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# Manual for environmental and economic accounts for forestry: a tool for cross-sectoral policy analysis

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## Foreword

In March 2001, the FAO Committee on Forestry (COFO) requested FAO to assist countries in incorporating linkages between sustainable forest management and other sectors, including agriculture. COFO also requested that FAO develop effective national policy frameworks and national forestry programmes and promote information exchange between forestry and related sectors. As a result of this demand coming from FAO member countries, the Forestry Policy and Institutions Service of the Forestry Department initiated in 2001 a series of studies on available information and research needs. This included a review of the use of the integrated system of environmental and economic accounting (SEEA) to monitor and measure cross-sectoral policy impacts.

The purpose of the current manual on Environmental and Economic Accounts for Forestry (EEAF) is to strengthen cross-sectoral policy analysis - promoting its use by regional or local institutions at sub-national level - 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 target audience includes policy analysts and decision-makers in government ministries at national and local levels, universities and research organizations, NGOs and other citizen groups. The manual is meant to be user-friendly and therefore strike a balance between the technical aspects of forest accounting and a clear explanation of how forest accounts can be used by each stakeholder in formulating policy.

Dr Glenn-Marie Lange, Centre for Economy, Environment and Society, Earth Institute, Columbia University, drafted the manual under the technical supervision of Yves C. Dubé, Forestry Officer.

It is hoped that this manual will be used and tested by many government agencies responsible for forestry and complement other information systems such as national forest resource assessments. It is part of a larger effort on cross-sectoral linkages that is carrying out work on other aspects of this issue: governance, institution strengthening, legal framework or economic and social aspects. Your comments and suggestions for improving it would be most welcome.

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## Acronyms

| | |
|---|---|
| CBA | Cost-benefit analysis |
| CFR | Catchment forest reserves |
| CGE | Computable general equilibrium |
| CVM | Contingent valuation method |
| EVRI | Environmental valuation reference inventory |
| FAO | Food and Agriculture Organization |
| GDP | Gross domestic product |
| GIS | Geographic Information System |
| IMF | International Monetary Fund |
| IO | Input-output |
| IUCN | World Conservation Union |
| NA | Not applicable |
| NAV | Not available |
| NDP | Net domestic product |
| NSCB | National Statistical Coordination Board |
| NTFP | Non-timber forest products |
| OECD | Organization for Economic Cooperation and Development |
| PES | Payment for environmental services |
| SAM | Social accounting matrix |
| SAP | Structural adjustment programme |
| SEEA | System of Environmental and Economic Accounts |
| SEK | Swedish krona |
| SNA | System of national accounts |
| SUT | Supply and use table |
| 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 operationalize 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.

SNA (UN *et 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, SNA has had a number of well-known shortcomings regarding the treatment of the environment.

With regard to forestry, SNA has treated cultivated forests and natural forests quite differently. For cultivated forests, 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, 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 goods and services that are often not included in national accounts, although they may be critical to rural livelihoods in developing countries. In principle, 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, rather than the forestry, sector. 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 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 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 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 SNA. SEEA provides a measure of forest values that is more comprehensive than SNA in two respects. First, SEEA forest accounts include both cultivated and natural forests in the asset accounts. Second, 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, FAO forest product reports and various frameworks for forest indicators (such as the criteria and indicators (C&I) approach). The major distinction is the emphasis of 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.

This manual is intended to fill a critical gap in forestry accounting literature: 1) how to use forest accounts for policy analysis, notably for the assessment of cross-sectoral policy linkages, and 2) how to address the special issues faced by developing countries in constructing forest accounts. Although SEEA provides the basic conceptual framework for all environmental accounts, including forest accounts, it 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. A number of specialized manuals have been compiled such as the manual for fisheries (FAO, forthcoming) and water (UN-Eurostat, forthcoming), but the UN and its agencies have not yet developed a manual for forests.

Eurostat initiated a pilot programme on forestry accounting in the late 1990s and has published several useful manuals, on which this manual draws. However, the Eurostat manuals and forest accounts are driven by issues that are important to European forests; furthermore, policy applications are not discussed. Hence, there is a need for a manual that clearly demonstrates how forest accounts can contribute to policy and the assessment of cross-sectoral policy linkages, and that addresses the data issues of developing countries.

This manual provides a comprehensive survey of all components of forest accounts that could be constructed, as well as many of their uses. The challenges of implementing forest accounts and utilizing them effectively for policy appear daunting, especially for developing countries short of data and technical expertise. The manual discusses (in Chapters 4 and 8) how to minimize the challenges by, for example, combining forest accounting efforts with national forest resource assessments. But it is also hoped that the manual will help motivate countries to collect the data for forest accounts by demonstrating to stakeholders and practitioners the usefulness of such accounts.

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 forest accounts and a discussion of the major policy issues that drive compilation of forest accounting. Although an in-depth, technical description of forest accounts is reserved for Part II of the manual, it is necessary to have a general idea of forest accounts in order to understand the policy applications. Chapter 1 also presents the five issues that have provided the major motivation for the construction of forest accounts throughout the world:

- What is the total economic contribution of forests and what are the benefits from sustainable forest management?
- What is the distribution of forest benefits among different groups in society?
- Is economic growth sustainable or is it based on the depletion of forests?
- What are the trade-offs among competing users and how can forest utilization be optimized?
- What are the impacts of non-forestry policies on forest use?

Chapter 2 reviews the policy applications of forest accounts at the national level. It begins with a review of the countries that have constructed forest accounts. The chapter then uses forest accounts from three countries, Sweden, South Africa and Romania, to see how the policy issues identified in Chapter 1 can be addressed. Additional examples are drawn from other countries, such as Swaziland and Spain. The basis for economic modelling with forest accounts is described.

Chapter 3 addresses an issue of growing importance: 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. Furthermore, forest goods and services can vary enormously from one region to another and are not easily generalizable. Because of the site-specific nature of many forest goods and services, national forest accounts are often derived from regional accounts, so it may not present an insurmountable challenge to disaggregate forest accounts by the appropriate geographic characteristics. Regional disaggregation is particularly useful for addressing cross-sectoral linkages and the dependence of rural communities on forests.

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. It discusses data challenges, potential data sources, including national forest resource assessments and the institutional requirements for implementing forest accounts. Chapter 4 also discusses some of the actions that could be taken in response to the policy analysis provided by forest accounts. Chapters 2 to 4 make use of a number of sometimes-complex economic tools, such as cost-benefit analysis and economy-wide modelling; it is not possible to provide detailed instructions in a manual of this size, so appropriate references that provide such instructions are given.

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 provide numerical examples of each forest account. Many examples are drawn 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. Additional examples from developing countries are used to suggest modifications for the needs of these countries. Chapter 7 also provides references for additional information about economic valuation techniques. Chapter 8 discusses data sources and provides a standard set of tables for constructing forest accounts.

# Chapter 1: Structure and policy uses of forest accounts

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 under way through the United Nations Statistics Division, Eurostat, 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 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 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 forest accounts is used to address these issues.

## 1.1 Structure

As satellite accounts, SEEA has a similar structure to SNA. 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 towards policy decisions that will improve environmental-economic performance in the future. The definition of environmental goods and services in SEEA is much broader than in SNA, in principle attempting to measure total economic value, not just market transactions.

SEEA has four major components:

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

- 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 SNA but are not made explicit because they are combined with all the other expenditures of these institutions. The purpose of this part of SEEA is to make those expenditures explicit. Forestry accounts include forest management expenditures by government, environmental protection expenditures by public and private sectors and user fees and taxes paid by forest users to the government.

- Environmentally-adjusted macroeconomic aggregates include commonly used indicators of macroeconomic performance that have been adjusted to better reflect sustainability, such as environmentally-adjusted gross domestic product (GDP), net domestic product (NDP), national savings or national wealth. For this component of SEEA, forestry accounts provide the addition to GDP of unvalued forest goods and services, the subtraction from NDP of the economic cost of deforestation or loss of forest services due to a change in management and the contribution of forest assets to national wealth.

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 may be applied.

There are two features that distinguish 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 SEEA is to link environmental data directly to economic accounts. SEEA achieves this by sharing structure, definitions and classifications with 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 and environmental issues are carried out independently of one another.

For issues such as forest management, the advantage of the SEEA approach is clear. It is not possible to promote sustainable forestry purely from the narrow perspective of managing forests; rather, an economy-wide approach is needed that can identify benefits that forests provide to other sectors as well as threats to forests from non-forestry policies. 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 production 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, SEEA is useful as a planning tool to coordinate policies across different line ministries and assess cross-sectoral impacts, weighing alternatives and trade-offs 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 3.

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

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. Forest accounts help address issues such as:

A. Establish a value closest to 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 optimized?*
   Optimization of infrastructure development, forestland 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 may be used in economy-wide models to anticipate impacts of non-forestry policies and design strategies for economic development that take into account all the goods and services, market and non-market, provided to all stakeholders.

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

# Chapter 2: Cross-sectoral policy applications of forest accounts

This chapter shows how forest accounts have been implemented and used for policy analysis. Country experience at the national level is discussed in relation to how it addresses 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?

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, forest 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 macroeconomy.

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 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 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 macroeconomic 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, electric power and water.

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 indirect impact through changes in land use. Forest accounts provide 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 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 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, as well as 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 programmes sponsored by government agencies or by non-governmental agencies in cooperation with governments. Forestry accounts are more common in developed than in developing countries. Eurostat has had an ongoing programme 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.

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 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. There is limited treatment of environmental services such as water and soil protection at the national level. This omission is due partly to the great uncertainty about these services (discussed further in Part II) compounded by the highly site-specific nature of the quantity of services provided and their economic value. For these reasons, forest environmental services are more commonly found in regional accounts or accounts for individual forests. This issue will be discussed in more detail in Chapter 3.

## 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, 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 forest 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.

**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 programme: | | | | | | | | |
| 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 ongoing accounting programmes 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.

### *2.2.1 Structure of forest accounts for Sweden, South Africa and Romania*

Sweden's forest accounts are part of a well established and comprehensive government programme 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. 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 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 woodlands; 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 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 and Moore, 1999). 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 percent 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 are 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, forestland, 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 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 forest: 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 forestland** | | | |
| Standing timber (m3 and value) | Timber cultivated forests classified by major species and age class.<br><br>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. |
| Forestland | Classified by three types of forest: cultivated, natural and fynbos woodlands<br><br>Land area (ha) only. | Classified by type of forest (cultivated, natural, other). Availability for wood supply, protection status.<br><br>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).<br><br>Pollination services of wild bees (number of farms, value).<br><br>Recreation and tourism (value).<br><br>Carbon storage (tons C, value).<br><br>Impact on water flow from cultivated forests (volume, value). | Recreation (number of visitors, value).<br><br>Carbon storage (tons C, value).<br><br>Biodiversity protection (land area, species count).<br><br>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.<br><br>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 and Moore, 1999)

There are similarities and differences among the forest values of these three countries, reflecting in part different forest uses and the different coverage of forest accounts. Notably absent from South Africa's 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[1]. Non-timber goods are less than 5 percent 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** |

*Recreational value was estimated for one year based on number of tourist-day visits to forest areas; the number of tourist-day visits is considered to have remained fairly stable over time.
Source: Norman *et al.* (2001).

In South Africa, commercial timber harvest accounts for 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 forest accounts. Environmental damage, in the form of a water abstraction externality by cultivated forests of alien species, accounts for about 12 percent 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.

[1] 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.

**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 and 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 and 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 combine 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 difficult to assess this value; in any case, it is likely that forest environmental services are substantial. An example of forest accounts that addresses the value of environmental protection services for water and soil will be discussed in Chapter 3.

### *2.2.3 How do forest accounts improve national economic accounts?*

With respect to the main objective of this policy application, providing a better understanding of the total economic value of forests than conventional national accounts provide, the benefit of accounts may be summarized in Table 2.6. In all countries, the values directly attributed to forests in national accounts greatly underestimate the true value of forests. The share attributed to forestry ranges from a high of 45 percent in Sweden to a low of 4 percent in Romania. A large part of forest services benefits other sectors and is attributed to these sectors, mainly recreation and agriculture, which account for 41 percent of forest output in Sweden and 24 percent in South Africa. Given the omission of many forest environmental services from 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 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, inter-generational and intra-generational. 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 forestland use planning, infrastructure development and assessing trade-offs among competing forest uses.

There are several ways in which the distribution of forest benefits may be evaluated, each of which is 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. Typically, they 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 use 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 vary 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 households 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 they 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 that 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 may 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 may 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 percent and 47 percent 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 carried out by local companies, but in Swaziland most of the logging operations are foreign owned, outsourced to local operators. 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 percent 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 and biodiversity protection, which account for 32 percent and 12 percent 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**<br><br>Subsistence household<br>(non-market timber and NTFP)<br>Foreign-owned local beneficiaries<br>(commercial logging) | 68%<br><br>55%<br><br><br>13% | **Local beneficiaries**<br>(commercial logging and NTFP) | 47% |
| | | **Non-local regional beneficiaries**<br>(recreation) | 42% |
| **Global beneficiaries**<br>(carbon storage, international tourism) | 32% | **Global beneficiaries**<br>(carbon storage, biodiversity protection) | 12% |

Source: Adapted from Mbuli, 2003 and Capparós, 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 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 percent 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 change in total wealth (produced capital plus natural 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 the SEEA forest accounting framework, they are examples of the kind of policy analysis that forest accounts can support. 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. An additional example, based on the conservation forest reserves of Tanzania, is provided in Chapter 4 where the implementation of cost-benefit analysis using forest accounts is discussed.

The assessment of trade-offs 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 modelling framework. The next section discusses such a modelling approach, which is used for capturing the full cross-sectoral impacts on forestry. But this modelling 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 towards 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, national economic accounts. Several versions of simulation modelling 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[2]. 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 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 travelling downstream as well: the use of timber as input to sawmills, the use of sawnwood by other wood processing sectors, the use of these wood products further downstream, etc. At each stage, upstream and downstream, employment and income are 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 SAM (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.

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 that 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. The model thus includes physical and monetary data about all the forest-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.

[2] 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 household.

**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 | Exports | Capital formation |
| 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 programmes in the Philippines and the impact of Indonesia's second long-term development plan on forests. The latter two studies are good examples of 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 the 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 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 direct 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 such accounts.

One of the major applications of SEEA in Europe has been in analyzing green taxes—especially carbon taxes, but also taxes on other air pollutants. These models, usually multisectoral computable general equilibrium (CGE) models, use the energy and pollution accounts of 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 eight 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.

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.

*Philippines: environmental-economic modelling 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 programmes. Stabilization programmes are short term in order 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 programmes (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 previous discussion of underlying causes of deforestation noted that such programmes 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 SAP, 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 SAP and alternative policies that could have been undertaken by 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 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 forestlands 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 SAP and safeguards 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 modelling 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 trade-offs 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 industry 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 were to expand 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 forest accounts have been implemented in different countries and how they have been used. In most countries, 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 forest accounts for analysis of the linkages between forestry and other sectors of the economy or by macroeconomic policies. Part of the problem is one of information. Detailed information is needed about the flows of forest 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 modelling, and supply and use tables for timber and wood products are used in modelling. But the broader forest accounts supply and use tables have not been used much.

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

# Chapter 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 that 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 better to represent regional differences, some forest accounts have been constructed at the regional level or for individual forests.

Chapter 1 identified three levels at which policy formulation and resource management takes place: the macroeconomic (national) level, the sectoral or industry-wide level and the community/regional or production level. This chapter explores the relationship between forest accounting at national as well as regional/forest levels. 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. Finally, a case study of Tanzania's catchment forest reserves is discussed because it provides a good example of an effort to include forest environmental protection services. These services are one of the major benefits to non-forestry sectors and are critical in establishing cross-sectoral linkages.

## 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 may 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, national forest accounts were disaggregated by geographic and ecological characteristics. The national-level framework of 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, 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, Philippines and others, were constructed from regional accounts, although the regional detail may not be reported in 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 may 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 percent of the value of forest goods and services, followed by regional communities that receive 42 percent. Commercial logging is the single most valuable activity, accounting for 40 percent of forest goods and services, split between landowners (35 percent) and forest workers (5 percent). Additional benefits from livestock grazing, hunting and local mushroom picking account for another 6 percent. Recreational activities, split between mushroom picking and other activities, account for 42 percent of forest benefits and accrue to regional communities, many from nearby Madrid. Global beneficiaries from carbon storage and biodiversity conservation receive 12 percent 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 |
| Landowners | 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*

Swaziland's national forest accounts 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,<br>Average annual rainfall 1000-1500mm<br>Semi-humid climate with short grassland forest patches | 33% | 0.29 |
| Middleveld | Average altitude 500 metres,<br>Annual rainfall 600-750mm<br>Tall grassland with scattered trees and shrubs<br>High rates of soil erosion | 28% | 0.37 |
| Lowveld | Average altitude 200 metres,<br>Annual rainfall 600-750mm<br>Near tropical climate<br>Mixed and acacia savannah | 31% | 0.21 |
| Lubombo plateau | Average altitude 600 metres<br>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 obtained largely from Swaziland's forest resource assessment carried out by the Department of Forestry (DANCED, 1999, 2000). Under 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. These uses are not included in 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 percent of the population in 1999, were not carried out. For 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 percent for craft wood to 28 percent for timber for home construction.

The value of commercial timber, the only economic contribution of forests reported in national economic accounts, is emlangeni (E) 40.4 million in 1999 (euro 6.2 million), 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 (euro 26.2 million) (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 percent of the total value of forest products. The Swaziland accounts further disaggregate this product into firewood and the construction of homes, fences and 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, in order to calculate benefits per hectare of forest, the study did not cross-tabulate forest benefits by region and forest cover.

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

| | **Cultivated forests (mainly highveld)** | **Natural forests and woodlands** | | | | | **Total** |
|---|---|---|---|---|---|---|---|
| | | **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 |
| **Sub-total** | | | | | | | 264.0 |

*Assumes virtually the entire production value of non-market forest goods is value-added (labour 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 and Dlamini, 2002, p.40, Table 11, and author's calculations.

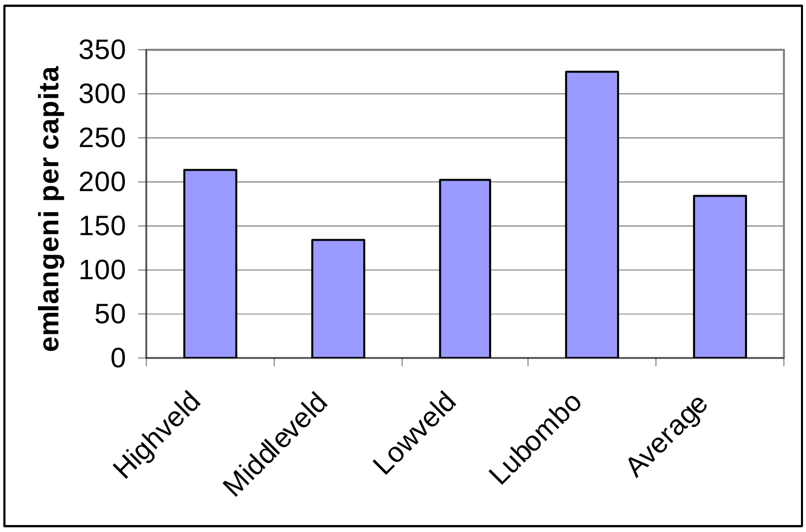
### *Local, foreign and global beneficiaries of forest goods and services*

The forest benefits in Swaziland's accounts may 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 3.5) and proximity to forest resources (Table 3.6). The responsibility for collection of forest products falls largely on women and children, a result of the traditional division of labour 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 percent of households in Lubombo region compared to 57 percent in the highveld region.

**Table 3.5: 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 and children | 13 | 34 | 23 | 29 | 25.4 |
| Children | 14 | 10 | 20 | 0 | 11.2 |
| Husband | 17 | 9 | 14 | 12 | 13.1 |
| Husband and children | 17 | 10 | 9 | 29 | 16.3 |
| Men as hired labour | 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 3.6: 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, Table 4.5, p. 68.

### *3.2.3 Accounting for forest environmental services in the catchment forest reserves of Tanzania*

Forest accounts for roughly 40 percent of Tanzania's land area and, in recent years, national forest policy has shifted from central control of forests to multi-stakeholder management, including participation by local communities under a joint forest management programme. It emphasizes sustainable forest management that takes into account macroeconomic policies and the participation of the private sector and other stakeholders. In support of joint forest management, the Ministry of Natural Resources and Tourism recently undertook an assessment of the total economic value of its catchment forest reserves (CFRs), forests set aside exclusively for watershed protection (Ministry of Natural Resources and Tourism, 2003).

The intended primary beneficiaries of CFRs are usually not local communities, but downstream users: downstream households, agriculture, fisheries, tourism and hydroelectric power. People worldwide benefit from carbon storage and biodiversity protection. But although extraction of forest resources is prohibited by law, forest products are harvested regularly by both local communities and, to a limited degree, commercial operators from outside the local community. While CFRs represent only 4 percent of total forested land in Tanzania, the conflict over forest use is most severe because these are the only forests explicitly gazetted for their non-consumptive functions. The challenge for CFR management is to assess the trade-offs between consumptive and non-consumptive uses of forests to determine a balance between these two objectives, and to find a mechanism for the downstream beneficiaries to pay for the services they receive or otherwise contribute financially towards forest management.

An assessment of the forest catchment protection services is particularly important for these forests. Although not a forest accounting exercise, the researchers discussed the need for forest accounting and the relationship between this study and forest accounts. Extensive fieldwork and surveys of the goods and services provided by CFRs were carried out in four regions of Tanzania, accounting for almost half of CFR land area. Although CFRs were originally established to protect water supply and soils, little is known about the quantitative links between forestland conversion, forest health and the quantity and quality of water flows. Furthermore, CFRs include various forest types and terrains throughout Tanzania, so it is likely that the protection services of specific CFRs differ significantly from region to region.

To value the water protection service, the report relied on the 'best guess' of experts of the impact on water services if CFRs were completely removed. Their best guess was that loss of CFRs would reduce water provided to domestic users and agriculture by 30 percent, freshwater fish catch by 50 percent and hydroelectric power by 15 percent in each region. The value of these services was estimated using two different approaches (see chapter 7 for discussion of these approaches):

- Market price plus partial replacement cost approach
    - the price charged for water (for irrigated crops) or the estimated net value of water as an input for the production of goods (for fish, electricity)
    - the hypothetical cost of developing alternative (groundwater) sources of water for livestock and domestic use to replace water provided by CFRs
    - no estimate was available for the potential costs of flooding.
- Damage prevention approach: the cost of dams and water control infrastructure needed to prevent floods during the rainy seasons and to ensure the flow of water during at least part of the dry seasons.

The first approach yielded an annual value of services of US$ 11.3 million, while the second approach yielded a much lower value, US$ 5.4 million (Table 3.7). In their final assessment, the authors used the lower estimate of the value of water services. However, the first approach demonstrates the relative importance of water services to different sectors: electricity production is the greatest beneficiary, followed by domestic and livestock use of water (these two uses were not differentiated in the report).

For soil stabilization services, the 'best guess' that experts could provide was that loss of CFRs would result in loss of 1 cm of topsoil on tilled areas downslope from the forests, reducing crop yields. It is assumed that the value of this service is at least equal to the higher yields possible with intact CFRs. The value of soil stabilization services was estimated at US $1.87 million. Together, the water and soil services of CFRs account for 21 percent of total forest values (using Method 2 for water services); carbon storage accounts for another 15 percent of forest values (Table 3.8).

**Table 3.7: Annual value of water services provided by conservation forest reserves in four regions of Tanzania, 2001** (thousands of US$)

| | | |
|---|---|---|
| **Method 1: Market price plus partial replacement cost** | | |
| | Irrigation | 32 |
| | Domestic + livestock | 3,218 |
| | Electricity | 7,720 |
| | Fisheries | 290 |
| | Total | 11,259 |
| **Method 2: Damage prevention** | | |
| | Infrastructure to control water flows | 5,410 |

Source: Author's calculations based on figures from MNRT, 2003.

**Table 3.8: Annual value of goods and services provided by conservation forest reserves in four regions of Tanzania, 2001** (thousands of US$)

| | |
|---|---|
| **Logging** | **3%** |
| **Forest goods used by rural households** | **22%** |
| Wood and wood products | 17% |
| NTFP | 5% |
| **Agriculture: fodder/livestock grazing** | **37%** |
| **Services to non-forestry sectors** | **39%** |
| Tourism | 3% |
| Environmental services | |
| Water supply protection services | 16% |
| Soil stabilization services | 5% |
| Carbon storage | 15% |
| **Total** | **100%** |

Source: Author's calculations based on figures from MNRT, 2003.

The report acknowledges that the estimates of environmental protection services are very crude but their study is important for demonstrating the quantitative links between forest health and production in non-forestry sectors. They have probably erred on the side of underestimating forest ecosystem values, choosing the most conservative assumptions in their valuations. There are many studies of this nature, often done in the context of cost-benefit analyses or for the development of forest management plans. The shortcoming of this valuation approach is that it does not say what would happen for marginal changes in CFRs, i.e. if only part of CFRs were converted to other uses. The economic impact of marginal changes cannot be reliably estimated from these forest values because most ecosystem functions do not exhibit a linear relationship with the area of forest cover and are often subject to critical thresholds.

## 3.3 Challenges for regional and local forest accounting

These case studies 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*

All three 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, an issue especially important for the Tanzanian case study.

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. 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, stakeholders can use regional forest accounts to demonstrate the rural livelihoods that would be lost, and would need to be replaced, if more forestland were converted to forest plantations or to large-scale commercial agriculture. The Tanzanian accounts indicate perhaps most strongly the cross-sectoral linkages with non-forestry sectors. Among the conclusions of the report were recommendations to include 'conservation fees' as a component of the tariff charged for electricity and water supply.

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. While the case studies for Spain and Swaziland did not include forest services like watershed protection, their inclusion is most likely to increase the total benefits from sustainable forestry.

The surveys used to construct forest accounts for Swaziland provide a 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, cross-tabulates resource use by region and forest cover and 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, 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 forestland were converted to forest plantations or to large-scale commercial agriculture.

### *3.3.2 Regional forestry-economic modelling*

More extensive policy analysis at the regional level, comparable to economic modelling 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 modelling 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 such 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 modelling with forest accounts.

# Chapter 4: Guidelines for policy analysis using forest accounts

The previous 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 forest accounts. These worksheets show how to calculate useful indicators and those parts of forest accounts used with economic models. While there are many indicators that can be produced from 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 Montreal Process set of C&I.

Of course, the details of 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 them. 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 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 summarizes 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 may 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. 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 may be obtained from this table, which may 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 forest accounts at this level was discussed in section 2.2 The first set of indicators identifies 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 this Table is the part of forest accounts that covers the 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 concerns 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 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 of rural communities are also a critical issue for forest management.

The final set of indicators shows 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 $CO_2$, 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 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<br>Share of forest goods and services included in GDP, and omitted values as % of GDP<br>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<br>% of national energy provided by firewood<br>% of tourists visiting forests<br>% of employment in non-logging industries dependent on forest services<br>Value of forest services as % of GDP<br>Value of forest services as % of output and sectoral GDP of sector that benefits (e.g. agriculture, tourist, etc.) |
| Rural livelihoods: economic importance of forests to rural communities | % of rural energy needs met by firewood<br>% of household nutritional requirements provided by forests<br>% of animals grazed in forests<br>Forest employment as % of rural employment<br>Value of output by non-market and small-scale producers as % of GDP<br>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<br>% of land devoted to biodiversity protection<br>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 (may 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, windbreak, cultural and spiritual values 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 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 may be viewed: regional distribution, scale of activity and distance of the beneficiary from the forest. There is some overlap among them and additional dimensions may also be useful. International comparisons of forest values may differentiate countries by their stage of development. For local or regional forest accounts, it may be useful to differentiate the household use of forest goods and services by household income group.

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 may be constructed for each region or for an individual forest, providing a picture of the importance of forests within a region. When accounts are compiled for multiple regions, it is possible to compare the contribution of forests among regions (Table 4.5).

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 forestland may also be a useful indicator.

**Table 4.5: Worksheet 3: Major indicators disaggregated by region**

<table>
<tr><th rowspan="2">Purpose</th><th colspan="4">Indicator</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th><th>Total</th></tr>
<tr><td>Economic contribution of forests relative to other sectors of the economy</td><td colspan="4" rowspan="4">Indicators from Table 4.2</td></tr>
<tr><td>Non-forestry sectors: economic contribution of forest services to non-forestry commercial sectors</td></tr>
<tr><td>Rural livelihoods: economic importance of forest to rural communities</td></tr>
<tr><td>Global benefits: Economic importance of forest services to the global community</td></tr>
</table>

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 beneficiary: 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, regional (recreation services; no regional forest protection services were included in the accounts) and global beneficiaries. For Swaziland, a small country, two types of local beneficiary 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 forest 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, 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 | Capitalized value of natural forests | Total national wealth including natural forest assets |

[1]Depletion of cultivated forests is included in 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 forest flow accounts, but these indicators also make use of 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, as well as a lack of institutions or regulations to monetize these services, so that forest owners are compensated for the services that 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, may be provided by forest accounts. Analysis of alternative uses usually requires some information about the impact of a change in forest use 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 forest accounts. Some of this information, at least in a preliminary version, is likely to be collected for forest accounts in order to assess the sustainability of present uses.

Forest accounts for conservation forest reserves (CFR) of Tanzania (Ministry of Natural Resources and Tourism, 2003), introduced in Chapter 3, were used for a simple CBA to assess alternative options for CFR management. Tanzania's CFRs are currently set aside exclusively for watershed catchment protection, but are subject to illegal consumptive exploitation by local communities surrounding the forests, which in some instances is unsustainable and threatens the catchment protection function. Under Tanzania's new national forest policy, joint forest management is being introduced which is mandated to consider all stakeholders in the management of forests. The report assessed the net benefits of CFRs generated under the present management option with the potential net benefits that could be generated under alternative management that combined catchment protection and consumptive utilization of the forests.

For CBA, one must compare the present value of net benefits of alternative uses of forests over the lifetime of the forest, not just current annual net benefits. However, the surveys provided information about annual net benefits for most goods and services. The stream of future net benefits was calculated from annual values by making assumptions about the sustainability of the supply of forest goods and services over time. Where forest use is sustainable, the value can be provided indefinitely; in such cases, the present discounted value over time is obtained by simply dividing the current value by the discount rate (10 percent was used).

Their analysis had several parts:

*Identify the value of forest goods and services under present management.* Forest accounts quantified the total economic value as well as the net value (gross value minus extraction costs) of CFRs for hydroelectric power, irrigated agriculture, municipal water supply, tourism, carbon storage and harvesting of forest goods by local communities.

*Identify the value of forests under alternative management that combines catchment protection and restricted consumptive use of forests.* The value of forest benefits under alternative management was determined by assessing the sustainability of present forest benefits. The study concluded that non-consumptive forest services, such as tourism and protection, are sustainable, so the value of these services continues at the current level under both present and alternative management. The study then determined the level of consumptive forest activities that could be undertaken without damaging the ability of CFRs to provide catchment protection:

- Extraction of sawn timber could be substantially increased over present levels without reducing the ability of the forests to provide catchment protection.
- Fodder extraction and grazing, currently an important forest value, are unsustainable; would have to be stopped in order to maintain the soil protection services of CFRs.
- The extraction of other NTFP is considered sustainable at current levels and could continue under alternative management.

*Value the present value of the stream of net benefits for alternative forest management options over the lifetime of the forest.* CBA requires comparison of the present value of net benefits of alternative uses of forests over the lifetime of the forest, not just current annual net benefits. The researchers made a simple assumption: sustainable activities would continue at the present level indefinitely, without increasing or decreasing. Unsustainable activities (livestock grazing) would be discontinued under the alternative management option. A discount rate of 10 percent was used to calculate the present value of future net benefits (Table 4.8).

The total value of CFRs is greater under mixed-use management, US$614.6 million, than under the present management for catchment protection only, US$ 490.3. The value of forest services remains the same under both forest management options. However, the value of wood is much higher under alternative management and the value of NTFPs is much lower. Under present management, very little timber is harvested, US$67.6 million; the alternative management would allow timber harvesting at the sustainable rate, yielding a net current value of US$ 445 million. Regarding NTFPs, fodder and livestock grazing would not be allowed under the alternative, mixed-use management system, so the contribution of NTFPs to forest values is much lower than under present management.

*Evaluate the distribution of forest benefits and identify policies to support sustainable management of CFRs.* The distribution of benefits is a key element in designing policies to ensure sustainable management of forests. The total value of CFRs under mixed-use management is higher than under present management, but there is a clear loss to local communities from cessation of grazing. Local communities will not benefit from alternative management unless their share of benefits from harvesting of timber is sufficient to compensate for their loss of grazing. Timber harvesting requires a combination of local participants as well as those in other areas where sawmills are located, with access to export markets, etc.

- Local communities: The report noted that local communities depend on CFRs and are using them in an open access manner, mainly because forest use is illegal so there is no local management of consumptive use of forests. By allowing selective consumptive use of CFRs, local management committees can be established to oversee forest use and ensure that local use does not compromise catchment protection services.
- Downstream beneficiaries: although downstream users received much of the benefits, they are unaware of this and contribute nothing to forest management. The report recommends that all stakeholders be educated and that conservation fees be introduced for water and electricity that would be used to finance forest management or possibly compensate local communities for loss of livestock grazing.

**Table 4.8: Total net economic values generated by catchment forest reserves under present management and alternative management in Tanzania**
(present discounted net value in million US$, 2001)

| | **Management objective** | |
|---|---|---|
| | **Present management** (catchment protection only, with illegal consumptive use) | **Alternative** (combined catchment protection + consumptive use) |
| **Forest goods** | | |
| Timber and timber-related products | 67.6 | 445.0 |
| NTFPs | 287.1 | 33.9 |
| **Forest services** | | |
| Water protection | 54.1 | 54.1 |
| Soil protection | 18.7 | 18.7 |
| Tourism | 11.9 | 11.9 |
| Carbon storage | 50.9 | 50.9 |
| Total | 490.3 | 614.6 |

Source: Based on author's calculations from Ministry of Natural Resources and Tourism, 2003.

The Tanzanian case study is a highly simplified assessment of trade-offs between two alternative forest management options, but it demonstrates that forest accounts can provide a useful first step in these assessments. 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 on forestry as well as 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 the 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 as well as the chain of effects of economic policies on the natural resource base.

As with CBA, forest accounts provide a starting point or base year for a model: forestland 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 behaviour, population movements and forest ecology. The data requirements for this kind of analysis are shown in Table 4.9. 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 may also be classified by economic or institutional characteristics such as degree of forest protection, accessibility to settlers and economic users 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, labour or exports, so they are particularly well suited to address the cross-sectoral policy linkages affecting forestry. CGE models are based on SAMs, which represent the most detailed implementation of national accounts. The drawback of simulation modelling is the amount of data required. For countries that do not compile SAMs, IO tables may be available, which may be used for more limited simulation modelling.

**Table 4.9: 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 asset accounts**
Timber
Non-timber values (by major type of value)
Forestland (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

Forest accounts provide a comprehensive framework for representing all goods and services provided by forests to all other sectors, with extensive policy applications described in Chapters 2 and 3. Examples of the policy uses of forest accounts and the actions that could be taken on the basis of the policy analysis are shown in Table 4.10. Prominent among the policies are the institution of fees for environmental services, which may be used to fund forest management—often woefully underfunded in many developing countries—and to compensate other users, often local communities who may have to sacrifice some forest uses in order to maintain the flow of forest protection services. Forest accounts help identify potential conflicts, at the level of Ministry development objectives as well as between local users of forest resources. By quantifying the relative values, trade-offs among users can be assessed and an optimal forest strategy designed that takes into account all stakeholders. Forest accounts also assist in the building of multidisciplinary alliances across ministries and among different stakeholders in the private sector, as they realize the extent of their dependence on forests.

**Table 4.10: Selected policy applications of forest accounts**

| Indicator/measure | Use for policy analysis | Examples of policies and actions taken from policy analysis |
|---|---|---|
| **1. What is the total economic contribution of forests and what are the benefits from sustainable management** | | |
| Total value of forests including *non-market* forest goods and services. | More comprehensive, accurate value of forests' contribution to GDP. | Showing a higher value for forest contribution to GDP may increase the forestry sector's ability to request a larger share of national budget for forest management and investment. |
| Value of forest services to non-forestry sectors. | Measure of the economic importance of forest services to agriculture, electricity, fisheries, tourism, municipal water supply, etc. | Design economic instruments to promote sustainable forest use, for example:<br>- institute conservation fee on water and hydroelectricity tariffs for downstream beneficiaries that can be used for forest management or to compensate local communities<br>- institute tourism fees for biodiversity conservation for forest management/compensation of local communities<br>- negotiate international payments for carbon storage services of forests.<br>Build multi-sectoral stakeholder alliances on the basis of mutual benefits.<br>Identify institutional weaknesses in forest management, e.g. where one sector benefits but does not pay, or does not have a say in forest management. |
| Value of forest goods and services used by local communities. | Share of forest goods in rural livelihoods provides measure of dependence on forests of local communities. | Useful for design and implementation of PRSPs. |
| **2. What is the distribution of forest benefits among different groups in society** | | |
| Share of forest benefits accruing to commercial, artisanal and subsistence users of forests, or, | Identify social benefits from preservation of local communities and increased equity. | Identify potential conflicts, e.g. benefits to subsistence users/local communities are low because commercial/downstream users obtain benefits. |

| Indicator/measure | Use for policy analysis | Examples of policies and actions taken from policy analysis |
|---|---|---|
| Share accruing to local, downstream and global beneficiaries. | | Design economic instruments so that beneficiaries pay for the benefits, compensating those who may sacrifice benefits. For example, property rights – some say over how a forest is managed – and fees for environmental services received.<br>Optimize investment in forests and forest infrastructure that balances social objectives for equity and regional development as well as economic objectives of maximizing national income. |
| **3. Is economic growth sustainable or is it based on the depletion of forests?** | | |
| Value of forest assets and the cost of deforestation and forest degradation. | Macroeconomic indicators of sustainability (such as NDP, national wealth, asset depletion). | Reassess forest management if deforestation is occurring. |
| **4. What are the trade-offs among competing users of forests?** | | |
| Value of forest goods and services under alternative forest management options. | Measure economic linkages between forestry and other sectors of the economy, upstream and downstream.<br>Identify the economic trade-offs among competing sectors. | Optimize forest use and investment in forests and forest infrastructure by taking into account total economic value of forests, market and non-market, including linkages to non-forestry sectors and impacts on all stakeholders, economy-wide.<br>Identify winners and losers.<br>Design appropriate economic instruments to achieve that strategy (fees, compensating payments, property rights, etc.). |
| **5. What are the impacts of non-forestry policies on forest use?** | | |
| Analyze economic development scenarios that trace the full chain of causation from macroeconomic policy and/or non-forestry sector policies to their impact on forestry and land use. | Measures the winners and losers, pressures on forests and forest users from alternative development strategies.<br>Identifies potential conflicts between development objectives of forestry and those of other sectors, e.g. commercial logging vs catchment protection (Ministry of Agriculture, Ministry of Energy, etc.).<br>Identify conflicts among divisions of the same ministry (Ministry of Agriculture), e.g. pastoralists' use of forest vs downstream crop farmers. | Identify winners and losers.<br>Identify optimal forest management strategy, based on addressing conflicts among ministries and within a single ministry.<br>Design appropriate economic instruments to achieve that strategy (fees, compensating payments, property rights, etc.). |

Implementation of forest accounts raises a number of challenges, technical as well as institutional. Regarding the institutional aspects, the manual cautions that good inter-disciplinary and inter-ministerial coordination is necessary to utilize forest accounts. Forest accounts provide some motivation, by quantifying the value of forests to non-forestry sectors, but this may not be sufficient. Other components of FAO's cross-sectoral linkages programme will address institutional issues in more detail.

The major data sources for forest accounts that are common to many countries are listed in Table 4.11. The coverage of these data sources will vary by country. For example, the national accounts of some countries may include most NTFP, while those of others may not. Most of the common data sources focus heavily on commercial products. The strongest data are those for commercial logging; physical and monetary data are relatively easy to collect and are available in most countries. Carbon storage accounts may be reasonably estimated from forest stock accounts. NTFP and other forest services pose additional challenges that are described below.

*Non-timber forest products*
The new guidelines for national forest resource assessments include non-timber and non-market forest goods and services. As assessments are 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, forest resource assessments could become an important tool for building forest accounts. However, at this time there has not been any harmonization of the definitions of NTFP and services across countries. It is also possible to obtain information about household use of NTFP from household income and expenditure surveys that are undertaken periodically at the national level in many developing countries. Special surveys and valuation studies are required to provide the missing data in forest accounts.

*Forest services*
The value of tourism is not usually measured in most countries (see Chapter 7 for further discussion of this topic), even when tourism is an important industry. Surveys collect figures for numbers of tourists, but national surveys of the economic value of tourism are still not common. Tourism surveys (tourist expenditure and tourism industry surveys) may be used to estimate this forest service and there is extensive literature on this subject. Care must be taken to isolate the contribution of forests from other attractions that occur simultaneously, such as mountains or wildlife.

Forest protection services that benefit other sectors, such as agriculture, hydroelectric power and fisheries, are the most difficult forest benefit to quantify; this component of the accounts remains a challenge for forest accounting and for any approach to cross-sectoral policy analysis. Clearly this is an area where much more research is needed.

*National and regional valuation: scaling and aggregation of forest values*
The value of forests is determined by local and regional site-specific characteristics and options for use. As discussed in the section on benefits transfer, the availability of NTFPs and their local economic value, for example, will often vary a great deal by region. The same applies to forest services: a forest catchment may provide significant water protection services, but unless there are downstream users who require these services they have little economic value. The site-specific nature of forest values means that values estimated for one area of a country cannot be assumed to hold in other areas. This poses a problem for constructing accounts for forests at the national level, because the method commonly employed for national accounts—scaling up to the national level from sample data—cannot be as readily applied.

*Proceeding incrementally with forest accounts*
It is recommended that countries proceed incrementally and not try to construct comprehensive forest accounts at one time. At the national level, there are often sufficient data to begin compiling accounts for commercial timber and forest activities. However, in addressing NTFPs and forest services, it is more accurate and useful to policy-makers to construct forest accounts at the regional level. When enough regional accounts are compiled, national accounts may be constructed by aggregating regional accounts. Regional accounts will be more useful for policy-makers because many forest management decisions are taken at the regional or local level, and even policy at the national level must take into account regional variations in forest resources and value.

**Table 4.11: 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.<br>Only undertaken at large time intervals |
| | National forest inventories | Physical data for area of wooded land and volume of standing timber.<br>Only undertaken at large time intervals |
| | Forestry statistics | Sometimes provide annual figures for forestland and stocks of standing timber updated from forest inventories<br>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 goods and services** | Forestry statistics | Physical data on forestry and forest industry products |
| | National forest resource assessment | Data on commercial forestry products plus non-timber forest products in physical units.<br>May collect information about NTFP |
| | National accounts | Monetary data for output of forestry and logging, and non-timber forest products in some countries.<br>Data include: output, intermediate consumption, value-added, consumption of fixed capital, compensation of employees, net operating surplus, changes in inventories<br>Supply and use tables<br>IO and SAMs |
| **3. Forest environmental services** | | |
| Carbon storage | Forest resource assessment, 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. |

# Chapter 5 : Overview of forest accounting

Forest accounts provide a framework for a) linking forest asset (balance) accounts with flow accounts for timber, NTFP and forest ecosystem services in physical and monetary terms; and b) linking forest asset and flow accounts with SNA. SEEA provides a measure of forest values that is more comprehensive than SNA in two respects. First, SEEA forest accounts include both cultivated and natural forests in the asset accounts. Second, 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 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, fuelwood, edible plants, game and medicinal plants) or non-extractive (e.g. recreation and tourism). Indirect use benefits refer to environmental services provided by forests that are of indirect value, 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 existence 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 (forestland 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 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<br>Non-timber forest products<br>Recreation and tourism<br>Livestock grazing |

| | |
|---|---|
| **Indirect use values:** indirect environmental services provided by forests, such as carbon storage, habitat and biodiversity protection, hydrologic function. | Carbon storage<br>Biodiversity protection<br>Hydrologic function<br>Soil protection/stabilization |
| **Option value:** value of maintaining the option for use of forest, 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, quite a bit of work has been done to estimate option value and non-use values. However, these values are rather experimental at the present time; neither 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

Forest accounts consist 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 forest accounts is shown in Table 5.1. Chapter 3 discussed the usefulness of accounts for regions or specific forests; for large countries, like Brazil, with extensive forest values that vary by region, it is especially useful to construct these accounts on a disaggregated level.

**Table 5.1: Components of SEEA forestry accounts**

| |
|---|
| **1. Forest-related asset accounts** |
| **Wooded land:** land area and economic value by main species, natural and cultivated forestland, available for wood supply or not available, etc. |
| **Standing timber:** volume and monetary value of by main species, natural and cultivated forestland, available for wood supply or not available, etc. |
| Depletion and depreciation of standing timber |
| **2.2. 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 forest 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

Forest accounts are based on two integrated assets: wooded land and standing timber. The definitions and classifications of forests in 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 may be found in SEEA-2003 (UN *et al.*, 2003, p. 341-344) and the Eurostat report (Eurostat, 1999a pp 13-18).

### *5.3.1 Wooded land*

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

EA.23 Wooded land

EA.231 Forested land
EA.2311 Forests available for wood supply
EA.2312 Forests not available for wood supply

EA.232 Other wooded land

*Forested land* is defined as tree crown cover (or equivalent stocking level) of more than 10 percent and an area of more than 0.5 hectares. The trees should be able to reach a minimum height of 5 metres at maturity *in situ*.

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

Although this definition does not cover all land with trees, it has been used so that data may be harmonized 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* may 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 SNA calculates the production of the forest industry differently for cultivated and natural forests. 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. 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 forest).

*Semi-natural managed forests* - management has substantially altered the structure and ecological processes of the forests but growth is still mainly a natural process with no regular and continuous human intervention.

*Plantations* - forests for intensive fuel or industrial wood production, planted or artificially regenerated and made up of exotic (non-indigenous) species and/or monocultures. (UN *et al.,* 2003, p.343).

Forested land may also be classified by the dominant tree species (constituting at least 75 percent 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) and 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 that can still be used for fibre or fuel. It excludes small branches, twigs and foliage. (UN *et al.*, 2003, p.346)

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

# Chapter 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' experience in 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 as well as 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 colonization | | | |
| 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 forestland 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 colonization 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 forestland from available for wood supply to not available 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 forestland |
|---|---|---|---|---|---|---|---|
| | 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 |
| Pulpwood | -91.7 | -23.5 | -115.2 | | | | -115.2 |
| Fuelwood | -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 change 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 may 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 that is 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 not available 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 experience with asset accounts

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

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 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 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 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 forestland is degraded to the point where it no longer meets the definition of forested land (tree cover falls below 10 percent), 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 may be indicated by many different attributes. In the forest accounts developed by Eurostat, defoliation was chosen as the measure of forest 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 Montreal Process C&I 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. sulphates, 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 Montreal 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, forest accounts would include as many of these factors as data allow. Some of these factors could be included directly in 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 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 CPC and industries by ISIC, the classifications used in 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 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 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 the 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 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 (Capparós *et al.*, 2001), India (Haripriya, 2000, 2001), South Africa (Hassan, 2002) and Swaziland (Mbuli, 2003). Typically, the amount of grazing may 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 forestland. 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 forestland 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 may also be compiled for the area of forestland used for tourism.

#### *6.2.1 Forest environmental services*

Forest accounts include three environmental services that do not correspond directly to an economic activity or product as defined in 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 that 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 modelling 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 experience with carbon accounting using time intervals from opening to closing stock that ranged from four years (Sweden) to nine 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)

| | Forestland | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 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, nutrient and chemical loads and 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, e.g. shading streams to reduce water temperature, providing woody debris and habitat for aquatic species

B. Habitat to conserve biodiversity (Dudley and Stolton, 2003; 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 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. A recent joint study by the World Bank and WWF International examined the water supply of the world's 105 largest cities, measured by population (Dudley and Stolton, 2003). The study identified the conditions under which forests may increase or decrease water supply and downstream soil erosion. With respect to regulating water quantity, the role of forests is mixed. However, there was consistent, strong evidence to support the claim that forests make a major contribution to maintaining water quality. Many urban areas rely on watershed protection for at least part of their water supply, especially water quality.

In the Eurostat pilot programme, several countries compiled physical accounts that identify the land area providing protection services, as 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**

| | | Number of endangered species | | | | |
|---|---|---|---|---|---|---|
| | Total number of known 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 colonization | | | | | |
| 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 account for flows of goods and services is provided by the supply and use table (SUT). SUT shows the origin of different forest products, the processing of raw forest products into other products such as sawnwood and firewood, and the use of each product by every sector of the economy as well as final users (households, government, capital formation and exports). National accounts provide monetary SUTs for forest products. The forest accounts of SEEA provide the corresponding physical SUTs and, in principle, extend SUTs for non-timber forest products as well. The two tables are linked to each other and the rest of the economy through the use of a common classification for industries and commodities. From these tables, commodity balances for forest products may be constructed, as well as an input-output (IO) table or SAM in which the production of forest products is represented in physical terms.

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 in tons and forest services in various physical units, as described in the previous section. The supply table shows the main forest products and the industries that provide them. Standing timber is provided only by the forestry and 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: firewood, manufactured wood and wood products such as furniture or construction timber, and paper. Any product except standing timber may be exported. Only standing timber and certain manufactured wood products are treated as capital goods.

In principle, these detailed supply and use tables may 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 |
| Firewood | 31200 | | | | | | | 31200 | 27 | 31227 |
| Pulpwood | 11869 | | | | | | | 11869 | 699 | 12568 |
| Wood and 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** | | | **Total use** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Forestry & logging** | **Wood products** | **Pulp** | **Paper** | **Printing** | **Recycling** | **Other** | **Total int.** | **Consump-tion** | **Capital formation** | **Exports** | |
| Standing timber | 66232 | | | | | | | 66232 | | 29688 | | 95920 |
| Sawn logs | | 23337 | | | | | | 23337 | | | 1276 | 24613 |
| Firewood | | | | | | | 2423 | 2423 | 28429 | | 375 | 31227 |
| Pulpwood | | | 10944 | | | | | 10944 | | | 1624 | 12568 |
| Wood and 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

# Chapter 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 forest accounts, notably, wooded land, standing timber and timber and wood products, often have market prices that 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 and assumptions required for valuation have not been standardized, and the approaches are not always consistent with SNA.

The Eurostat pilot programme identified three major difficulties faced when 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 vary 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 standardized, 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, limits 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 national accounts. Also, 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 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 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 forest economics literature and will be only briefly described here. 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 that, 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, 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 7.2). 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 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 forestland.

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, SEEA lists three alternative methods for calculating the value of standing timber (mathematical formulas for each method are given in Box 7.1):

> Net present value approach implements the Faustmann method described above. It may 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 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 7.1. 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. 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 $v_\tau$, the value per hectare of forestland of age class $\tau$, weighted by $A_\tau$, the total area in age-class $\tau$, 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.)

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

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

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 may 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.

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 standardized approach recommended by 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 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 colonization | | | |
| 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

**Box 7.2. 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 forest 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 may 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 wooded land may be owned by the state, or as common property managed by local communities, there may be no sales of land.

**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 |
| Pulpwood | -8,130 | -1,831 | -9,961 |
| Fuelwood | -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 may be calculated from 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<br>(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 1990s, 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 affects asset value. All methods have included only timber value of forests. The mathematical formulation for these methods is provided in Box 7.3.

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. 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 relate forest health direct to forest ecosystem productivity (with the possible exception of timber production) and there has been no attempt so far to value forest health accounts.

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 remedy 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 7.3. 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 SNA. The value of an asset is affected not only by 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 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 SNA method of calculating depreciation of manufactured assets.

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 wellbeing, 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 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 firewood, the primary inputs are labour, cutting implements and sometimes transportation if the firewood is not carried by hand. In many developing countries the labour 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 forest 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 labour 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 labour. Chomitz and Kumari (1996, p. 22) report studies where the *in situ* value is close to zero.

Forest goods and services may be divided into three categories based on the approach to valuation. Some forest 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 that 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 may 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<br>Price of close substitute product<br>Production cost |
| **Non-timber forest goods** | Local market prices of same product<br>Price of close substitute product<br>Production cost |
| **Forest services** | |
| Livestock grazing | Price of close substitute product<br>Production cost |
| Recreation and tourism | Travel cost<br>Hedonic price of land<br>Contingent valuation method, conjoint analysis |
| **Forest environmental protection services** | |
| Carbon storage | Carbon tax<br>Carbon emission permit trading price<br>Global damage from climate change averted |
| Biodiversity and habitat preservation | Contingent valuation method, conjoint analysis |
| Protective services for water, soil, etc. | Damage cost (e.g. reduced productivity in non-forestry sectors)<br>Damage prevention costs<br>Contingent valuation method, conjoint analysis |

*Valuation of market and near-market forest products*

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 forest accounts. 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 in their national accounts food grown for own consumption as well as the value of owner-occupied housing, near-market products that are valued at the price of their market equivalents. 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 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 utilize 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 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 a surplus that is sold in local markets. Local market prices for these goods may 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, which is 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 the 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 adjustment 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 may be divided into ‘revealed preference’ and ‘stated preference’ methods. The former derives forest values from observed market (revealed) behaviour towards 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 behaviour, 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 7.4.

*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 national economic accounts; rather, it cuts across a range of industries, such as hotels and accommodation, restaurants and transportation services. The only tourism services that are directly recorded as such in 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 determine separately 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 7.2 for land valuation) and travel cost approaches (Box 7.4), both of which are 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 developing countries. Recreation and tourism values in forest accounts of developing countries are often omitted or only partially represented. In South Africa, for example, the tourism values for only one kind of forest, fynbos woodlands, were represented; no reliable estimate was available for national parks.

**Box 7.4. 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 may 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: Output related to wooded land in Sweden, 1999 (million euros)**

| | Output | | | | Valuation technique |
|---|---|---|---|---|---|
| | **Market** | **For own final use** | **Other non-market** | **Total** | |
| **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 | 6 | | 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 at the cost farmers would have paid for commercial pollination.

*Carbon storage*

Carbon storage is the non-timber value most often included in 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 modelling 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. Nordhaus (1992) provided the first estimate of global damage from carbon. He constructed a model (the DICE model) that integrated an economic and a geophysical model to estimate the damages from future climate change on the productivity of primary sectors in the US economy, and then extrapolated the damage in the US economy to the rest of the world. Since 1992, there have been many refinements to this model and new estimates of damages. In a recent book, Nordhaus and Boyer give a figure for damage from carbon emitted in the range of US$5-10 per ton of carbon (Nordhaus and Boyer, 1999).

The $10/ton figure 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 at estimating 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 and quality, soil stabilization and water quality. As inputs to production, they are similar to livestock grazing 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 may 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, 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. The case study of the conservation forest reserves in Tanzania was discussed in Chapter 3. 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. Some alien invasive species outside plantation forests have a similar damaging effect on water supply and are being eliminated at considerable expense; the impact of these tree species has not been estimated.

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 the following 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 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 or use averages from other parts of the country, or even from other countries (see discussion of benefits transfer, below).

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 forestland 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 future forest accounts.

**Table 7.8: Annual payments for water quality services by hydroelectric power companies in Costa Rica**

| Company | Payment to forestland 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 are 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, benefits 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; Pérez 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 benefits transfer are even greater.

## 7.3 Monetary supply and use table

The general framework of SUT was described in Chapter 6, 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 SUTs may 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 | | | | | | | | Imports | Taxes - subsidies on products | Trade & transport margins | Total supply |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Forestry & logging | Wood products | Pulp | Paper | Printing | Recycling | Other | Total ind. supply | | | | |
| Standing timber | **1982** | | | | | | | **1982** | | | | **X** |
| Sawn logs | **1311** | | | | | | | **1311** | **219** | | | **X** |
| Firewood | **977** | | | | | | | **977** | **3** | | | **X** |
| Pulpwood | **245** | | | | | | | **245** | **67** | | | **X** |
| Wood and wood products | | **5664** | | | | | | **5664** | **1881** | | | **X** |
| Paper pulp | | | **1046** | | | | | **1046** | **956** | | | **X** |
| Paper | | | | **5685** | | | | **5685** | **3697** | | | **X** |
| Wood waste as product | | **75** | | | | | | **75** | **41** | | | **X** |
| Paper waste as product | | | | **381** | | | | **381** | **77** | | | **X** |
| Other products | 305 | | | | **8063** | | | **8368** | | | | |
| **Non-timber forest products** | | | | | | | **X** | **X** | **X** | **X** | **X** | **X** |
| **Forest Services** | | | | | | | **X** | **X** | | | | **X** |

| USE | Intermediate consumption by industries | | | | | | | | Final users | | | Total use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Forestry & logging | Wood products | Pulp | Paper | Printing | Recycling | Other | Total int. | Consump-tion | Capital formation | Exports | |
| Standing timber | **1368** | | | | | | | **1368** | | **613** | | **1981** |
| Sawn logs | | **1390** | | | | | | **1390** | | | **140** | **1530** |
| Firewood | | | | | | | **86** | **86** | **884** | | **9** | **979** |
| Pulpwood | | | **173** | | | | | **173** | | | **140** | **313** |
| Wood and wood products | | **3294** | | | | | **2587** | **5881** | | | **1663** | **7544** |
| Paper pulp | | | | **1814** | | | | **1814** | | | **188** | **2002** |
| Paper | | | | | **6559** | | | **6559** | | | **2824** | **9383** |
| Wood waste as product | | **21** | **20** | | | | **31** | **72** | | | | **72** |
| Paper waste as product | | | | **375** | | | | **375** | | | | **375** |
| **Other intermediate inputs** | **646** | | | | | | | | | | | |
| **Total intermediate consumption** | **2014** | | | | | | | | | | | |

| USE | Intermediate consumption by industries | | | | | | | | Final users | | | Total use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Forestry & logging | Wood products | Pulp | Paper | Printing | Recycling | Other | Total int. | Consump -tion | Capital formation | Exports | |
| **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** | | **X** |
| **Forest Services** | **X** | | | | | | **X** | **X** | **X** | **X** | | **X** |

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

### 7.4 Expenditures for forest resource management and protection

Although forest managers are likely to view almost all forest-related activities as part of forest management—logging, silviculture, etc.—this component of SEEA is much more narrowly defined. This third component of SEEA differs from the others in that it does not add any new information to 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, such as trade negotiations (e.g. USA/Canada timber dispute and tariffs). 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. Both public and private sectors contribute to forest management and protection expenditure. The accounts 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 Forest accounts and macroeconomic indicators

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 forest accounts, the value of natural forests and carbon storage can (and should) 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, because the value of forest services was previously included in the value of non-forestry sectors (as mentioned in the Introduction).

**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 carbon storage |
| **National saving and comprehensive saving** | Include changes (depreciation/appreciation) of natural forests |

# Chapter 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 them.

## 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 those of others may not. Most of the common data sources focus heavily on commercial products. The new guidelines for forest resource assessments 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, these assessments could become an important tool for building forest accounts.

Several major weaknesses remain in the available data:

- the economic value of forest 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 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 forest accounts.

At a minimum, it would be useful to disaggregate 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 with periodic household income and expenditure surveys that 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.<br>Only undertaken at large time intervals |
| | National forest Inventories | Physical data for area of wooded land and volume of standing timber.<br>Only undertaken at large time intervals |
| | Forestry statistics | Sometimes provide annual figures for forestland and stocks of standing timber updated from forest inventories<br>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 |
| | National forest resource assessment | Data on commercial forestry products plus non-timber forest products in physical units.<br>May collect information about NTFP |
| | National accounts | Monetary data for output of forestry and logging, and non-timber forest products in some countries<br>Data include: output, intermediate consumption, value-added, consumption of fixed capital, compensation of employees, net operating surplus, changes in inventories<br>Supply and Use Tables<br>IO and SAMs |
| **3. Forest environmental services** | | |
| Carbon storage | Forest resource assessment, 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 chapter 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 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 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 colonization | | | |
| 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 colonization | | | |
| 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 colonization or natural regression, or for other reasons which cannot be determined

*Changes in classification:* changes in classification such as a reclassification of forestland from available for wood supply to not available 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 m3)**

| | 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 that 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 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, or number of animal-days of grazing) | | | | | | | | | | | | |
| Wild agricultural products: vegetables, fruits, nuts, medicines, construction materials, etc. | | | | | | | | | | | | |
| Meat, skins, fur from wild game | | | | | | | | | | | | |
| Fodder, livestock grazing | | | | | | | | | | | | |
| Other forest products: charcoal, peat, etc. | | | | | | | | | | | | |
| **Forest services** (measured in numbers of visitors to recreational areas) | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | |
| Fodder, livestock grazing | | | | | | | | | | | | |
| Other forest products: charcoal, peat, etc. | | | | | | | | | | | | |
| **Forest services** | | | | | | | | | | | | |
| 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 that 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 |
|---|---|---|---|---|---|---|---|
| | | Number of endangered species | | | | | |
| | Total number | 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 colonization | | | | | | | |
| 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 8.8a: 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 | | | |

**Table 8.8b: Value of environmental protective services by type of forest** (million national currency units)

| | Forest and wooded land | | Total |
|---|---|---|---|
| | Available for wood supply | Not available for wood supply | |
| Soil protection | | | |
| Protection of water resources | | | |
| Avalanche protection | | | |
| Coastline protection | | | |
| Other | | | |
| Total | | | |

## Supply and use tables

**Table 8.9a: 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** | **Imports** | **Total supply** |
| Standing timber | | X | | | | | | | X | | X |
| Sawn logs | | X | | | | | | X | X | X | X |
| Firewood | | X | | | | | | X | X | X | X |
| Pulpwood | | X | | | | | | X | X | X | X |
| Wood and wood products | | | X | | | | | | X | X | X |
| Paper pulp | | | | X | | | | | X | X | X |
| Paper | | | | | X | | | | X | X | X |
| Wood waste as product | | | X | | | | | X | X | X | X |
| Paper waste as product | | | | | X | X | X | X | X | X | X |
| **Non-timber forest products** | X | X | | | | | | X | X | X | X |
| **Forest Services** | X | X | | | | | | X | X | | X |

### Use

| | Intermediate consumption by industry | | | | | | | | | Final users | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Wood products** | **Agricul-ture** | **Forestry & logging** | **Wood products** | **Pulp** | **Paper** | **Printing** | **Recycling** | **Other** | **Total** | **Consump-tion** | **Exports** | **Capital formation** | **Total use** |
| Standing timber | | X | | | | | | | X | | | X | X |
| Sawn logs | | | X | | | | | | X | | X | | X |
| Firewood | | | | | | | | X | X | X | X | | X |
| Pulpwood | | | | X | | | | | X | | X | | X |
| Wood and wood products | | | | | | | | X | X | X | X | X | X |
| Paper pulp | | | | | X | | | | X | | X | | X |
| Paper | | | | | | X | X | X | X | X | X | | X |
| Wood waste as product | | | X | X | | | | | X | | | | X |
| Paper waste as product | | | | X | | | X | | X | | | | X |
| **Non-timber forest products** | X | X | | | | | | X | X | X | X | | X |
| **Forest services** | X | X | | | | | | X | X | X | | | X |

**Table 8.9b: 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 |
| Firewood | X | X | X | X | X |
| Pulpwood | 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 users | | | Total use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Agricul-ture | Forestry & logging | Wood products | Pulp | Paper | Printing | Recycling | Other | Total int. | Consump-tion | Exports | Capital formation | |
| **Wood products** | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Non-timber forest products** | X | X | | | | | | X | X | X | X | | X |
| **Forest services** | X | 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 C&I for sustainable forestry, based on economic, social, ecological and institutional statistics. There is considerable overlap between work on sustainability indicators and SEEA, although these two efforts have proceeded, for the most part, independently of one another. One of the advantages of SEEA is that it produces both indicators as well as the detailed statistics needed for analysis. The relationship between SEEA and one set of forest C&I, the Montreal Process indicators, is described below.

The Montreal Process represents one attempt to develop and implement internationally agreed C&I for the conservation and sustainable management of temperate and boreal forests. (See their website http://www.mpci.org for more information.) The Montreal 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 that can be measured or described and which, when observed periodically, demonstrate trends. Table 8.10 shows the relationship between the Montreal Process C&I and the information provided by SEEA.

Many of the Montreal Process indicators are provided by 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. SEEA does not provide information for the legal and institutional aspects of forest health and provides only partial information about social aspects of forests. To provide some of the indicators, a more comprehensive set of forest-related accounts is necessary, which would include comprehensive land, water and pollution accounts.

**Table A.1: Correspondence between sustainability indicators and 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 systems | Forest asset accounts, physical |
| 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. Number of forest-dependent species | Forest service accounts for biodiversity protection, physical |
| b. Status (threatened, rare, vulnerable, endangered or extinct) of forest-dependent species at risk of not maintaining viable breeding populations, as determined by legislation or | Forest service accounts for biodiversity protection, physical |

| Criteria and indicators for sustainable forestry | SEEA source of indicator |
|---|---|
| scientific assessment | |
| **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 forestland and net area of forestland available for timber production | Forestland and land asset accounts, physical |
| b. Total growing stock of both merchantable and non-merchantable tree species on forestland available for timber production | Forest asset accounts, physical |
| c. 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, salinization and domestic animals | Only that part attributable for economic activities, such as land clearance and salinization |
| b. Area and percent of forestland subjected to levels of specific air pollutants (e.g. sulphates, 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 forestland 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 forestland with significant soil erosion | Land and forestland accounts by ecological characteristics, physical |
| b. Area and percent of forestland 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<br>Could be obtained from SEEA water accounts |
| d. Area and percent of forestland with significantly diminished soil organic matter and/or changes in other soil chemical properties | NA |
| e. Area and percent of forestland 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 |

| Criteria and indicators for sustainable forestry | SEEA source of indicator |
|---|---|
| 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 forestland 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 and monetary |
| b. Value and quantities of production of non-wood forest products | Forest non-timber flow accounts, physical and 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 forestland managed for general recreation and tourism, in relation to the total area of forestland | 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 forestland managed in relation to the | NA |

| Criteria and indicators for sustainable forestry | SEEA source of indicator |
|---|---|
| total area of forestland to protect the range of cultural, social and spiritual needs and values | |
| 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 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 forestland 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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