts are compiled for administrative regions; in the two case studies, Swaziland regionalized forest accounts on the basis of ecological criteria, while the Spanish accounts were compiled for a particular forest. Neither of these geographic areas corresponds to administrative regions used for collecting economic statistics.

Furthermore, economic data may be less accurate and less detailed at the regional level. Often, statistical methods are used to estimate some national economic figures, and these methods may be less accurate at the regional level. Furthermore, a single company may dominate industrial activity within a given region, and confidentiality requirements prevent publication of detailed economic accounts for that industry. Of course, this is not a problem just affecting forestry; the lack of good regional economic data limits all local and regional decision-making. Some of these issues are addressed further in the section on economic modeling with forest accounts.

Chapter 4. Guidelines for policy analysis using forest accounts

The last two chapters described the major policy applications of forest accounts, demonstrating these applications with examples from a number of countries. In this chapter, general guidelines for implementing forest accounts as a tool for cross-sectoral policy are proposed in the form of a standard set of tables or worksheets that can be filled out based on the forest accounts. These worksheets show how to calculate useful indicators and the parts of the forest accounts used with economic models. While there are many indicators that can be produced from the forest accounts this chapter will focus on the indicators that are useful for cross-sectoral policy analysis. A more complete set of indicators is shown in Appendix A, which shows the correspondence between forest accounts and the Montréal Process set of Criteria & Indicators.

Of course, the details of the forest accounts—the type of NTFP and forest services provided, the geographic disaggregation, household classifications, the classification of forests, etc.—and the resulting worksheets, will vary from country to country. It is not possible to provide a worksheet for every possible variation, but possible modifications for each worksheet will be noted. The worksheets are developed first for national forest accounts, but most can be used at both the national and the regional or local level. Each worksheet indicates the section of the preceding chapters where the application was discussed. Indicators are presented for each of the major policy issues identified in the previous chapters.

Constructing forest accounts is a highly technical undertaking, and the discussion below assumes familiarity with the accounts. Precise definitions, data sources, and economic valuation techniques are discussed in Part II of the manual.

4.1 Economic value of forests, including market and non-market goods and services

Whether forest accounts are used at the national level to highlight the economic importance of investing in sustainable forestry relative to other sectors, or at the local level for land use planning, it is useful to start with an overview of the economic importance of forests in relation to other economic activities as sources of income and employment. In contrast to national accounts, which often include only commercial logging, forest accounts also include the non-market products, including timber, NTFPs, and forest services. As examples in Chapters 2 and 3 indicated, these non-market goods and services may surpass the value of commercial timber.

It is especially important to identify the dependence of rural communities on forests for their livelihoods, and the dependence of other sectors of the economy on forest services. These values demonstrate to a broader, non-forestry constituency why they have a stake in sustainable forestry. Table 4.1 summarises the accounts for forest goods and services; they are aggregated into three major categories for presentation here, but of course would be disaggregated by type of product as seen in previous chapters and described in Part II. Both physical and monetary accounts are included.

Physical accounts are useful so that forest services to other sectors can be recognized (for example, by land area) even if a reliable economic value cannot be established. Also, forests may not appear economically significant, even after including all the 'missing non-market values,' but forests may be very important from a social or environmental perspective, factors that also enter into the discussion about sustainable forestry. The physical accounts may help reveal this. For example, although the economic value of firewood may be small, firewood may account for a large share of national or regional energy.

Many useful indicators can be obtained from this table, which can be used by forest managers and other stakeholders to demonstrate the importance of forests in the economy, to other sectors, and for rural livelihoods. Some of these indicators are shown in Table 4.2. The analysis of the forest accounts at this level was discussed in section 2.2 The first set of indicators identify the true economic contribution of forests to GDP, including goods and services often underestimated or omitted.

The second set of indicators is related to services to non-forestry sectors. They show how dependent other sectors are on forestry and what is gained from investing in sustainable forestry. These indicators are clearly central to understanding cross-sectoral linkages. They also show the potential for the creation of markets for environmental services and other economic instruments to promote sustainable forestry. The expanded worksheet for these indicators is shown in Table 4.3. The first part of Table 4.3 is the part of the forest accounts that covers use of forest services in physical units; the second part shows the monetary accounts and some of the indicators that could be derived to measure dependence of non-forestry sectors on forests.

The third set of indicators concern the utilization of forests by rural communities, an issue discussed in greater detail in the next section. These indicators are critical for decision-makers because economic values alone may not provide a good measure of the broader social value of forests, that is, the dependence of rural communities on forests. For example, although the value of NTFP used by rural communities may be small value in relation to GDP, it may constitute a large share of household livelihoods. While much of the discussion of cross-sectoral linkages has focused on other economic activities, the livelihoods or rural communities is also a critical issue for forests management.

The final set of indicators show the forest services rendered to the global community in terms of carbon storage and biodiversity protection. As with regional forest services, these indicators also show the potential for the creation of markets for these services, such as carbon markets and other payments for biodiversity.

Table 4.1 Output of forest goods and services

	Commercial forestry	Non-market (Household)	Non-forestry economic activities (agriculture, tourism, hydropower, water supply, etc.)	Total
Physical accounts (various units described in Chapter 6)				
1.Products of the forestry and logging industry (e.g., m^3)				
2. Non-timber forest products (e.g., kg, number of livestock grazed, land area)				
3. Forest services (e.g., land area providing service, tons of CO2, etc.)				
Employment generated				
Monetary accounts (valued in national currency units, described in Chapter 7)				
1.Products of the forestry and logging industry				
2. Non-timber forest products				
3. Forest services				
Total value of forest output				

Note: This version of the accounts for forest goods and services is aggregated for presentation here. The full accounts are based on a detailed set of goods and services.

Table 4.2 Worksheet 1: Major indicators derived from accounts for output of forest goods and services

Purpose	Indicator
Economic contribution of forests relative to other sectors of the economy	Value of total forest goods and services as % of GDP
	Share of forest goods and services included in GDP, and omitted values as % of GDP
	Forest employment as % of total (national or regional) employment
Non-forestry sectors: economic contribution of forest services to non-forestry commercial sectors	% of land area providing forest services
	% of national energy provided by firewood
	% of tourists visiting forests
	% of employment in non-logging industries dependent on forest services
	Value of forest services as % of GDP
	Value of forest services as % of output and sectoral GDP of sector that benefits (e.g., agriculture, tourism, etc.)
Rural livelihoods: economic importance of forest to rural communities	% of rural energy needs met by firewood,
	% of household nutritional requirements provided by forests,
	% of animals grazed in forests
	Forest employment as % of rural employment
	Value of output by non-market and small-scale producers as % of GDP
	Value of output by non-market and small-scale producers as % of total forest value
Global benefits: economic importance of forest services to the global community	Carbon storage as % of national/global carbon emissions
	% of land are devoted to biodiversity protection
	Value of carbon storage as % of total forest value and of GDP

Table 4.3 Forest services to non-forestry sectors

Physical accounts (various units)	**Agriculture**	**Fisheries**	**Tourism**	**Hydroelectric power**	**Municipal water supply**	**Other sectors**	**Global beneficiaries**
Pollination of crops	X						
Livestock grazing (can be treated as NTFP)	X						
Tourism services in forests			X				
Water and soil protection services	X (water quality)	X (protection of fish habitat)	X (Water quality and flow on rivers)	X (Water quality and flow)	X (water quality and flow)		
Carbon storage							X
Biodiversity protection (in addition to tourism)							X
Other services (e.g., coastal storm protection, noise reduction, protection from avalanches, etc.)							

Monetary accounts (national currency units)	**Agriculture**	**Fisheries**	**Tourism**	**Hydroelectric power**	**Municipal water supply**	**Other sectors**	**Global beneficiaries**
Services							
Pollination of crops							
Livestock grazing							
Tourism services in forests							
Water and soil protection services							
Carbon storage							
Biodiversity protection							
Other services							
Total value of services to industry							
Indicators							
Value of services as % of industry's value-added							
Value of services as % of industry's output							
Industry employment							

Table 4.4 Worksheet 2: Average output of timber and non-timber forest products per household

	HOUSEHOLD 1				HOUSEHOLD 2			
	Amount collected	**Amount sold**	**Amount purchased**	**Total use**	**Amount collected**	**Amount sold**	**Amount purchased**	**Total use**
Physical accounts (various units/household)								
1.Timber and tree products								
2. Non-timber forest products								
Employment generated								
Monetary accounts (valued in national currency units/household)								
1.Timber and tree products								
2. Non-timber forest products								
Total value of forest output								
Additional information								
Forest products as % of average household consumption								
Number of households								
Average number of people in household								

It is also useful to include information about the average household utilization of forest products, and to calculate the share of total household consumption that forest products account for (Table 4.4). Here, a distinction is made between the amount collected, sold and purchased by a household. Additional information useful in a socio-economic assessment of forests includes: which family members within a household collect forest products and how much time it takes to collect. This type of account requires very detailed surveys. In many countries, there is little information about use of forest products by different households, so that only a single set of data for the nation (or region) can be derived about household dependence on forest products. There have been case studies that differentiate households within a region, such as (Cavendish,…; Shackleton and Shackleton, 2002), but no forest accounts have included this information at this time.

The indicators could further distinguish by other policy-relevant characteristics. For example, output for each producer could distinguish by the type of forest from which products were extracted. Forests can be defined by a number of attributes, most commonly tree species or 'degree of naturalness (cultivated *v* natural forest). This can be useful in decisions affecting use of natural forests. It is also helpful for policy makers to have a time series, for comparison of the indicators in Table 4.2 over time.

4.2 Distribution of forest benefits

Distribution of forest goods and services is also useful for cross-sectoral policy analysis, helping to identify who benefits from forests by region, scale of operation, and other features. As discussed in Chapters 3 and 4, there are several ways in which distribution of can be viewed: regional distribution, scale of activity, and distance of the beneficiary from the forest. There is some overlap among them. Alternative dimensions may be useful.

Regional distribution was described in section 3.2.2 and an example shown in Table 3.4 of forest values in Swaziland disaggregated by ecological zone. The indicators listed in Table 4.2 can be constructed for each region or for an individual forest, providing a picture of the importance of forests with a region. When accounts are compiled for multiple regions, it is possible to compare the contribution of forests among regions (Table 4.5).

The regional accounts can also identify the use of forest products by non-forestry sectors, as in Table 4.3, and for different households, as in Table 4.4. This will reveal in which regions non-forestry industries and rural communities are most dependent on forest products. Although not shown in Tables 4.3 or 4.4, comparison of average regional output of non-market forest products per hectare of forest land may also be a useful indicator.

Table 4.5 Worksheet 3: Major indicators disaggregated by region

Purpose	Indicator: Region 1	Region 2	Region 3	Total
Economic contribution of forests relative to other sectors of the economy	Indicators from Table 4.2			
Non-forestry sectors: economic contribution of forest services to non-forestry commercial sectors				
Rural livelihoods: economic importance of forest to rural communities				
Global benefits: Economic importance of forest services to the global community				

Scale of activity—the distribution of benefits to commercial, artisanal, and subsistence users—is another useful dimension to consider. Table 2.6 gave examples for Sweden and south Africa that distinguished three categories of beneficiaries: private commercial operators (logging as well as other commercial activities like agriculture), households, and multiple beneficiaries (including services that benefit several sectors, like watershed protection, and the global community). Other countries may wish to make other distinctions among beneficiaries, depending on the institutions utilizing forest resources.

Finally, distance of the beneficiary from the forest is another characteristic useful for cross-sectoral policy analysis. It is relatively easy to identify the benefits to local users and to draw them into discussions about forest management. But the further the distance between the forest and the benefits from the forest, the more of a challenge it may be. As Table 3.7 showed, the classification of benefits may differ from one country to another. For Spain, benefits could be allocated to local beneficiaries, regional beneficiaries (recreation services; no regional forest protection services were included in the accounts), and global beneficiaries. For Swaziland, a small country, two types of local beneficiaries were identified: subsistence households and large, foreign-owned commercial companies. There were no regional beneficiaries because regional protection services were not estimated and virtually all tourism is foreign. Global beneficiaries included global forests protection services plus tourism. Table 4.6 shows a generalized version of a worksheet that could be used to monitor the distribution of forest goods and services.

4.3 Forestry and sustainable economic growth

Understanding the contribution of forestry to sustainable economic development, viewed from the macroeconomic perspective, is important, although perhaps not central to the analysis of cross-sectoral policy linkages, so it is dealt with only briefly here. At the macroeconomic level, the forest accounts provide indicators of total forest value and the cost of forest depletion such as those listed in Table 4.7. These indicators are discussed in detail in Part II.

Table 4.6 Worksheet 4: Distribution of forest goods and services among local, regional and global beneficiaries (as percent of total value of forest goods and services)

	Local beneficiaries			Regional beneficiaries	Global beneficiaries
	Commercial-domestic	Commercial-foreign owned	Households		
1.Products of the forestry and logging industry	X	X	X		
2. Non-timber forest products			X		
3. Forest services	X[1]	X[1]		X[2]	X[3]

[1] Agriculture, tourism and recreation, commercial fisheries, etc.
[2] Recreation of regional tourists and forest environmental protection services to hydroelectric power, agriculture, municipal water supply, fisheries, etc.
[3] Forest environmental protection services: carbon storage and biodiversity protection

Table 4.7 Macroeconomic indicators including forest values

Conventional indicator from national accounts	**Proposed adjustment from forest accounts**	**Revised indicator**
GDP	Omitted non-market forest values	GDP including full value of forests
Depreciation capital stocks	Depletion of natural forests[1]	Total depreciation including depletion of natural forests
NDP	Depletion or degradation of natural forests[1]	NDP including loss of natural forests
National wealth	Capitalised value of natural forests	Total national wealth including natural forest assets

[1]Depletion of cultivated forests is included in the national accounts. This issue is discussed further in Part II.

The indicators tell policy-makers, for example, how dependent the national economy is on forests, whether this dependence is increasing or the economy is becoming more diverse, and the extent to which economic growth is sustainable or has been obtained by liquidating natural capital like forests. The indicators identified earlier in this chapter are based on the forest flow accounts, but these indicators also make use of the forest asset accounts.

4.4 Trade-offs among competing users

Cost-benefit analysis is the main economic tool used for assessing trade-offs among competing uses; it is often used for project or policy evaluation at the local or regional level. The example from Malaysia in Chapter 2 showed how land use conversion and deforestation could result from a lack of information about all the goods and services provided by forests to other sectors of the economy, and a lack of institutions or regulations to monetize these services so that forest owners are compensated for the services forests provide.

Analysis of trade-offs requires assumptions about what will happen if forest management objectives change. The starting point, an assessment of the value of present uses of a forest, can be provided by forest accounts. Analysis of alternative uses usually requires some modeling, because a change in forest use is likely to have an impact on the ability of a forest to deliver goods and services. A change in logging, for example, could affect tourism, water quality (affecting many users), or the availability of NTFP to rural communities in ways that cannot be determined from the forest accounts.

The CBA for Malaysia described in Chapter 2 provides a good example of the general steps necessary for carrying out the analysis of trade-offs among alternative uses of a forested water catchment area. Initially, the forest was protected from logging and maintained entirely for its water production services. Shahwahid et al, (1999) analyse three alternative options for the forest: 1) maintain present forest management for water services production, 2) allow only restricted-impact logging, or 3) allow unrestricted logging. Their analysis has four parts:

Identify the values of the present uses of the forested catchment. In this case, several users were identified: hydroelectric power, irrigated agriculture, municipal water supply, and harvesting of forest goods by local communities. Additional services not included in the study include tourism, biodiversity protection and carbon storage.

*Model physical changes under alternative land use options (*in this case, sediment yield). A biophysical model is required to assess the affect of changes in forest use on water flow and quality—measured here in terms of soil erosion and sediment flow into the river.

Value the benefits and costs for alternative land use options. This step involves calculating the value of the *benefits* from two alternative options for logging and the *costs* from reduced water services provided to other users. Measurement of benefits is a relatively straightforward valuation of timber harvested. Measurement of losses is more complicated in that it has two components: measuring the physical impact of the changes in water services on the productivity of the users, and valuing it.

Evaluate the potential economic rents and their distribution. Finally, the economic rent is calculated under each of the three options; rent indicates the value of the forest itself. Distribution of benefits is also considered because the decision about land use must take into account both economic and social impacts.

The accounts for forest goods and services provide information for the first step, identifying the value of forests services (water production services) to current users. The present use of the forest constitutes one of the options for forest management, so the forest accounts also provide information about economic rent and the distribution of benefits under this option.

A more extensive analysis of the socio-economic benefits of forests would include measurement of the upstream and downstream linkages from each user, in terms of changes in employment and national income under each option. This is a standard analytical technique developed for input-output and SAM analysis. This analysis shows more fully the dependence of the regional and national economy of forestry, and the impact of land use change.

4.5 The impacts of non-forestry policies on forest use

Cross-sectoral policy impacts on forestry result from a range of macroeconomic, sector-specific, and institutional policies that have far-reaching effects throughout the economy on unemployment, wages and income, relative prices, and other factors that ultimately affect decisions about use of forests. Simulation analysis is an ambitious tool for understanding this process, which seeks to represent the full chain of effects from indirect causes at the macroeconomic level, through the activities and policies of different economic sectors, to the direct causes and ultimately, to decisions by individual agents about the use of forests.

The data requirements for simulation models are quite extensive and not all countries will be able to implement this application of forest accounts. The examples for the Philippines and Indonesia discussed in section 2.6.2 used environmental-economic models based on combined database of an IO/SAM and environmental accounts can trace the interdependencies of the economy and the environment, and the chain of effects of economic policies on the natural resource base.

As with CBA, the forest accounts provide a starting point or base year for a model: forest land use, timber harvest, NTFP harvest, and provision of forest services. The model itself typically generates a change in pressure on forestland due to a combination of economic, demographic or other factors (such as climate change). The model includes equations that generate feedback effects on forests in terms of economic behavior, population movements, and forest ecology. The data requirements for this kind of analysis are shown in Table 4.8. They include an IO table or, preferably, a SAM to represent the economy and its inter-dependencies, and forest accounts.

Accounts used to build simulation models also include resources that are closely related to forest use such as land, pollution, water, and energy. For forestry issues, land could be classified by ecological characteristics such as type of land cover, agricultural potential, and slope and soil erosion potential. Land accounts can also be classified by economic or institutional characteristics such as degree of forest protection, accessibility to settlers, economic user of the land (with detailed accounts for users like agriculture and infrastructure, which put the most pressure on forestland).

Simulation models used to assess impacts of non-forestry policies on forests require a great deal of data. Even the relatively simple forestry multiplier models require input-output tables of the economy, which are not constructed by all developing countries and the data are not always up-to-date or very reliable. CGE models are designed to assess the response of households and firms to changes in market signals, such as the relative prices of products, labor, or exports, so they are particularly well suited to addressing the cross-sectoral policy linkages affecting forestry. CGE models are based on SAMs, which represent the most detailed implementation of the national accounts. The drawback of simulation modeling is the amount of data required. For countries that do not compile SAMs, IO tables may be available, which can be used for more limited simulation modeling.

Table 4.8 Data requirements for simulation models of cross-sectoral policy impacts

1. ECONOMIC ACCOUNTS
IO table or SAM for the national or regional economy
2. FOREST ACCOUNTS
2.A Forest assets accounts
Timber
Non-timber values (by major type of value)
Forest land (by type of tree-cover, availability for use, ecological characteristics including agricultural potential, slope, etc.)
Carbon storage
Forest balance accounts
2.B Forest resource flow accounts
Detailed supply and use tables for wood products, market + non-market
Detailed supply and use of non-timber goods and services
Environmental degradation from different forest-based activities
3. LAND AND ECOSYSTEM ACCOUNTS
Land use and land cover by economic sector, and ecological characteristics appropriate to policy: agricultural potential, tourism potential, soil erosion potential, etc.
Land use change accounts
4. OTHER RESOURCE ASSETS AND FLOW ACCOUNTS
Pollution, energy, water as relevant to deforestation in a given country

4.6 Concluding comments

4.6 Concluding comments

Forest accounts provide a comprehensive framework for representing all goods and services provided by forests to all other sectors. However, data is not readily available for all components of the accounts:

- *Commercial logging:* physical and monetary data are relatively easy to collect and are available in most countries
- *Non-market timber and NTFP use by households*: data not readily available but can be collected through surveys
- *Forest services provided directly to other sectors* (tourism, agriculture): data not usually available but can be measured and valued through surveys
- *Environmental protection services*: very little data is available, biophysical measurement is difficult, and the prospects for scaling up from case studies is very limited.
- *Carbon storage and biodiversity*: physical data are generally available; carbon storage can be valued, but valuation of biodiversity may be difficult

The strongest data are those for commercial logging. Carbon storage data is readily estimated from forest stock accounts. Household use of timber and NTFP can be collected through surveys. Forest services to sectors like tourism can also be directly measured through surveys. However, another component of forest accounts that is important for cross-sectoral policy analysis, environmental protection services, is extremely weak and remains a challenge for any approach to cross-sectoral policy analysis. The data sources and experiences with implementing forest accounts are discussed in Part II of the manual.

PART II. CONSTRUCTION FOREST ACCOUNTS

5. Overview of forest accounting

Forest accounts provide a framework for a) linking forest asset (balance) accounts with flow accounts for timber, non-timber forest products (NTFP), and forest ecosystem services in physical and monetary terms; and b) linking forest asset and flow accounts with the SNA. The SEEA provides a measure of forest values that is more comprehensive than the SNA in two respects. First, the SEEA forest accounts include both cultivated and natural forests in the asset accounts. Second, the SEEA forest accounts attempt to include all forest goods and services, both market and non-market, in the flow accounts. This section begins with a brief discussion of forest goods and services and how they are represented in the SEEA forest accounts. It then presents the definitions and classifications used for the forest accounts

5.1 Forest goods and services

Forest accounts address the total economic value of forests, that is, all the goods and services provided by forest ecosystems. Economists divide these economic benefits into several categories, first of all distinguishing between *use values* and *non-use values* (Text Box 1.1). The former include *direct use values*, *indirect use values* and *option values*. Direct use values include economic benefits obtained from direct use of the forest, which can be extractive (e.g., timber, fuel wood, edible plants, and game, medicinal plants) or non-extractive (e.g., recreation and tourism). Indirect use benefits refer to environmental services provided by forests that are of value indirectly, such as carbon sequestration, the provision of habitat to protect biodiversity, or various ecosystem protection services, such as the ability to reduce soil erosion and the siltation of rivers. Option value refers to the value people may place on maintaining the option to enjoy the direct or indirect use values at some time in the future, including preservation of a natural gene bank.

Non-use values are of two kinds: bequest value and option value. Bequest value refers to the desire to leave natural capital to future generations. Existence value refers to the benefit obtained simply from knowing that certain wilderness areas, or species are being conserved. For example, many people will never have the opportunity to see the Amazon rainforest, yet are willing to pay for its preservation.

Wherever possible, all these values would be represented in both physical (forest land in hectares, timber harvested in cubic metres) and monetary units in the accounting framework. Box 5.1 shows the goods and services most commonly included. Because of measurement problems, forest accounts have been limited to use values, direct and indirect. 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 the SNA although in practice the estimation of non-market goods and services may be quite limited in some countries. Indirect use of forest services such as for biodiversity protection and hydrologic function are often represented in physical terms only because of difficulties with valuation.

Box 5.1 Forest goods and services included in forest accounts

Use Values	**Examples of goods and services in forest accounts**
Direct use values: direct use of forests to extract resources such as timber, tree products, wild game and plants, and other non-timber forest products; and the direct use of forests for non-extractive purposes such as recreation and cultural activities.	Timber Non-timber forest products Recreation and tourism Livestock grazing
Indirect use values: indirect environmental services provided by forests such as carbon storage, habitat and biodiversity protection, hydrologic function.	Carbon storage Biodiversity protection Hydrologic function Soil protection/stabilisation
Option value: value of maintaining the option for use of forests, direct or indirect, in the future.	Not included in forest accounts
Non-Use Values	
Bequest value: value of nature left for future generations.	Not included in forest accounts
Existence value: intrinsic value of forest ecosystems, including biodiversity, the value people place simply on knowing that a forest exists even if they never visit it.	Not included in forest accounts

Indirect use of forest services for carbon storage is relatively easy to measure in physical terms and there is some international consensus on valuation. But use of other indirect services, such as biodiversity protection, is represented qualitatively through physical indicators. In the economics literature, a range of economic techniques has been developed to estimate these values, but there is no agreement on valuation at this time, so monetary forest accounts have omitted them.

In the forestry economic literature, there has been quite a bit of work to estimate option value and non-use values. However, these values are rather experimental at the present time; neither the SEEA nor any official forestry accounts have attempted to include these values. In future, when there is greater consensus on these values, they may be included.

5.2 Representing forest goods and services in the accounts

The forest accounts consists of the four major components described for environmental accounts at the beginning of this chapter. The representation of forest goods and services in the four components of the forest accounts is shown in Table 5.1.

Table 5.1 Components of the SEEA forestry accounts

1. Forest-related asset accounts **Wooded land:** land area and economic value by main species, natural and cultivated forest land, available for wood supply or not available, etc. **Standing timber:** volume and monetary value of by main species, natural and cultivated forest land, available for wood supply or not available, etc. Depletion and depreciation of standing timber
2. Flow accounts: forest goods and services (volume and economic value) **Forestry and logging products** market and non-market production **Non-timber products** Output of game, edible plants, medicinal plants, etc. **Forest services** Direct intermediate inputs to other sectors, e.g., livestock grazing Recreation and tourism Carbon sequestration Protective services: Biodiversity and habitat preservation Protective services such as prevention of soil erosion **Supply and use tables for wood products, forestry and related industries** **Degradation of forests** due to forestry or non-forestry activities, such as defoliation **Environmental degradation** caused by forest-related activities, e.g., soil erosion from logging, water and air pollution from wood processing industries **3. Expenditure on forests management and protection** Government expenditures Private sector expenditures
4. Macroeconomic aggregates Value of forest depletion and degradation Measures of national wealth, national savings and Net Domestic Product adjusted for forest depletion/accumulation
Memorandum items (examples) Employment, income, exports from non-timber goods and services Number of households dependent on non-timber forest products Rights of forest exploitation Stumpage fees and other taxes or subsidies for forestry and related industries Manufactured assets like roads, buildings and equipment for forestry, logging, tourism and other uses of forestry

5.3 Definition and classification of forests and wooded land

The forest accounts are based on two integrated assets: wooded land and standing timber. The definitions and classifications of forests in the SEEA 2003 as well as the European framework for forest accounts are based on the UN-ECE/FAO Temperate and Boreal Forest Resource Assessment 2000. The definitions are summarized here; more detailed discussion can be found in the SEEA 2003 (UN et al., 2003, p. 341-344) and the Eurostat report (Eurostat, 1999a pp 13-18).

5.3.1 Wooded land

The 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

> *Forested land* is defined as tree crown cover (or equivalent stocking level) of more than 10 per cent 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 per cent of trees able to reach a height of at least 5 metres at maturity *in situ*, or a crown cover of more than 10 per cent of trees not able to reach a height of 5 metres at maturity *in situ* and shrub or brush cover. Areas having tree, shrub or brush cover that are 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).

Although this definition does not cover all land with trees, it has been used so that data can be harmonised at the international level. In implementing forest accounts, countries may choose to revise this definition for more policy-relevant information.

Forested land is further subdivided into *forests available for wood* supply, even though harvesting may not be occurring at the present time, and *forests not available for wood supply*, where legal, economic, or environmental restrictions prevent any significant wood production.

Forested land available for wood supply can be further disaggregated by the degree of "naturalness" of the forest, ranging from completely uncultivated to plantation forests. It is important to make this distinction because the SNA calculates the production of the forest industry differently for cultivated and natural forests. The SNA treats natural growth of cultivated assets as a process of production, and hence it is accounted for as output of the forest industry. Natural growth of non-cultivated forest is, instead, a natural process and therefore not treated as a productive activity. The SEEA recommends the FAO classification of 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 forests.)

> *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 mono-cultures. (UN et al., 2003, p.343)

Forested land may also be classified by the dominant tree species (constituting at least 75 per cent of the tree crown): coniferous (*gymnospermae*), broad-leaved (*angiospermae*), bamboo, palms, etc. (*gramineae*, etc.), and a residual category for mixed forests. *Forested land not available for wood supply* may be classified by the degree of restriction (for example, using IUCN categories), as well as by major tree species.

The forested land classification developed by a given country may not include all these sub-classifications, and there may be difficulties in cross-classifications, for example between naturalness of the forest and dominant tree species. More detailed classifications of wooded land may be most appropriate for regional forest accounts, with national accounts compiled for more aggregate classification.

5.3.2 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 which 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.

6. Physical forest accounts

Physical accounts for forests are described in three parts:

- Asset accounts for wooded land and standing timber
- Production of forest goods and services
- Supply and Use Table

Examples are drawn mostly from the SEEA 2003 Handbook and the Eurostat Pilot Programme in forest accounting, notably (Eurostat, 1999a, 1999b, 2002a, 2002b). Each section provides some discussion of countries' experiences implementing the accounts.

In seeking to strike the balance described in the introduction between the technical information required to construct forest accounts and the focus on policy applications needed by forest managers and other forest stakeholders, the technical description is relatively brief. Practitioners can find a more detailed treatment of the technical aspects of constructing forest accounts in the numerous reports by Eurostat referred to in this chapter and the SEEA-2003.

6.1 Physical asset accounts for wooded land and standing timber

6.1.1 Wooded land and standing timber

All asset accounts have three parts: opening stocks, changes during the accounting period, and closing stocks. Changes during the period are divided into those that are due to economic activities and those that are due to natural or other causes. The components appropriate for forest accounts are demonstrated with examples from Finland.

The first two tables constitute forest balance accounts, the asset accounts for forestland and for standing timber in physical units (Tables 6.1 and 6.2). These tables report only the distinction by availability for wood supply; the full accounts are compiled on a more detailed basis for each category of forest, that is, by dominant species and age class of tree, naturalness of the forest, protection status, etc.

Table 6.1 Forest asset accounts for wooded land, Finland 1998 (1000 hectares)

	Available for wood supply	Not available for wood supply	Total
Opening area	20675	2093	22768
Changes due to economic activities			
Afforestation	7		7
Deforestation	-7		-7
Other changes			
Natural colonisation			
Natural regression			
Other			

Changes in classification	-3	3	0
Revaluation			
Closing area	20672	2096	22768

Source: Adapted from Eurostat 2002a, Table 10, p. 24

Changes in forest land fall into three categories:

Changes due to economic activity: afforestation, the increase in wooded land area due to human activity, and deforestation, the reduction in area due to human activity, such as forest clearing for agriculture, building, etc.

Other changes: changes in area due to natural causes such as natural expansion or colonisation or natural regression, or for reasons which cannot be determined

Changes in classification: changes in classification within wooded land area, such as a reclassification of forest land from available for wood supply to unavailable for wood supply. Changes may also occur due to catastrophic events such as fires or storms. The former is an economic decision while the latter is classified as non-economic

Table 6.2 Forest asset accounts: volume of standing timber, Finland, 1998
(million m^3)

	Available for wood supply			**Not available for wood supply**			**Total on all forest land**
	Conifers	**Broad-leaved**	**Total**	**Conifers**	**Broad-leaved**	**Total**	
Opening stock	1501.5	322.9	1824.4	57.3	5.3	62.6	1887
Natural growth	279.8	80.3	360.1	8.1	2.3	10.4	370.5
Fellings	-215.2	-55.9	-271.1				-271.1
Harvested timber	-201.5	-45.2	-246.7				-246.7
Saw logs	-102	-5.9	-107.9				-107.9
Pulp wood	-91.7	-23.5	-115.2				-115.2
Fuel wood	-7.8	-15.8	-23.6				-23.6
Timber left in forest	-13.7	-10.7	-24.4				-24.4
Other removals							
Other changes							
Changes in classification	-7.9	-1.7	-9.6	7.9	1.7	9.6	0
Closing stock	1558.2	345.6	1903.8	73.3	9.3	82.6	1986.4

Source: Adapted from UN et al., 2003, Table 8.14, p. 349

There are five categories of changes in stocks of standing timber:

Natural growth is the volume of natural growth during the period, usually calculated by biological modelling

Fellings included timber harvested during the current period, which can be disaggregated by type of product, and timber left in the forest.

> *Other removals* include timber that was felled but not removed in an earlier period. Removals may distinguish trees felled by human activity from trees felled by natural causes (such as disease, fire, storms, etc.). In an alternative representation used for the Eurostat forest tables, the primary category is *Removals*, with a further distinction between removal of fellings during the current period and fellings from an earlier period.
>
> *Other changes* include all reductions in standing timber which are not removed, such as thinnings or trees killed by natural causes that are left in the forest.
>
> *Changes in classification*: changes in classification of standing timber by type of land, such as a reclassification of timber from forests available for wood supply to forests unavailable for wood supply. Changes may also occur due to catastrophic events such as fires or storms. The former is an economic decision while the latter is classified as non-economic.

In some countries, data do not distinguish fellings from removals, and it is assumed that all fellings are removed.

6.1.2 Data sources and country experiences with asset accounts

Asset accounts for forest land and standing timber are perhaps the easiest component of the 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, who 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.

Classifications of forests vary considerably among countries. The Eurostat attempted to find a single set of classifications for forests that all countries participating in its pilot programme could apply. One of the classifications was between cultivated and non-cultivated forests. The conceptual distinction in the 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. Eurostat recommended dropping this characteristic from the classification of asset accounts, although individual countries continue to use it. This distinction is important in many developing countries and the SEEA has recommended three categories natural forests, semi-cultivated natural forests, and cultivated forests.

Most other countries have included some distinction between cultivated forest plantations and uncultivated, natural forests. Data about species composition and age class are often available for forest plantations, but not for natural forests, especially in developing countries. Natural forests comprise a mix of tree species; often a more general classification is needed. For example, the forest accounts of the Philippines classify forests as dipterocarps (new growth and old growth) and pines.

6.1.3 Deforestation, depletion and forest degradation

Estimating the volume and cost of deforestation and forest degradation has been a major motivation for forest accounting, especially in developing countries. The loss of wooded land or standing timber is calculated as the difference between opening and closing stocks, but the SEEA has a separate category, called depletion, which includes only those losses of wooded land or timber that are *due to economic activity*. Depletion of timber includes fellings that exceed net natural growth, but does not include loss of timber due to storms or fires. Depletion of forestland would refer to a permanent change in land use due to economic activity such as land use conversion for agriculture, while clearcutting without the intention of a permanent change in land use would not. If forest land is degraded to the point where it no longer meets the definition of forested land (tree cover falls below 10%), then the land is reclassified as other wooded land.

It would be useful to include in the asset accounts some indication of the health of the forests. Forest degradation can be indicated by many different attributes. In the forest accounts developed by Eurostat, defoliation was chosen as the measure of forests health. Accounts were constructed by all countries in the Eurostat pilot programme from data collected both nationally and transnationally, as part of a European programme to monitor air pollution and its impacts. Table 6.3 shows an example of this account for forests in France. Forest health accounts usually include a reference year for comparison; in the example of France, a comparison between 1995 and 1999 is given. Table 6.3 illustrates accounts for two tree species, but the accounts may be disaggregated by dominant tree species in a given country. It may also be useful to distinguish additional classes of defoliation.

Table 6.3. Forest health: defoliation by species in France

	Defoliation % > 25% (percent of trees)		**Corresponding standing volume of timber** (1000 m3)	
	1995	**1999**	**1995**	**1999**
Conifers	9.2	14.2	78,820	121,180
Broad-leaved	14.2	22.9	189,040	308,850
Total	12.5	19.8	267,860	430,030

Source: Based on Eurostat 2002a, Table 26, p. 30.

Defoliation is only one aspect of forest health. The Crtieria and Indicators (C&I) of the Montréal Process include a much broader assessment of forest health, such as soil erosion, compaction or change in soil physical properties, accumulation of persistent toxic substances, loss of soil organic matter and/or changes in other soil chemical properties, and forest area subjected to levels of specific air pollutants (e.g. sulfates, nitrate, ozone) or ultraviolet B. Forest health is also evaluated in terms of abnormal infestation by pests, disease, exotic species, and other factors affecting forest ecosystem health. The Montréal Process C&I also include the health of bodies of water in forests: deviation of stream flow and timing from historic range of variation, biodiversity of forest lakes and stream, and biochemical health of lakes and streams.

In principle, the forest accounts would include as many of these factors as data allow. Some of these factors could be included directly in the forest accounts. Others require the construction of forest-related accounts for land, water and pollution.

6.2 Physical accounts for forest goods and services

The components of the forest flow accounts discussed here include timber, non-timber forest products, forest services to other commercial sectors and forest environmental protection services. The account for forest products distinguishes products for sale in formal markets, from household's own use and other non-market uses. This characteristic is important for tracking the distribution of benefits from forests.

6.2.1 Timber, non-timber forest products and forest services

Table 6.4 shows accounts for the production of timber and non-timber forest products, and the industries that produce these products in Sweden. Products are classified by the CPC and industries by the ISIC, the classifications used in the SNA.

The first set of products is associated primarily with the forestry and logging industry, which are normally compiled in national accounts. The output of cultivated forests is measured as the natural growth of the forest. The output of uncultivated or natural forests is measured as the felling of timber. Forestry and logging-related services are excluded from the physical accounts for lack of appropriate physical measures. In principle, non-market harvest of timber for firewood, construction and other purposes is also included in the national economic accounts, although in developing countries, they are often omitted for lack of data.

Non-timber forest products include items such as wild foods that are considered agricultural products. Forest goods can be measured in tons, or in other physical units considered appropriate. Figures for timber, both net growth in cultivated forests and fellings from non-cultivated forests, are included in the national economic accounts based on annual forest statistics. In many developing countries, however, the estimates of own-account felling of timber for fuel, construction and crafts may be missing or underestimated; often, it is the largest single non-market forest product harvested by households.

There is considerable controversy over the volume of timber and NTFP. In developed countries, like Sweden and other countries in the Eurostat pilot programme, information is gathered by statistical agencies about the household collection of products such as wild mushrooms and berries. In developing countries, reasonably accurate figures for NTFP may be obtained for activities that are regulated, like hunting, from official statistics. But most information about use of non-market timber as well as NTFP is often collected by household surveys, which are undertaken at wide intervals. Furthermore, the main purpose of household surveys is to obtain information about overall expenditure and income and the survey may not be well designed to capture forest use. In some countries, like Swaziland, this information has been collected under the Forest Resource Assessment programme.

Table 6.4 Output related to wooded land by product and industry in Sweden, 1998

	Industries producing forest products				Type of output		
	Agricul-ture	Forestry and logging	Other industries	Total	Market output	Output for own final use	Other non-market output
Products of the forestry and logging industry (million m3)							
Natural growth of forests		70		70	70		
Raw wood		27		27	26	1	
Other tree products: gum, cork, etc.*							
Forestry and logging-related services**							
Non-timber forest products							
Wild agricultural products: berries, mushrooms (million kg)	31			31	8	23	
Meat, skins, fur from wild game (thousand tons)	16.4			16.4	4.2	12.2	
Livestock rearing (reindeer feeding days, in millions)	56			56	56		
Other forest products							
Forest services							
Recreational services in forests (number of visits in millions)***			373	373			

* not available
**not measurable in physical units
***The number of days could not be determined from the original survey data; it is estimated that most visits are for less than one day.

Source: Statistics Sweden, 2001, Tables 2.3 and 2.6, p. 49 and 5

Estimating the use of non-market forest products requires community surveys, which are expensive and usually not undertaken on a regular basis. Because of the expense of conducting extensive surveys, it is common to use the ‘benefits transfer’ approach, which entails applying estimates of values for NTFP and forest services obtained in one location to many other locations. Because wood and NTFP use may vary a great deal by region, estimates of national volumes are sensitive to the extent of the surveys and the assumptions made in applying survey results to the rest of the country.

Livestock grazing is an important component of the natural forests of some developing countries as well as some European countries. Livestock grazing has been included in the forest accounts of Sweden (Norman et al., 2001), Finland (Statistics Finland, 2000), Spain (Capparos et al., 2001), India (Haripriya, 2000, 2001), South Africa (Hassan, 2002) and Swaziland (Mbuli, 2003). Typically, the amount of grazing can be represented either as the number of days of grazing service for a standard livestock unit, or the tons of fodder. The former is calculated as the product of the number of livestock, and the number of days spent in forest land. This approach was used in India, South Africa and Swaziland. The latter is calculated as the product of the number of livestock, the number of days spent in forest land, and the daily food requirements per animal. This approach was used in Sweden, Spain and Finland. Both calculations distinguish different types of livestock and may further distinguish livestock by age and sex.

Recreational services may be measured in terms of the total number of visitor days provided, a figure often easily obtained from official statistics in both developing and developed countries. Figures can also be compiled for the area of forest land used for tourism.

6.2.1 Forest environmental services

Forest accounts include three environmental services that do not correspond directly to an economic activity of product as defined in the SNA: carbon storage, biodiversity preservation, and protective services for water, soil and other ecosystem functions. Other services may be included where relevant.

Carbon storage is compiled in almost all forest accounts because it can be fairly easily estimated and there is reasonable consensus about valuation. Carbon storage is measured using standard conversions of biomass to carbon content. Table 6.5 shows a standard table for carbon content of total woody biomass. This table, like the table for standing timber, may be further disaggregated by tree species and other forest characteristics. Additional tables may be constructed for forest ecosystems that include carbon contained in forest soils and other biomass in forests such as ground vegetation and leaf litter.

The natural changes to carbon storage are usually calculated by modeling based on stocks of timber, age and species of tree, and other biological parameters. Because of climatic variations, actual change in carbon may vary from one year to the next, so Eurostat has recommended that averages over several years be used. In the Eurostat pilot programme, five countries reported on their experiences with carbon accounting using time intervals from opening to closing stock that ranged from 4 years (Sweden) to 9 years (Finland) (Eurostat, 2002b). Countries reported that carbon estimates for standing timber are fairly reliable, but estimates for carbon in other woody biomass (small branches, stumps, etc.) were not as accurate. Given the importance of climate change, it is likely that scientific information and methods for estimation will improve in the future. This will be especially important for developing countries where there has been less research into parameters for forest carbon storage other than standing timber.

Table 6.5 Carbon balance accounts for woody biomass, Finland
(million tons of carbon)

	Forest land								
	Available for wood supply			Not available for wood supply			Total tree biomass		
	Conifers	Broad-leaved	Total	Conifers	Broad-leaved	Total	Above ground	Below ground	Total
Opening stocks	511	134	645	20	2	22	667	199	866
Natural growth	95	33	129	3	1	4	132		132
Fellings	-73	-23	-96			0	-96		-96
Changes in land classification	-3	-1	-3	3	1	3	0		0
Other changes								11	11
Closing stocks	530	144	674	25	4	29	703	210	913

Note: date not given in source document
Definitions of entries in the table are the same as those in the accounts for standing timber.

Source: Adapted from UN et al., 2003, Table 8.20 p. 357

In addition to carbon storage, forests are widely believed to provide other important ecological services:

A. watershed protection to
    - regulate hydrological flows by maintaining dry season flow and flood control
    - maintain water quality for domestic use by minimizing sediment load, nutrient load, chemical load, salinity
    - reduce land salinization and regulate groundwater levels
    - control soil erosion and sedimentation of streams that adversely affect hydroelectric power plants, irrigation systems, water supply systems, and fisheries habitat
    - maintain aquatic habitats, eg, shading streams to reduce water temperature, providing woody debris and habitat for aquatic species
B. habitat to conserve biodiversity (Pagiola et al., 2002)

There is a great deal of debate about the nature and value of these services and very few forest accounts include environmental services other than carbon storage. The impact of land use change on soil and water can only be verified at relatively small scales (tens of kilometres) (FAO, 2002). At larger scales it may be difficult to distinguish the impact of land use change from other processes because of the complexity of the processes at the watershed level and the time lags between change and its impact. The extent of the watershed protection services can vary enormously due to site-specific characteristics such as catchment size, topology, and the state of land use (Chomitz and Kumari, 1998; FAO, 2002).

The links between forest services to agriculture, hydroelectric power, domestic water supply, etc. are difficult to measure in physical terms and services can vary enormously by site making it difficult to extrapolate from case studies. In the Eurostat pilot programme, several countries compiled physical accounts that identify the land area providing protection services, an example is shown in Table 6.6.

Table 6.6 Wooded land providing environmental protective services in France, 1990-1999 (1000 hectares)

	Opening area, 1990	Changes	Closing area, 1999
Soil protection	3272	131	3403
Protection of water resources	800	0	800
Avalanche protection	191	141	332
Coastline protection	95	6	102
Other or multiple objectives	1338	104	1442
Total	Na	Na	Na
% of total wooded land	Na	Na	Na

Na: Not applied
Source: Eurostat, 2002b, Table 26, p.38

It is not possible to measure biodiversity conservation services directly, so indicators are derived based on species counts and protection status of wooded land, as shown in Tables 6.7 and 6.8. The species categories are usually further disaggregated, and a table is compiled for a reference year and one for the most recent year.

Table 6.7 Indicator of biodiversity: forest-occurring species at risk or endangered in Sweden, 2000

	Total number of known species	Number of endangered species				
		CR	EN	VU	CR+EN+VU	% of total
Vascular plants (trees and flowers)	2200				48	2.2
Non-vascular plants (mosses, lichens, etc.)	7400	61	121	204	386	5.2
Vertebrates (mammals, birds, etc.)	503	4	5	23	32	6.4
Invertebrates (insects, etc.)	30000	46	125	297	468	1.6

Note: The IUCN categories of species facing a high risk of extinction in the wild in the near future are defined as CR= critically endangered, EN= endangered, VU = vulnerable.

Source: Adapted from Eurostat 2002b, Table 16, p. 29

Table 6.8 Protection status of wooded land in Sweden, 1993-1998 (1000 hectares)

	IUCN Category		Total legally protected area	Other protected areas	% of total wooded land
	I and II	III and IV			
Opening area (1993)	33	382	415	303	3.1
Afforestation					
Deforestation					
Natural colonisation					
Natural regression					
Other changes					
Changes in land classification	6	220	226	-183	0.2
Closing area (1998)	39	602	641	120	3.3

Note: IUCN categories are:
I. Strict nature reserve, wilderness area
II. National park
III. Natural monument
IV. Habitat/species management area

Source: Based on Eurostat 2002b, Table 14, p. 27

6.3 Supply and use table for forest products

The most detailed accounts for flows of goods and services is provided by the supply and use table (SUT). The SUT shows the origin of different forest products, the processing of raw forest products into other products such as sawn wood and fire wood, and the use of each product by every sector of the economy as well as final users (households, government, capital formation and exports). The national accounts provide monetary supply and use tables for forest products. The forest accounts of the SEEA provide the corresponding physical supply and use tables, and, in principle, extend the SUT 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 can be constructed, as well as an input-output (IO) table or social accounting matrix (SAM) in which the production of forest products is represented in physical terms.

Table 6.9 shows the framework for the supply and use of nine different wood products, including two waste products, NTFP and forest services in physical units. Wood products are measured in thousands of cubic metres, NTFP are measured in tons and forest services are measured in various physical units, as described in section above. The Supply table shows the main forest products and the industries that provide them. Standing timber is provided only by the forestry & logging industry; all other products can be supplied by a number of industries, or imported. Total supply equals domestic output plus imports.

The Use table shows the use of forest products as intermediate inputs to industry and use by final users, households, government, exports and capital formation. The intermediate use of wood products is concentrated in several related industries: forestry, manufacture of wood products, pulp, paper, printing, and recycling. Final consumption is generally restricted to three products: fire wood, manufactured wood and wood products such as furniture or construction timber, and paper. Any product except standing timber can be exported. Only standing timber and certain manufactured wood products are treated as capital goods.

In principle, these detailed supply and use tables can be extended to include other, non-timber forest products. In practice, however, such extensive tables are often created only for wood products because of limited data about the use and transformation of non-timber forest goods and services. The forestry SUT for France shown in Table 6.9 includes only wood and wood products.

Table 6.9 Physical supply and use table for wood products, France 1999
(timber, logs and wood in 1000 cubic metres; pulp, paper and waste in 1000 tons)

SUPPLY	Output by industry									
	Forestry & logging	**Wood products**	**Pulp**	**Paper**	**Printing**	**Recycling**	**Other**	**Total ind. Supply**	**Imports**	**Total supply**
Standing timber	95920							95920		95920
Sawn logs	23162							23162	1451	24613
Fire wood	31200							31200	27	31227
Pulp wood	11869							11869	699	12568
Wood & wood products		13017						13017	3490	16507
Paper pulp			2591					2591	2212	4803
Paper				9602				9602	5612	15214
Wood waste as product		8152						8152	686	8838
Paper waste as product					5066			5066	1238	6304
Non-timber forest products							X	X		X
Forest Services							X	X		X

USE	Intermediate consumption by industries								Final users			
	Forestry & logging	**Wood products**	**Pulp**	**Paper**	**Printing**	**Recycling**	**Other**	**Total Int.**	**Consump-tion**	**Capital formation**	**Exports**	**Total use**
Standing timber	66232							66232		29688		95920
Sawn logs		23337						23337			1276	24613
Fire wood							2423	2423	28429		375	31227
Pulp wood			10944					10944			1624	12568
Wood & wood products		7736					6076	13812			2695	16507
Pulp				4372				4372			431	4803
Paper							4465	4465			4167	8632
Wood waste as product		2265	2162				3431	7858			980	8838
Paper waste as product				5276				5276			1028	6304
Non-timber forest products												
Forest Services												

Source: Eurostat 2002a, Table 61, p. 65

7. Monetary accounts for forests

While policy-makers need information about the physical status of forests, policy must also be informed by the economic value of forest resources. Some components of the forest accounts, notably, wooded land, standing timber and timber and wood products often have market prices, which are used for valuation. Many other forest products, especially forest services, are not exchanged in markets and do not have market prices for valuation. Valuation techniques for non-market forest products are not as well developed. There have been many academic case studies and studies related to specific projects, especially for carbon storage, but the methodologies, assumptions required for valuation have not been standardized, and the approaches are not always consistent with the SNA.

The Eurostat pilot programme identified three major difficulties faced to incorporating the value of non-market forest products in monetary forest accounts:

- *Availability of data for non-market forest products.* The underlying physical data as well as the monetary value for non-market forest products varies greatly across countries and, for some forest services, may not exist.

- *Comparability of monetary estimates.* The methods and assumptions used in the valuation studies are not standardised, and many theoretical and practical problems are still being debated. Weaknesses in the physical data, which are often the basis for the value estimates, compound this problem. The use of different methods and assumptions for valuation of different forest services even within the same country limit comparability.

- *Comparability with national accounts data.* When results from valuation studies are combined with national accounts data, care must be taken to avoid overlapping and double counting with values already included in the national accounts. Also, the national accounts data are mainly based on market prices, while most non-market valuation techniques include the consumer surplus (Eurostat, 2002b, p. 45).

The first part of this chapter discusses valuation for forest assets. The next two sections discuss flow accounts and the monetary SUT. The final two sections discuss the two other monetary components of the forest accounts: accounts for expenditures for forest management and macroeconomic indicators.

7.1 Valuing forest assets

7.1.1 Value of wooded land and standing timber

The asset value of forests is based on the stream of benefits a forest generates over its lifetime. In principle, the asset accounts should include the value of all goods and services provided by forests, but, so far, the accounts have been limited to land and standing timber because of the problems of valuation of non-market forest goods and services.

Land value is included in the SNA and is the only non-produced asset that often has a market price. The valuation of wooded land and standing timber is well established in the forest economics literature and will be only briefly described here. The SEEA 2003 provides further discussion of valuation issues in general and Eurostat 2000 provides a detailed discussion of valuation of wooded land and standing timber. In principle, wooded land and standing timber should be treated as separate assets. However, it is not always easy in practice to separate these two assets. Due to location, regulation, or other considerations, the use of wooded land may be restricted to timber (as well as NTFP and forest environmental services); transactions may combine both assets, which, taken together, are called a 'forest estate.'

Wooded land

Ideally, the value of forestland is based on the market value of the bare land that is revealed through sales of land. Where data are not available, the SEEA recommends that land value be estimated on the basis of tax values, or other administrative data, or as a share of the market value of forest estates (land and standing timber combined). Tax values, or similar administrative assessments, are the simplest to use but they may be lower than market values and should be checked against market transactions. Typically, the value per hectare is estimated and applied to the entire area of wooded land.

Where land and timber are combined in a forest estate, it is necessary to estimate the share of land in the total value of a forest estate. An economic technique called hedonic pricing may be used (Box 2). Valuation of wooded land may be especially difficult in developing countries, where the number of market transactions is likely to be small, and administrative data may be weak.

Standing timber

The value of any asset is the discounted present value of the economic benefits it will generate in future years. For forests, the theoretical value of timber based on this concept was first established by Faustmann in 1849 (Faustmann, 1849) and is well established in the forest economics literature. Timber asset value is the discounted future stumpage price for mature timber after deducting costs of bringing the timber to maturity. The stumpage price is the price paid to the owner of the forest for standing timber, or in the absence of such markets the stumpage value can be estimated by deducting the costs of logging and transportation from the price received for raw wood (see below). Costs include thinning (net of any income), other forest management costs and rent on forest land.

Box 2. Estimating land value with the hedonic pricing technique

Hedonic pricing is based on the idea that the purchase of a forest estate represents the purchase of a bundle of attributes that cannot be sold separately: land itself, volume of standing timber of particular species and age composition, and other forest goods and services, such as hunting rights and recreational services. Statistical regression analysis of forests estate sales on the attributes of the forest reveals the amount that bare land, timber volume and characteristics, and NTFP contribute to the total value of land. The same method can be applied to wooded land not available for wood supply. It will have a positive value that includes the value of land plus the value of NTFP. The limitation to this technique is the small number of annual market transactions. In developing countries, where a large share of

The Faustmann method is rather complex as it bases forest asset value on the age structure of forests and the time to harvest. To implement timber valuation, the SEEA lists three alternative methods for calculating the value of standing timber (Mathematical formulas for each method are given in Text Box 3):

Net present value approach implements the Faustmann method described above. It can be implemented using the average stumpage value for all removals, or by distinguishing stumpage values for different species.

Stumpage value approach, also known as the net price method, is a highly simplified version of the net present value approach. It multiplies the physical stock with the average stumpage price of the timber removed. Where there is a market for standing trees, the stumpage values are directly observable. In the absence of such markets (or where market prices may be distorted), the stumpage value can be estimated.   Under highly restrictive assumptions (that the discount rate equals the natural growth rate of the forest), this approach is the same as the net present value approach. This approach may be refined by applying the stumpage value for different species to the remaining stock of each species.

Consumption value approach is a variant of the stumpage value approach where stumpage value is distinguished not only by species, but by age or diameter class as well. The distinction between the two is that the stumpage approach uses the structure of *fellings* for weighting stumpage prices, whereas the consumption approach uses the structure of the *stock.*

Box 3. Value of standing timber

The general expression for the value of an asset, *V*, in the base year, *0*, is simply the sum of the net economic benefits it yields in each year *t*, over the lifetime, *T*, of the asset, discounted to present value by the discount rate, *r*.

$$V_0 = \sum_{t=0}^{T} \frac{p_t Q_t}{(1+r)^t}$$

where *p* is the unit rent (stumpage price) calculated as revenue minus the marginal cost of harvesting, and *Q* is the total harvest in a given period. The SEEA identifies three alternative methods for valuation of standing timber:

1. Stumpage value method

The simplest of the three approaches, asset value of standing timber, *V*, is given as the product of total forest area in hectares, *A*, the stumpage price per cubic metre of timber, *p*, and the quantity of timber per hectare (cubic metres), *Q*:

$$V = ApQ$$

2. Consumption value method

This method expands the stumpage value method to account for the difference in value of trees of *n* different age or diameter classes, *k*:

$$V = \sum_{k=1}^{n} A_k p_k Q_k$$

3. Net present value method

The total value of standing timber, *V*, is the sum of v_τ, the value per hectare of forestland of age class τ, weighted by A_τ, the total area in age-class τ, where *T*, is the actual cutting age, p_t is the stumpage price, q_T, is the timber yield at actual cutting age. The value is discounted at a rate, *r*, by the time remaining until harvest, $T-\tau$. (The following presentation abstracts from other important characteristics that affect forest value such as species, region, site quality, etc, for ease of reading.)

$$V_t = \sum A_{t,\tau} v_{t,\tau} \qquad \text{for } \tau = 1, \ldots, T-1$$

$$v_{t,\tau} = \frac{p_t q_T}{(1+r)^{T-\tau}}$$

or,

$$V_t = \sum_{\tau=1}^{T-1} \frac{A_t p_t q_T}{(1+r)^{T-\tau}}$$

This expression for forest asset valuation can be further refined to reflect timber value, the value of the bare land, p_L, and full rotation management costs, C^s.

$$v_{t,\tau} = \frac{p_t q_T + p_{L,t}}{(1+r)^{T-\tau}}$$

$$p_{L,t} = [-C_t^s + (p_t q_T)(1+r)^{-T}]/[1-(1+r)^{-T}]$$

Additional variations of the net present value method are described in (Eurostat, 2000).

Under the Eurostat pilot programme, countries applied each method with quite different results. Table 7.1 reports the value of standing timber calculated using the three main alternative valuation methods. Although conceptually preferred, Eurostat found the present value approach to standing timber was complicated and required a great deal of data, which not all countries had. Consequently, the stumpage value approach was recommended.

The experience in other countries is mixed; some using the net present value approach and others the stumpage value approach, depending on the availability of data. There is no single standardised approach recommended by the SEEA at this time. International comparability of timber asset values will be limited by the adoption of different valuation methods depending on a country's data availability.

Table 7.1 Value of standing timber using different valuation techniques
(million ECUs)

Valuation method	Germany, 1995	Austria 1995	France, 1991	France, 1996
Stumpage	19.1	19.8	32.1	35.3
Consumption	31.1	22.0	20.8-26.8*	Na
Net present value	-53.0	26.5-28.1*	39.5	Na

* Different assumptions resulted in a range of values

Source: Adapted from Eurostat 2002a

An example of complete monetary asset accounts for wooded land and for standing timber is shown in Tables 7.2 and 7.3. The entries correspond to the physical accounts but contain an additional entry for *revaluation,* which records the change in asset value due to changes in prices between the beginning and end of the period.

Table 7.2 Forest asset accounts: value of wooded land, Finland 1998 (million ECU)

	Available for wood supply	Not available for wood supply	Total
Opening area	5180	524	5704
Change due to economic activity			
Afforestation	2		2
Deforestation	-2		-2
Other changes			
Natural colonisation			
Natural regression			
Other			

Changes in classification	-1	1	0
Revaluation	36	4	40
Closing area	5215	529	5744

Source: Adapted from Eurostat 2002a, Table 10, p. 24

Table 7.3 Forest asset accounts: value of standing timber, Finland
(million Finnish marks)

	Conifers	**Broad-leaved**	**Total**
Opening stock	242,187	32,112	274,299
Natural growth	36,343	6,811	43,154
Fellings	-28,960	-4,342	-33,302
Harvested timber	-28,182	-3,785	-31,967
Saw logs	-19,708	-1,342	-21,050
Pulp wood	-8,130	-1,831	-9,961
Fuel wood	-344	-612	-956
Timber left in forest	-778	-557	-1,335
Other removals	0	0	0
Changes in classification	-1,015	-141	-1,156
Revaluation	-24,351	-518	-24,869
Closing stock	224,204	33,922	258,126

Note: year for accounts not given in source

Source: Adapted from UN et al., 2003, Table 8.15, p. 352

Measuring stumpage value

In some instances the resource rent from timber, or stumpage value, is known from the value paid for standing timber. In other cases, it must be calculated. For individual companies, stumpage value equals raw wood prices minus the logging, transportation and stacking costs. Total national resource rent from logging can be calculated from the national accounts, as in the example in Table 7.4. In this example, forest operations are conducted in part by owner operators. Gross value-added for the industry is 849, of which 200 is paid for employment costs and 649 remains as mixed income. Mixed income includes the labour of owner-operators (100) plus fixed capital costs (consumption of fixed capital (174) and a return to capital assets (133)) and stumpage value (242). Stumpage value is calculated as a residual after estimating all other components of mixed income.

Table 7.4 Example of calculation of stumpage value for timber
(million currency units)

Gross value-added (assuming no taxes or subsidies on production)	849

Compensation of employees	200	
Mixed income/Gross operation surplus	649	
of which:		
Compensation for labour of owner-operators		100
Consumption of fixed capital		174
Return to fixed capital*		133
Stumpage value (resource rent)		242

* calculated as the product of the stock of fixed capital and the rate of return.

Source: Adapted from UN et al. 2003, Table 7.16, p. 308)

7.1.2 Value of deforestation and forest degradation

In the early years of environmental accounting, measuring the cost of deforestation—depletion of forest assets—was a primary motivation for constructing accounts for forests as well as for other natural resources. By the 1990's, a number of alternative approaches to valuing depletion emerged, which result in very different estimates. One approach applies the stumpage value to the excess of fellings over natural growth. The other approach measures the difference in asset value from the beginning to the end of the period. The latter approach takes into account both excess of fellings over natural growth as well as changes in stumpage value during the period that affect asset value. All methods have included only timber value of forests. The mathematical formulation for these methods is provided in Text Box 4.

There has been no agreement about which method to use. The European pilot programme does not recommend monetary estimates of the cost of deforestation or defoliation. The SEEA discusses valuing deforestation but does not recommend a particular method.

Forest degradation has been more difficult to value. The health of a forest determines its ability to provide all goods and services. In principle, the monetary value of a change in forest health would be the monetary value of the resulting change in forest goods and services provided. It is very difficult to directly relate forest health to forest ecosystem productivity (with the possible exception of timber production) and there has been no attempt so far to value the forest health accounts.

The SEEA-2003 provides two different conceptual approaches to valuing degradation: the maintenance cost approach and the damage cost approach. Maintenance cost is based on the cost of actions that would have to be taken to prevent or remediate degradation, for example, the cost of changing logging practices so that they are less environmentally damaging, or the cost of removing silt from a dam. Damage cost is based on the value of the damages or loss of function due to degradation. Damage valuation includes, for example, the reduced income from tourism due to forest damage, the loss of fish production and harvest due to damage of river spawning grounds, or the loss of hydroelectric capacity due to siltation.

Box 4. Monetary value of forest asset depletion

The early approach to depletion valuation applied the stumpage value method to measure net loss (gain) of standing timber in a given year (Bartelmus et al., 1992; Repetto 1987, 1989; van Tongeren et al., 1992). This approach was popular because it was quite easy to calculate. However, it was later recognized that this concept, which corresponds to ecological concepts of sustainability, was not consistent with the economic concept of depreciation used in the SNA. The value of an asset is affected not only by the physical volume, but also by holding gains and losses. (For further discussion, see (Davis and Moore 2000, Vincent 1999)). The revised SEEA-2003 proposes a concept of depletion cost more consistent with economic depreciation: the change in the asset value from one period to the next. However, several alternative ways to measure this cost have been proposed and no consensus has yet been reached.

***1. Depletion using stumpage value method for net loss (gain) of standing timber*:**
Depletion, D, is calculated as the volume of harvest above net growth times, Q - G, times the stumpage fee, p:

$$D_t = p_t(Q_t - G_t)$$

***2. Economic depreciation approach*:**

$$D_t = V_t - V_{t+1}$$

where V_t , V_{t+1} are defined using net present value method to calculate *V*, an approach developed by Vincent (1999) specifically for forests. The change in asset value takes into account both physical changes in the asset as well as value changes, capital gains or losses, which is consistent with the method of calculating depreciation of manufactured assets in the SNA.

In the absence of efficient markets, these measures are likely to be quite different. The damage cost is the theoretically correct approach for measuring changes in economic well-being, but both measures provide useful information for environmental management. Calculating the cost of degradation relies on good data linking the physical status of a forest and the services it provides; these data are often difficult to obtain and sometimes highly speculative. In calculating the costs of forest degradation, practitioners must take care not to double count. Forest degradation that affects production is already included in the national accounts in terms of higher production costs or lower output for hydroelectricity, agriculture, fisheries, etc. The forest degradation accounts are useful for making explicit the reason for higher costs, relating these costs to forestry.

7.2 Valuation of forest goods and services

Ideally, forest accounts would identify three components of the value of forest goods and services: the output or production value, the value-added part of output value, and the *in situ* value of a resource. The value-added generated by forest goods and services is a portion of the extraction costs, measured as output minus all intermediate costs of production. This value is the contribution to GDP. In some instances, such as the collection of fire wood, the primary inputs are labor, cutting implements, and sometimes transportation if the fire wood is not carried by hand. In many developing countries the labor input constitutes the largest input and other inputs are ignored. Where there is extensive commercialization of forest products, other costs, such as transportation may become important.

The *in situ* value is the resource rent generated by forest products, the value of the product minus its extraction costs, which is comparable to the stumpage value of timber. It is, in principle the amount that someone would be willing to pay to rent the forest in order to have access to the product. If non-market forests products were to be included in forest asset accounts, it is the *in situ* value that would be used.

As a general observation, forest accounts have most often measured the physical quantities and output value of NTFP, but have not always calculated the value-added component of these products, and have rarely considered the rent or *in situ* value. For the harvest of NTFP, household labor is often the main input and the distinction between total value-added and *in situ* value is highly sensitive to the assumptions made about the opportunity cost of labor. Chomitz and Kumari (1996, p. 22) report studies where the *in situ* value is close to zero.

Forest goods and services can be divided into three categories based on the approach to valuation. Some forests goods and services are exchanged in markets and can be readily valued at their market price. The second group consists of non-market forest products with close substitutes that have a market price. These ‘near-market’ products can be valued at the price of the substitute products. Finally, there are some non-market forest services, which have no market counterpart. Environmental economists have developed a number of techniques to estimate the value of these forest services.

Table 7.5 shows how each product in the forest accounts is usually valued. There are several alternative valuation techniques that can be used for non-market goods and services. Valuation techniques are described below.

Table 7.5 Valuation techniques for forest goods and services

Forest product	Valuation technique
Land	Market prices
Timber	
Commercial timber	Market prices
Non-market timber	Local market prices of same product Price of close substitute product Production cost
Non-timber forest goods	Local market prices of same product Price of close substitute product Production cost
Forest services	

Livestock grazing	Price of close substitute product Production cost
Recreation and tourism	Travel cost Hedonic price of land CVM and conjoint analysis
Forest environmental protection services	
Carbon storage	Carbon tax Carbon emission permit trading price Global damage from climate change averted
Biodiversity and habitat preservation	CVM and conjoint analysis
Protective services for water, soil, etc.	Damage cost (e.g., reduced productivity in non-forestry sectors) Damage prevention costs CVM and conjoint analysis

Valuation of market and near-market forest products

The SNA provides complete monetary accounts for the production of commercial timber and other forest products that are exchanged in formal markets; these monetary values are included in the forest accounts. The SNA also includes some near-market goods and services, that is, products that are identical or very similar to marketed products but which are produced for own-use or exchanged in informal markets. Values for near-market products are based on the market price of the closest substitute product, or various techniques to estimate the cost of production. For example, virtually all countries include food grown for own consumption and the value of owner-occupied housing in their national accounts, near-market products that are valued at the price of their market counterparts. Government administration is a non-market service with no identifiable product sold in markets, so it is valued in national accounts at its cost of production.

Many forest goods and services are not exchanged in markets. In principle, they should be included in the SNA, but are often poorly measured or completely omitted, especially in developing countries with limited resources for data collection. In developing countries the volume of these goods and services may be quite large. Even when the volume is not large, they may be critical for the livelihoods of many communities so it is important to include them.

Valuation of many non-market forest goods and services utilise the SNA near-market approach where possible; there are three major variations:

> *Price of identical or very similar product*. Generally, the preferred method is to apply the price of the same, or a very similar, product that is sold in a market. Production of forest goods may be primarily for a household's own-use, but often there is often a surplus, which is sold in local markets. Local market prices for these goods can be used to value non-market production taking care to account for regional variations in prices.

Price of replacement product. A variation of this approach is to value forest products at the cost of replacing them with close substitutes. For example, grazing of livestock may be valued at the market cost of purchasing an equivalent amount of fodder or renting grazing land.

Production cost approach. An alternative method is applied when there are no local market prices or close substitutes: estimating the production cost of a product. In the case of many NFTP, the most significant production cost is labour. Products may be valued at the opportunity cost of the time it takes to gather them. An average local wage is used for this calculation, adjusted for factors affecting the economic value of the alternative use of a person's time. Where significant, additional, non-labour inputs should also be included in estimating the production cost.

There is considerable controversy over the volumes extracted and value of non-timber goods and services. Some have argued (e.g., Batagoda et al., 2000; Pearce et al., 1999) that the global value of non-timber goods and services has been overestimated and is small relative to timber value, although these products may be very important to some local communities. Information about the price of wood or NTFP in informal markets may be collected in the kind of surveys described in Chapter 6 to collect information about physical volumes.

In scaling up to the regional or national level from surveys, one must be very careful. The use and value of non-market forest products by local communities depends on many factors which can vary enormously even within a region, such as the availability of forest products, alternatives available to local communities, opportunities for selling products in local markets and local demand. In applying benefits transfer, the values should be adjusted for regional variations, but there may not be enough information to determine what the adjustments factors should be. Consequently, it is not uncommon to apply the same values to all areas.

Valuation of non-market forest products with no near-market substitute

The value of recreational services and environmental services of forests often have no market or near-market prices, so other techniques must be used to value them. Economists have many techniques for measuring non-market values and a great deal of practical experience applying them to forests. Economic valuation techniques can be divided into 'revealed preference' methods and 'stated preference' methods. The former derives forest values from observed market (revealed) behavior toward a marketed good related to forest goods and services. The latter is based on surveys that ask people to state (stated preferences) their values. Economists are often more comfortable with estimates derived from actual market behavior, but for some forest services even indirect market information may not be available, such as protecting endangered species. The techniques most commonly used for forest services are briefly described in Box 3.

Recreation, tourism and cultural services
Physical accounts for tourism are relatively easy to compile but valuation of tourism poses a greater challenge. Tourism is not a distinct industry in the national economic accounts; rather, it cuts across a range of industries, such as hotels and accommodations, restaurants, and transportation services. The only tourism services that are directly recorded as such in the national accounts are payments such as entrance fees for national parks, licensing fees for hunting, etc. However, entrance and license fees are often not related to the cost of providing the recreation service and cannot be taken as the value of recreation. Moreover, some forest recreation opportunities are provided free to the consumer. Thus, it is very difficult to determine the output of the tourism industry, and to separately determine how much of that output is dependent on forest ecosystems.

Special surveys are undertaken and a framework for tourism satellite accounts has been created for the construction of complete economic accounts for tourism, but extremely few countries compile tourism satellite accounts. As an alternative, researchers often use hedonic pricing (described in Box 2 for land valuation) and travel cost approaches (Box 3), which are both revealed preference techniques. More recently, stated preference techniques such as the contingent valuation method (CVM) and conjoint analysis have been used.

In developed countries, these tourism valuation studies are often available, but they may not be as readily available in many in developing countries. Recreation and tourism values in forest accounts of developing countries are often omitted or only partially represented. In South Africa, for example, only the tourism values for one kind of forest, fynbos woodlands, was represented; no reliable estimate was available for the national parks.

Box 3. Non-market valuation techniques

Travel Cost Method measures the value of forest recreation services by estimating how much people are willing to pay to travel to that site. Information about travel costs and other socio-economic characteristics of users that affect demand (e.g., income, distance from site, etc.) is collected through site surveys and aggregated to estimate a demand curve, or several demand curves for different zones around the site. Most costs associated with travel can be easily measured, although there remains controversy over whether to include the visitor's travel time as part of the cost.

Contingent valuation method (CVM) elicits the value individuals place on a hypothetical situation such as preservation of a forest or a species by asking them how much they would be willing to pay for it, or how much they would have to be compensated to do without it. This is particularly useful for eliciting the value of environmental goods and services for which there are no market prices, such as recreation and biodiversity.

Conjoint analysis is a survey technique developed by marketing experts to analyze consumer choice. It is similar to CVM, but the survey instrument differs. CVM poses the question 'How much are you willing to pay for a good?' or 'Would you be willing to pay $X for a good?' Conjoint analysis separates out the attributes of the good and asks individuals to rank the importance of each attribute. The survey presents a series of questions about different combinations of attributes. This approach can be particularly useful for forest ecosystem valuation because ecosystems provide multiple services; for example, a forest may provide recreation, wildlife habitat, and hydrologic management.

Table 7.6 provides an example of the value of forest goods and services for Sweden, indicating the valuation technique used for each product. Most products had both a market and a non-market component. For those with a market component, the market price was used for both components. Only the value of recreational services required the use of non-market valuation techniques, in this case, the travel cost method.

Table 7.6 Value of output related to wooded land in Sweden, 1999

	Output				
	Market	**For own final use**	**Other non-market**	**Total**	**Valuation Technique**
Products of the forestry and logging industry					
Natural growth of forests	1573			1573	Market price
Raw wood	2080	71		2151	Market price
Other tree products: gum, cork, etc.	24		10	34	Market price
Forestry and logging-related services	216		8	224	Market price
Non-timber forest products					
Wild agricultural products: vegetables, fruits, nuts, medicines, construction materials, etc.	8	22		30	Market price
Meat, skins, fur from wild game	15	44		59	Market price
Rearing of animals in forests	15	4		19	Cost of fodder or rental of grazing land
Forest services					
Recreational services in forests		2370		2370	Travel cost
Total output	**3931**	**141**	**18**	**4090**	

Source: Eurostat, 2002a, Table 38, p. 40 and Norman et al. (2001) for recreation services.

Other forest environmental services

In South Africa, an additional service, pollination of commercial agriculture, is included. In the region, many farmers pay for commercial pollination; other farmers benefit from close proximity to fynbos woodlands that provide habitat for wild bees. The value of pollination services was estimated as the cost farmers would have paid for commercial pollination.

Carbon storage
Carbon storage is the non-timber value most often included in the forest accounts. The unit value of carbon is usually based on one of the following alternative approaches:

- carbon emission tax in those countries that levy such a tax
- market price for emission permits where markets have developed
- damage cost: estimate of the global damage from climate change averted by reducing emissions by a unit of carbon, based on one of the major climate change modeling studies
- damage avoidance cost: the cost of reducing carbon emissions

Most developing countries do not have carbon taxes and have very limited experience in markets for carbon emissions, so carbon storage is most often valued by the global damage per ton of carbon estimated by one of the global climate change models. This is a figure that is widely used in many studies related to climate change, and is also used by the World Bank to value carbon emissions in its measure of Comprehensive Saving, a sustainability indicator designed to adjust conventional National Savings for net gains/losses in human and natural capital, including carbon emissions. At this time, there is no consensus about which methodology to use and the values are often very different, as shown in the example for Sweden in Table 7.7.

Table 7.7 Value of carbon binding, Sweden 2000
(million euros)

Valuation method	Euros per ton of carbon	Total value of carbon storage (million euros)
Carbon tax	42	810
Damage cost[1]	2	42
Emission permit price, low[2]	6	110
Emission permit price, high[3]	110	2080

[1] Based on values derived in a study by Nordhaus, 1992
[2] Assuming no restrictions of international trade of emission permits
[3] Assuming major restrictions on international trade of emission permits

Source: Adapted from Eurostat 2002b, Table 32, p.47

Biodiversity and habitat preservation
This service is most commonly measured in forest valuation studies using CVM. There have also been some attempts to estimate a value based on the potential economic value of new pharmaceutical or agricultural products that might be derived from forests, but these values are highly speculative and not given much weight in most forest valuation studies. The value of biodiversity preservation has not been included in forest accounts.

Environmental protection services

Protective services constitute (unpaid for) inputs to the production of non-forestry goods, such as the regulation of water flows, soil stabilization, and water quality. As inputs to production, they are similar to livestock grazing services or recreational services. However, it is much more difficult to quantify the amount of protection service provided and its value. In many cost-benefit analyses, protective services have been valued by estimating the lost output of the using sector if these services were reduced. For example, if a natural forest were disturbed, soil erosion might accelerate siltation of a dam downstream, reducing the generation of hydroelectricity over the dam's lifetime and the water available from the dam for irrigation. Siltation might also increase the costs of municipal water treatment and degrade fisheries habitat. The loss of productivity in each of these sectors can be valued at their market prices (or the cost of producing substitutes).

Because of the difficulty in establishing the level of service provided by a forest and the change resulting from a given change in forest use, the SEEA-2003 and the Eurostat framework make no recommendations regarding valuation of these protective services. There are many case studies that have attempted to review some of these forest values (for example, see reviews in Batagoda et al., 2000; Chomitz and Kumari, 1996), but they are typically not included in forest accounts.

The South African forest accounts include one measure of the loss of environmental service: the reduction of water flow from cultivated forests. South African forest plantations cultivate alien species, mainly pines and gums, which have a higher rate of evapotranspiration than native vegetation. This reduces runoff from precipitation and the amount of water available to downstream users. Cultivated forests have resulted in a reduction of water supply, which is valued in terms of potential agricultural income that has been lost.

A promising development for valuation of forest environmental services is Payment for Environment Services (PES), a recent initiative mainly in Central America to establish a market in which downstream beneficiaries pay the forestland owners/users for these services (Pagiola et al., 2002). The idea behind PES is that forest environmental services are not traded in markets, and this market failure can result in greater deforestation and land use conversion than is socially or economically optimal.

From an accounting perspective, PES is useful because it establishes a market value for the forest service provided. For several reasons, the market price is likely to be a lower bound on the total value of forest protection services:

- Payments usually capture only part of the forest services; often the PES markets address only one forest service, e.g., carbon storage, or hydrological flow
- It is difficult to identify all the beneficiaries and to eliminate 'free riders' so the market will not capture the total value to all users.
- There are difficulties in extrapolating the values obtained in one forest area to others, so national forest accounts might only include values for environmental services in part of the country

Most PES markets are established for watershed protection and carbon storage. There are also a few initiatives for biodiversity protection, mainly in the form of shade-grown coffee. One example of PES is a market for forest watershed protection services in Costa Rica (Table 7.8). Hydroelectric power companies in Costa Rica have contracted with forest land users upstream from the power plants to introduce sustainable forestry in order to reduce sol erosion and resulting stream sedimentation, as well as to preserve stream flow. The power companies pay local land users with approved management plans from US$10-42 per hectare annually. Negotiations to add municipal water users and other beneficiaries are under discussion.

The experience with PES is fairly limited so far but may provide useful values for the forest accounts in the future.

Table 7.8 Payments for water quality services by hydroelectric power companies in Costa Rica

Company	Payment to forest land user (US$/ha)	Area of watershed covered by contract (ha)
Energia Global	10	4,311
Platanar S A	10-30	1,400
CNFL	42	11,900

Source: Adapted from (Pagiola et al., 2002, Table 3.1)

Benefits transfer: applying forest values from one site to another

Valuation of forest goods and services can be quite complex and expensive. When there is insufficient time or the cost is prohibitive, an approach known as benefits transfer may be used. Benefits transfer is a valuation method where environmental benefits measured for one site is applied to other sites. A meta-database of valuation studies, EVRI (Environmental Valuation Reference Inventory), has been compiled by Environment Canada and the US Environmental Protection Agency. It provides information from over 700 valuation studies, mainly from North America. This is an extremely attractive approach that has been widely used for some environmental studies, especially air pollution. However, there are major obstacles to successful implementation of benefits transfer.

At best, benefit transfer can only be as accurate as the original study. Moreover, the new site may differ substantially from the original study site in ways that affect the level and value of forest goods and services provided. Non-market forest goods and services are especially likely to have values that are highly site-specific (Batagoda et al., 2000, Pagiola et al., 2002; Pearce et al., 1999; Perez and Arnold, 1997). Unless these differences are factored in, the value estimate will not be accurate. For example, the harvest rate per hectare of NTFP will vary among regions due to differences in forest characteristics and differences in the demand by local communities. Similarly, prices for

NTFP may vary significantly from one region to another. The challenges of providing reasonably accurate values for forest services with benefit transfer are even greater.

7.3 Monetary supply and use table

The general framework of the supply-and-use table was described in Chapter 6, the physical accounts. Monetary tables have identical entries, measured in currency units, with a few extensions: the Supply table includes i) taxes less subsidies on products and ii) margins for trade and transport, the Use table includes i) other intermediate inputs and ii) the components of value added.

In principle, these detailed supply and use tables can be extended to include other, non-timber forest products. In practice, however, such extensive tables are often created only for wood products because of limited data about the use and transformation of non-timber forest goods and services. The forestry SUT for France shown in Table 7.9 includes only wood and wood products.

Table 7.9 Monetary supply and use table for wood products, France 1999

SUPPLY	Output of Industries									
	Forestry & logging	Wood products	Pulp	Paper	Printing	Recycling	Other	Total ind. supply	Imports	Taxes - subsidies on products
Standing timber	**1982**							**1982**		
Sawn logs	**1311**							**1311**	**219**	
Fire wood	**977**							**977**	**3**	
Pulp wood	**245**							**245**	**67**	
Wood & wood products		**5664**						**5664**	**1881**	
Paper pulp			**1046**					**1046**	**956**	
Paper				**5685**				**5685**	**3697**	
Wood waste as product		**75**						**75**	**41**	
Paper waste as product				**381**				**381**	**77**	
Other products	305				**8063**			**8368**		
Non-timber forest products							**X**	**X**	**X**	**X**
Forest Services							**X**	**X**		

USE	Intermediate consumption by industries								Final users		
	Forestry & logging	Wood products	Pulp	Paper	Printing	Recycling	Other	Total Int.	Consump-tion	Capital formation	Exp
Standing timber	**1368**							**1368**		**613**	
Sawn logs		**1390**						**1390**			**1**
Fire wood							**86**	**86**	**884**		
Pulp wood			**173**					**173**			**1**
Wood & wood products		**3294**					**2587**	**5881**			**16**
Paper pulp				**1814**				**1814**			**1**
Paper					**6559**			**6559**			**28**
Wood waste as product		**21**	**20**				**31**	**72**			
Paper waste as product				**375**				**375**			
Other intermediate inputs	**646**										
Total intermediate consumption	**2014**										
Gross value added	**2806**										
consumption of fixed capital	**288**										
Net value added	**2518**										
Compensation of employees	**654**										
Other taxes - subsidies	**16**										
NOS/mixed income	**1848**										
Output (basic prices)	**4820**										
Non-timber forest products	**X**						**X**	**X**	**X**	**X**	
Forest Services	**X**						**X**	**X**	**X**	**X**	

Source: Eurostat 2002a, Table 68, p. 72

7.4 Expenditures for forestry management and protection

This third component of the SEEA differs from the others in that it doesn't add any new information to the national accounts but reorganizes expenditures in the conventional SNA that are closely related to protection and management of forests. The purpose is to make these expenditures more explicit, and thus, more useful for policy analysis. In this sense, they are similar to other satellite accounts, such as transportation or tourism accounts, which reorganize existing information. These accounts are compiled separately for government and private sector expenditures; they are also disaggregated according to major function and purpose.

Table 7.10 shows the accounts compiled by Finland. Most of the forest management and protection expenditure is undertaken by the private sector as part of its forestry and logging operations. The accounts also provide an estimate of the implicit cost incurred to protect the forests by introducing environmentally sound logging practices. This is estimated at the stumpage value of timber foregone.

Table 7.10 Expenditure for forestry management and protection, Finland 1991-1995

(million Finnish marks)

	Private sector	Public sector	Total
Forestry and logging	15,463	2,628	18,091
Forest improvement and silviculture	5,260	564	5,824
Logging	9,813	2,014	11,827
Environmentally sound forestry and logging*	390	50	440
Forest conservation	0	920	920
Total	15,463	3,548	19,011

*Estimated stumpage values lost because of environmentally preferable methods of logging

Source: Adapted from UN et al., 2003 Table 8.17 p. 354

7.5 Forestry accounts and macroeconomic indicators

The forest accounts provide essential information for the calculation of improved macroeconomic aggregates such as national wealth, Gross Domestic Product (GDP), Net Domestic Product (NDP) and national savings. A more comprehensive measure of GDP is obtained by adding the production of non-market forest goods and services that were previously omitted. In conventional measures of national wealth, or the consolidated balance sheet, only cultivated forests were included. With information from the forest accounts, the value of natural forests and carbon storage can be included as well. NDP and national savings can also be revised by including the value of deforestation or afforestation. Accounting for forest services used by non-forestry sectors does not affect the level of these macroeconomic aggregates, only the distribution of sectoral GDP.

Table 7.11 Adjustments to macroeconomic indicators from SEEA forest accounts

GDP	Include production of non-market forest goods and services previously omitted from national accounts
NDP	Include changes (depreciation/appreciation) of natural forests
National Wealth	Include value of natural forest assets and perhaps carbon storage
National Saving and Comprehensive Saving	Include changes (depreciation/appreciation) of natural forests

8. Guidelines for implementation of forest accounts

This final chapter discusses the major data sources for forest accounts and provides a standard set of tables for forest accounts.

8.1 Data sources

The major data sources that are common to many countries are listed in Table 8.1. The coverage of these data sources will vary by country. For example, the national accounts of some countries may include most NTFP, while the national accounts in others may not. Most of the common data sources focus heavily on the commercial products. The new guidelines for Forest Resource Assessments (FRA) include non-timber and non-market forest goods and services. As this is implemented, coverage of this important aspect of forest resources will improve: more products will be covered and in a more consistent manner across countries. As such, the FRA could become an important tool for building forest accounts.

Several major weaknesses remain in the available data:

- the economic value of forests products is regularly available only for market and near market products. Values for recreation and tourism are not regularly estimated in most countries.
- information about forest environmental services except for carbon storage is generally not available
- the degree of spatial disaggregation is not consistent among different data sources. For physical data from other sources, it is likely that data can be disaggregated by region or forest, but economic data from the national accounts is not likely to be disaggregated spatially, or at least not with the same geographic classification as forest statistics.

Surveys and valuation studies are required to provide the missing data in the forest accounts.

At a minimum, it would be useful to disaggregate the forest accounts spatially and link them to population figures to indicate average per capita use of forest products. Useful additional information includes, for example, the share of total household consumption that forest products comprise, and the dependence on forest products by different categories of households within a community. It is possible to collect information about household consumption in surveys of NTFP. It might also be possible to link forest utilization for, periodic Household Income and Expenditure Surveys which are undertaken at the national level in many developing countries.

Table 8.1 Major data sources for constructing forest accounts

Component of forest accounts	Data source	Data provided
1. Asset accounts for wooded land and standing timber	Forest Resource Assessment	Physical data for area of wooded land and volume of standing timber accounts, including changes over time. Only undertaken at large time intervals
	National forest Inventories	Physical data for area of wooded land and volume of standing timber. Only undertaken at large time intervals
	Forestry statistics	Sometimes provide annual figures for forest land and stocks of standing timber updated from forest inventories May provide data on forest health, e.g., defoliation
	National accounts, National balance sheets	Monetary accounts for cultivated forests: wooded land and standing timber. Do not include natural forests unless SEEA has been implemented
2. Flow accounts for forest good and services	Forestry statistics	Physical data on forestry and forest industry products
	Forest Resource Assessment	Data on commercial forestry products plus non-timber forest products in physical units. May collect information about prices of some NTFP
	National accounts	Monetary data for output of forestry and logging, and non-timber forest products in some countries Data include: output, intermediate consumption, value-added, consumption of fixed capital, compensation of employees, net operating surplus, changes in inventories Supply and Use Tables IO and SAMs
3. Forest environmental services		
Carbon storage	FRA, country climate change programmes	Carbon storage, change in carbon storage in cultivated and natural forests in physical units
Other environmental services	No regular source of data at this time.	
4. Forest resource management expenditures	National accounts	Expenditures are included but require supplementary surveys to identify these expenditures as part of total government or industry expenditures.

8.2 Standard tables for constructing forest accounts

This appendix contains the set of tables for compiling forest accounts, as described in Chapters 6 and 7. The tables are mostly adapted from (Eurostat 2002a, 2002b) and modified where necessary to comply with the terminology used in the SEEA (UN et al., 2003). They are intended to provide general guidance in the construction of forest accounts. In implementing forest accounts, countries may find it useful to expand or modify some of the classifications to suit local circumstances and policy needs. These accounts may be implemented at the national level or for individual forests or regions within a country. The tables include:

1. Forest balance accounts for wooded land and standing timber

2. Output from wooded land including products from forestry and logging, non-timber forest products, and forest services

3. Forest environmental protection services

4. Supply and use tables for forest products

5. Forest environmental protection and resource management

Forest balance accounts

The first five tables constitute forest balance accounts: asset accounts for forestland and for standing timber in both physical and monetary units, and accounts for forest health. These tables are intended to represent the general form of the forest accounts and should be compiled on a more detailed basis for each category of forest as described in Chapters 6 and 7, that is, by dominant species of tree, naturalness of the forest, protection status, and for regions within a country.

Table 8.1a. Forest asset accounts: area of wooded land (1000 hectares)

		Forest and other wooded land		
		Available for wood supply	Not available for wood supply	Total
Opening area				
Changes due to economic activities				
	Afforestation			
	Deforestation			
Other changes				
	Natural colonisation			
	Natural regression			
	Other			
Changes in classification				
Closing area				

Table 8.1b. Forest asset accounts: value of wooded land (million national monetary units)

		Forest and other wooded land		
		Available for wood supply	Not available for wood supply	Total
Opening area				
Changes due to economic activities				
	Afforestation			
	Deforestation			
Other changes				
	Natural colonisation			
	Natural regression			
	Other			
Changes in classification				
Revaluation				
Closing area				

Changes due to economic activity: afforestation, the increase in wooded land area due to human activity, and deforestation, the reduction in area due to human activity such as forest clearing for agriculture.

Other changes: changes in area due to natural causes such as natural expansion or colonisation or natural regression, or for other reasons which cannot be determined

Changes in classification: changes in classification such as a reclassification of forest land from available for wood supply to unavailable for wood supply, recorded as a negative entry for the initial category and a positive entry for the final category.

Revaluation: change in value due to change in prices between beginning and end of the period.

Table 8.2a. Forest asset accounts: volume of standing timber (1000 m^3)

	Standing timber volume on wooded land			Standing timber on other land	Total
	Available for wood supply	Not available for wood supply	Total		
Opening stocks					
Gross increment (natural growth)					
Total removals (fellings that are removed in this period, regardless of when felling took place					
Other changes					
Changes in classification					
Closing stocks					

Table 8.2b. Forest asset accounts: value of standing timber (million national monetary units)

	Standing timber volume on wooded land			Standing timber on other land	Total
	Available for wood supply	Not available for wood supply	Total		
Opening stocks					
Gross increment (natural growth)					
Total removals (fellings that are removed in this period, regardless of when felling took place					
Other changes					
Changes in classification					
Revaluation					
Closing stocks					

Notes:
Gross annual increment: the volume of natural growth during the period

Removals: fellings removed during the accounting period including timber that was felled but not removed in an earlier period.

Other changes: all reductions in standing timber which are not removed, such as thinnings or trees killed by natural causes that are left in the forest.

Changes in classification: changes in classification of standing timber by type of land during the period, recorded as a negative entry for the initial category and a positive entry for the final category.

Revaluation: change in value due to change in prices between beginning and end of the period.

Table 8.3. Forest health: defoliation

	None (0 to 10%)	Slight (11% to 25%)	Moderate (26% to 60%)	Severe and dead (>60%)
Coniferous				
Broad-leaved				
Other species				
Total				

Production of forest goods and services

Tables 8.4a and 8.4b show accounts for the production of timber, non-timber goods, and the forest services and the industries that produce these products.

Table 8.4a. Output related to wooded land by product and industry (goods in tons; services in other units)

	Industries producing forest products					Type of output			Institutional sector			
	Agricul-ture (01)	Forestry and logging (02)	Recreational, cultural and sporting activities (92)	Other industries	Total	Market output	Output for own use	Other non-market output	House-holds	Private non-financial corps.	Public non-financial corps.	General govt and NPISH
Products of the forestry and logging industry (measured in tons)												
Natural growth of forests												
Raw wood												
Other tree products: gum, cork, etc.												
Non-timber forest products (measured in tons)												
Wild agricultural products: vegetables, fruits, nuts, medicines, construction materials, etc.												
Meat, skins, fur from wild game												
Other forest products: charcoal, peat, etc.												
Forest services (measured in numbers of animals and numbers of visitors to recreational areas)												
Rearing of animals in forests												
Recreational services in forests												
Total output												

Table 8.4b. Output related to wooded land by product and industry **(millions of national currency units)**

	Industries producing forest products					Type of output			Institutional sector			
	Agricul-ture (01)	Forestry and logging (02)	Recreational, cultural and sporting activities (92)	Other industries	Total	Market output	Output for own use	Other non-market output	House-holds	Private non-financial corps.	Public non-financial corps.	General govt and NPISH
Products of the forestry and logging industry												
Natural growth of forests												
Raw wood												
Other tree products: gum, cork, etc.												
Forestry and logging-related services												
Non-timber forest products												
Wild agricultural products: vegetables, fruits, nuts, medicines, construction materials, etc.												
Meat, skins, fur from wild game												
Other forest products: charcoal, peat, etc.												
Forest services												
Rearing of animals in forests												
Recreational services in forests												
Total output												

Forest environmental services
Forest accounts include three additional environmental services:

- carbon storage
- biodiversity preservation
- protective services for water, soil and other ecosystem functions.

Carbon storage
Carbon storage is measured using standard conversions of biomass to carbon content. Table 8.5a shows a standard table for carbon content of total woody biomass. This table, like the table for standing timber, may be further disaggregated by tree species and other forest characteristics. Additional tables may be constructed for forest ecosystems that include carbon contained in forest soils and other biomass in forests such as ground vegetation and leaf litter. Table 8.5b, the value of carbon balances, is constructed using one of the three methods described in Chapter 7.

Table 8.5a. Carbon balance accounts for woody biomass (1000 tonnes of carbon)

	Total woody biomass			
	Standing timber		Other woody biomass	Total
	Available for wood supply	Not available for wood supply		
Opening stocks				
Gross increment				
Total removals				
Other changes				
Changes in classification				
Closing stocks				

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Table 8.5b. Carbon balance accounts for woody biomass (million national currency units)

	Total woody biomass			
	Standing timber		Other woody biomass	Total
	Available for wood supply	Not available for wood supply		
Opening stocks				
Gross increment				
Total removals				
Other changes				
Changes in classification				
Revaluation*				
Closing stocks				

* There is usually no entry for revaluation as the price used to value carbon storage does not change.

Note: Definitions of entries in the table are the same as those in the accounts for standing timber.

Biodiversity and habitat preservation

Table 8.6 Indicator of biodiversity: forest-occurring species at risk or endangered

	Forest occurring species						Forest-occurring as % of all species
	Total number	Number of endangered species					
		CR	EN	VU	CR+EN+VU	% of total	
Vascular plants (trees and flowers)							
Non-vascular plants (mosses, lichens, etc.)							
Vertebrates (mammals, birds, etc.)							
Invertebrates (insects, etc.)							

Note: The IUCN categories of species facing a high risk of extinction in the wild in the near future are defined as CR= critically endangered, EN= endangered, VU = vulnerable.

Table 8.7. Protection status of wooded land (1000 hectares)

	IUCN Category			Other legal protection	Total legally protected area	Other protected areas	% of total wooded land
	I and II	III and IV	Total IUCN				
Opening area							
Afforestation							
Deforestation							
Natural colonisation							
Natural regression							
Other changes							
Changes in land classification							
Closing area							

Note: IUCN categories are:
I. Strict nature reserve, wilderness area
II. National park
III. Natural monument
IV. Habitat/species management area

Protective services of forests

Table 8.8. Wooded land providing environmental protective services (1000 hectares)

	Opening area	Changes	Closing area
Soil protection			
Protection of water resources			
Avalanche protection			
Coastline protection			
Other or multiple objectives			
Total			
% of total wooded land			

Supply and Use Tables

Table 8.9.a Physical supply and use table for wood products (wood in thousands of cubic metres, other products in various units)

Supply

	Output of products by industry									
Wood products	**Agricul-ture**	**Forestry & logging**	**Wood products**	**Pulp**	**Paper**	**Printing**	**Recycling**	**Other**	**Total ind. supply**	**I**
Standing timber		X							X	
Sawn logs		X						X	X	
Fire wood		X						X	X	
Pulp wood		X						X	X	
Wood & wood products			X						X	
Paper pulp				X					X	
Paper					X				X	
Wood waste as product			X					X	X	
Paper waste as product					X	X	X	X	X	
Non-timber forest products	X	X						X	X	
Forest Services	X	X						X	X	

Use

	Intermediate consumption by industry									Final u	
	Agricul-ture	**Forestry & logging**	**Wood products**	**Pulp**	**Paper**	**Printing**	**Recycling**	**Other**	**Total**	**Consump-tion**	**Expo**
Wood products											
Standing timber		X							X		
Sawn logs			X						X		X
Fire wood								X	X	X	X
Pulp wood				X					X		X
Wood & wood products								X	X	X	X
Paper pulp					X				X		X
Paper						X	X	X	X	X	X
Wood waste as product			X	X					X		
Paper waste as product				X			X		X		
Non-timber forest products	X	X						X	X	X	X
Forest Services	X	X						X	X	X	

Table 8.9.b Monetary supply and use table for wood products (million national currency units)

Supply

Wood products	**Output of products by industry**	**Imports**	**Taxes - subsidies on products**	**Trade, transport margins**	**Total supply**
Standing timber	X		X	X	X
Sawn logs	X	X	X	X	X
Fire wood	X	X	X	X	X
Pulp wood	X	X	X	X	X
Wood & wood products	X	X	X	X	X
Paper pulp	X	X	X	X	X
Paper	X	X	X	X	X
Wood waste as product	X	X	X	X	X
Paper waste as product	X	X	X	X	X
Non-timber forest products	X	X	X	X	X
Forest Services	X				X

Use

	Intermediate consumption by industry									**Final us**	
	Agricul-ture	**Forestry & logging**	**Wood products**	**Pulp**	**Paper**	**Printing**	**Recycling**	**Other**	**Total Int.**	**Consump-tion**	**Expor**
Wood products	X	X	X	X	X	X	X	X	X	X	X
Non-timber forest products	X	X						X	X	X	X
Forest Services	X	X						X	X	X	
Other intermediate inputs	X	X	X	X	X	X	X	X	X		
Total intermediate consumption	X	X	X	X	X	X	X	X	X		
Gross value added	X	X	X	X	X	X	X	X	X		
Consumption of fixed capital	X	X	X	X	X	X	X	X	X		
Net value added	X	X	X	X	X	X	X	X	X		
Compensation of employees	X	X	X	X	X	X	X	X	X		
Other taxes - subsidies	X	X	X	X	X	X	X	X	X		
NOS/mixed income	X	X	X	X	X	X	X	X	X		
Output (basic prices)	X	X	X	X	X	X	X	X	X		

Appendix A. Forest accounts and sustainability indicators for forestry

In recent years, there have been a number of efforts to develop criteria and indicators for sustainable forestry, based on economic, social, ecological, and institutional statistics. There is considerable overlap between work on sustainability indicators and the SEEA, although these two efforts have proceeded, for the most part, independently of one another. One of the advantages of the SEEA is that it produces both indicators as well as the detailed statistics needed for analysis. The relationship between the SEEA and one set of forest criteria and indicators, the Montréal Process indicators, is described below.

The Montréal Process represents one attempt to develop and implement internationally agreed criteria and indicators for the conservation and sustainable management of temperate and boreal forests. (See their website http://www.mpci.org for more information.) The Montréal Process has identified a set of *criteria*: categories of conditions or processes by which sustainable forest management may be assessed. Each criterion is characterized by a set of related *indicators*, quantitative or qualitative variables which can be measured or described and which, when observed periodically, demonstrate trends. Table 8.10 shows the relationship between the Montréal Process criteria and indicators, and the information provided by the SEEA.

Many of the Montréal Process indicators are provided by the SEEA, notably those associated with conservation of biological diversity, maintenance of productive capacity of forest ecosystem, maintenance of forest contribution to global carbon cycles, and maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies. The SEEA does not provide information for the legal and institutional aspects of forest health, and provides only partial information about social aspect of forests. To provide some of the indicators, a more comprehensive set of forest-related accounts is necessary, which would include comprehensive land accounts, water accounts, and pollution accounts.

Table 8.10 Correspondence between sustainability indicators and the SEEA

Criteria and Indicators for Sustainable Forestry	SEEA source of indicator
Criterion 1: Conservation of biological diversity **Indicators:**	
Ecosystem diversity	
a. Extent of area by forest type relative to total forest area	Forest asset accounts, physical
b. Extent of area by forest type and by age class or successional stage	Forest asset accounts, physical
c. Extent of area by forest type in protected area categories as defined by IUCN or other classification	Forest asset accounts, physical

systems	
d. Extent of areas by forest type in protected areas defined by age class or successional stage	Forest asset accounts, physical
e. Fragmentation of forest types	Can be included in forest asset accounts
Species diversity	
a. The number of forest dependent species	Forest service accounts for biodiversity protection, physical
b. The status (threatened, rare, vulnerable, endangered, or extinct) of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment	Forest flow accounts for biodiversity protection, physical
Genetic diversity	
a. Number of forest dependent species that occupy a small portion of their former range	Could be calculated from changes in forest service accounts for biodiversity protection
b. Population levels of representative species from diverse habitats monitored across their range	Forest service accounts for biodiversity protection, physical

Criterion 2: Maintenance of productive capacity of forest ecosystems **Indicators:**	
a. Area of forest land and net area of forest land available for timber production	Forest land and land asset accounts, physical
b. Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production	Forest asset accounts, physical
c. The area and growing stock of plantations of native and exotic species	Forest asset accounts, physical
d. Annual removal of wood products compared to the volume determined to be sustainable	Forest flow accounts for timber, physical
e. Annual removal of non-timber forest products (e.g. fur bearers, berries, mushrooms, game), compared to the level determined to be sustainable	Forest flow accounts for non-timber goods and services, physical

Criterion 3: Maintenance of forest ecosystem health and vitality **Indicators:**	
a. Area and percent of forest affected by processes or agents beyond the range of historic variation, e.g. by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinisation, and domestic animals	Only that part attributable for economic activities, such as land clearance and salinisation

b. Area and percent of forest land subjected to levels of specific air pollutants (e.g. sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem	Forestland accounts, land accounts, pollution accounts (physical)
c. Area and percent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g. soil nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)	Forest degradation accounts (flow and/or asset), physical

Criterion 4: Conservation and maintenance of soil and water resources **Indicators:**	
a. Area and percent of forest land with significant soil erosion	Land and forestland accounts by ecological characteristics, physical
b. Area and percent of forest land managed primarily for protective functions, e.g. watersheds, flood protection, avalanche protection, riparian zones	Forestland accounts, physical
c. Percent of stream kilometres in forested catchments in which stream flow and timing has significantly deviated from the historic range of variation	NA Could be obtained from SEEA water accounts
d. Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties	NA
e. Area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities	NA
f. Percent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variance of biological diversity from the historic range of variability	NA
g. Percent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity), sedimentation or temperature change	NA
h. Area and percent of forest land experiencing an accumulation of persistent toxic substances	NA

Criterion 5: Maintenance of forest contribution to global carbon cycles **Indicators:**	
a. Total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age class, and successional stages	Forest carbon storage accounts, physical
b. Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon (standing biomass, coarse woody debris, peat and soil carbon)	Forest carbon storage accounts, physical

c. Contribution of forest products to the global carbon budget	Forest carbon storage and flow accounts, physical

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies **Indicators:**	
Production and consumption	
a. Value and volume of wood and wood products production, including value added through downstream processing	Forest wood flow accounts, supply and use table, physical & monetary
b. Value and quantities of production of non-wood forest products	Forest non-timber flow accounts, physical & monetary
c. Supply and consumption of wood and wood products, including consumption per capita	Forest wood supply and use accounts, physical
d. Value of wood and non-wood products production as percentage of GDP	Forest flow accounts for goods and services, monetary
e. Degree of recycling of forest products	Forest wood supply and use accounts, physical
f. Supply and consumption/use of non-wood products	Forest non-timber flow accounts, physical
Recreation and tourism	
a. Area and percent of forest land managed for general recreation and tourism, in relation to the total area of forest land	Forestland asset accounts, physical
b. Number and type of facilities available for general recreation and tourism, in relation to population and forest area	Forest asset accounts memorandum items for fixed capital
c. Number of visitor days attributed to recreation and tourism, in relation to population and forest area	Forest flow accounts for services, physical
Investment in the forest sector	
a. Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism	Forest flow accounts + Environmental expenditure and resource management accounts for forests
b. Level of expenditure on research and development, and education	Environmental expenditure and resource management accounts for forests
c. Extension and use of new and improved technologies	Memorandum items to the asset accounts (fixed capital in the forest sector)
d. Rates of return on investment	Calculated from forest flow accounts, monetary
Cultural, social and spiritual needs and values	

a. Area and percent of forest land managed in relation to the total area of forest land to protect the range of cultural, social and spiritual needs and values	NA
b. Non-consumptive use forest values	Forest flow accounts for services, physical
Employment and community needs	
a. Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment	Forest flow accounts, memorandum items
b. Average wage rates and injury rates in major employment categories within the forest sector	Wages: Forest flow accounts, memorandum items
c. Viability and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities	NA
d. Area and percent of forest land used for subsistence purposes	Forest flow accounts, memorandum items

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management	
Indicators for extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests	NA
Indicators for extent to which the institutional framework supports the conservation and sustainable management of forests	NA
Indicators for extent to which the economic framework supports the conservation and sustainable management of forests	Capacity provided by complete SEEA forest-related accounts
Capacity to measure and monitor changes in the conservation and sustainable management of forests	Capacity provided by complete SEEA forest-related accounts
Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services, including:	Capacity provided by complete SEEA forest-related accounts
a. Development of scientific understanding of forest ecosystem characteristics and functions;	NA
b. Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems;	Capacity provided by complete SEEA forest-related accounts
c. New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies;	Capacity provided by complete SEEA forest-related accounts

d. Enhancement of ability to predict impacts of human intervention on forests;	Capacity provided by complete SEEA forest-related accounts
e. Ability to predict impacts on forests of possible climate change.	NA

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