

Potential Uses of the SEEA to Measure Cross-Sectoral Policy Linkages Affecting Forestry

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List of Acronyms

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

1. Introduction

There is worldwide concern about the accelerating rate of deforestation and forest degradation, and the negative local and global environmental consequences from this loss. In response, many countries have implemented policies to promote more sustainable forestry, but deforestation continues (FAO, 2001). It has long been recognized that the main threat to forests often comes not from forestry policy itself, but from non-forestry policies that affect forests, directly or indirectly. Such non-forestry policies span a wide range of sectoral policies (e.g., agriculture, mining, and infrastructure development) and macroeconomic policies (e.g., trade liberalization and promotion of economic growth). Of course, non-forestry policies may also support forest conservation; for example, policies for climate change mitigation promote protection of forests as a sink for carbon.

Sustainable forest management has been hampered by a lack of information about the multiple economic contributions of forests, and how the goods and services provided by forests are linked to the rest of the economy. While there is information about the economic value of commercial timber, many other contributions of forests are often missing from the national accounts, our primary source of information about the economy. Examples of these contributions include non-marketed forest goods and services that contribute to the livelihoods of rural populations, the use of forests for tourism and recreation, and ecosystem protection services, such as carbon storage. Forest preservation depends on identifying all the forest benefits derived by different users, and how these benefits are affected by changes in policy, especially policies beyond the control of forest managers that are taken at the macroeconomic level or in other sectors of the economy.

To understand the intricate web of economy-wide interdependencies that affects forest use, a framework is needed that integrates environmental and economic information. Environmental accounts are widely recognized as providing such a framework: they bring together economic and environmental information in a common framework to measure the contribution of the environment to the economy and the impact of the economy on the environment. The accounts provide both indicators for monitoring sustainability as well as detailed statistics for use as a planning tool. Detailed statistics enable governments to set priorities, monitor the environmental impact of economic policies more precisely, enact more effective environmental regulations and resource management strategies, and design more efficient market instruments for environmental policies.

The United Nations, along with other major international organizations (OECD, Eurostat, World Bank, IMF) has prepared a handbook for environmental accounts, the System of Environmental and Economic Accounts (SEEA) (UN, 1993; 2001). The purpose of this report is to describe the potential use of the SEEA for measuring the impact on forestry of non-forestry sector policies. This report will identify the relevant components of the SEEA and develop a framework that can be used for economic analysis of the impact of cross-sectoral policy linkages and, hence, contribute to better sectoral and macroeconomic policy-making by governments, and ultimately, to more effective forest conservation.

The organization of the report is as follows. Section 2 reviews the economic literature about cross-sectoral policy linkages to sustainable forestry. This step is essential in determining the environmental and economic data necessary for policy analysis and building the SEEA-based framework. Section 3 provides a brief introduction to the SEEA; a more detailed discussion of the SEEA is provided in Annex A. Section 4 begins with a review of country experiences with forestry accounting and their use for policy. Links between the SEEA and sustainability indicators for forestry are provided in Annex B. In section 5, a framework based on the SEEA is developed that will contribute to better understanding of cross-sectoral policy impacts on sustainable forestry. Concluding remarks are provided in section 6.

2. Cross-sectoral Policy Impacts Affecting Forestry

Cross-sectoral policy impacts operate in two directions: forests affect other sectors of the economy, and non-forestry policies affect forestry. The former has been addressed mainly in the literature on forest and land use management and, more recently, in the literature on environmental accounting for forestry. The latter has been addressed mainly in terms of how indirect policy impacts may threaten sustainable forestry, in the most extreme case, resulting in land conversion and deforestation. Both directions of impact are discussed in this section.

2.1 Impact of forestry on non-forestry sectors

In the past, it was not common to consider the full range of forest goods and services when assessing the economic value of forests. Most often, analysis focused on timber values. The impact of forestry on the rest of the economy was commonly evaluated by measuring what is called in the economics literature the ‘upstream and downstream linkages’¹ from logging. Upstream linkages measured all the direct inputs for logging such as fuel, road-building and capital goods plus the indirect inputs, that is, the inputs required for the production of direct inputs to logging. Downstream linkages assessed the use of timber as inputs to industries such as wood processing, pulp and paper, furniture and the use of these industries’ products further downstream in the economy. Employment and income multipliers for logging showed the direct and indirect impact of logging in a regional or national economy.

However, commercial timber is only one of the products from forests, albeit a very important one. Sustainable forestry has been defined as forest management based on preserving the full range of benefits provided by forest ecosystems, which are shown in Table 2.1

Table 2.1 Forest goods and services and their beneficiaries

Forest goods and services	Direct beneficiaries
1. Timber products	
Commercial timber	Logging and wood processing industries
Non-market timber	Households, for domestic use and small-scale industry

¹ See any basic textbook on input-output analysis (e.g., Miller and Blair, 1985; UN, 1999, or regional economics and land use planning (e.g., Loomis, 1993) for further discussion of this concept.

2. Non-timber products	
Food, game, medicines, crafts, etc.	Households, small producers
3. Intermediate inputs to other economic activities	
Tourism and recreation	Tourism industries, households
Livestock grazing, pollination, etc.	Agriculture
4. Ecosystem protection services	
Soil and water conservation	Agriculture, municipal water supply, hydroelectric power, fisheries, infrastructure, etc.
Biodiversity protection	Tourism, agriculture, pharmaceutical industry
Carbon storage	All sectors
5. Cultural and aesthetic services	Communities and individuals

Because forest ecosystems provide multiple benefits, sustainable forestry management must balance the tradeoffs among competing uses. Economists often cite market failure as a major reason for failure to preserve forests (e.g., Pearce, 1996; Pearce et al., 1999). For forestry, the most significant market failure is the lack of market prices for many of the goods and services provided by forest ecosystems. As a consequence, decision-makers may fail to take into account the full value of forests in their decisions about land use. Pearce (1996) and Kaimowitz and Angelsen (1999) note that if the full value of forests were included in the cost-benefit analyses of development projects, many projects could not be justified economically or environmentally.

Increasingly, forests are managed to optimize multiple benefits. Table 2.1 also lists the major beneficiaries of forest amenities. It is important to identify all the beneficiaries because policies that affect forest users may indirectly affect forestry. For example, an expansion of the tourism and recreation industry may increase incentives to protect forests and reduce other competing uses, such as logging.

Commercial timber products benefit commercial logging and wood processing industries; non-marketed timber mainly benefits households either for domestic use (fuel wood, construction timber) or small-scale industry (e.g., fuelwood for drying fish, tobacco curing). Non-timber products include a range of products, marketed and non-marketed, which mainly benefit households and small producers such as wild foods and medicines. In developing countries, subsistence households often depend heavily on forests for their livelihoods. Non-timber products such as gums and chickle can be of value to commercial producers.

Forest services are used as intermediate inputs to other economic activities such as the tourism industry, agriculture, and households. However, when these forestry inputs are not paid for, their value is not attributed to the forestry sector in the national accounts; rather, the value is incorrectly attributed to the sector using forest services. Consequently, the economic value of forests is underestimated.

Ecosystem protection services benefit many sectors of the economy: soil and water conservation services benefit agriculture, municipal water supply, fisheries, hydroelectric power, and others. These protection services can be difficult to value because the economic benefits of these services do not accrue to the owner or user of the forest, but rather to third parties downstream from the forest. The direct beneficiaries of other protection services are not so easy to identify and valuation can be even more difficult. Biodiversity conservation benefits tourism, agriculture (by preservation of genetic diversity), and may potentially benefit pharmaceutical industries as a source of medicines derived from natural substances. Households may also benefit simply from the existence of biodiversity.

Although valuation of non-marketed goods and services presents a challenge to economists, there are a number of techniques to determine the economic value of these goods and services. Examples provided in section 4 for Sweden and South Africa show that these benefits may be substantial, sometimes greater than the commercial timber value of forests.

2.2 Impact of non-forestry policies on forests

The impact of non-forestry policies on forests has been extensively examined, especially in the literature addressing the causes of tropical deforestation (See, for example, Kaimowitz and Angelsen, 1998; Schmithüsen et al., 2001). Although the concern in this report is much broader than deforestation, the discussion that follows draws heavily on this body of work because it has explored cross-sectoral linkages so extensively and systematically.

A distinction is made in the literature between *direct causes*—the immediate reasons why agents engage in activities that affect forest and land use, —and *indirect or underlying causes*—the complex chain of causation outside forestry that ultimately leads agents to act in particular ways. Direct causes include those that result, for example, in the immediate conversion of forestland to other uses, such as a land use policy that grants title to forestland cleared for agriculture. Indirect causes may include, for example, trade liberalisation that affects the price of agricultural products relative to other prices in the economy, which, in combination with other economic and institutional factors, may create incentives for a change in land use, ultimately affecting forests.

The distinction between direct and underlying causes is not always clear, and the chain of causation may be difficult to identify and quantify. Furthermore, there is not a one-to-one correspondence between the concept of cross-sectoral policy linkages and the concept of direct and indirect causes. While all underlying causes are examples of cross-sectoral linkages, some of the direct causes are also examples of cross-sectoral policy effects. For example, agricultural expansion has a direct impact on forestry, but it results from non-forestry policies, so, it is also a cross-sectoral policy impact.

The distinction between direct and indirect causes is a useful way to approach the problem of sustainable forestry management because the data and methodological requirements for analysis of the two sets of cause can be quite different. The impact of direct causes can, to a large extent, be represented by a limited database concerning only the sectors directly

involved. The analysis of indirect causes requires economy-wide analysis that is able to follow the chain of causation.

While many reports were reviewed for this report, the discussion that follows is based mainly on the following key documents: Contreras-Hermosilla (2000), De Montalembert (1995), Kaimowitz and Angelsen (1998), Pearce et al. (1999), and Schmithüsen et al. (2001). A review by Kaimowitz and Angelsen (1998) synthesizes the results of more than 140 economic studies to assess the relative importance of the different direct and indirect causes. There is considerable disagreement and conflicting evidence about the impacts of some policies, for example, structural adjustment policies. It is not the intention of this report to evaluate the relative importance assigned by different researchers to each underlying cause; all are treated as having a *potential* impact on forests, which the SEEA framework should be able to address. All major causes cited in the literature are included in the discussion that follows. Hopefully, the SEEA framework will help clarify some of these disagreements in the future.

2.2.1 Direct impacts of non-forestry sectors on forests

Forests and forestland are used directly by individuals, communities, and institutions in the pursuit of commercial economic activity or subsistence livelihoods. The relative impact of different economic activities and the pressure on forests from subsistence households vary from one part of the world to another, and sometimes within different parts of a single country. The major sectors with a direct impact on forestry and the agents through which they act are shown in Table 2.1. It is useful to summarise how these agents decide how to use forestland as this helps to motivate the type of data and economic tools that are needed for analysis.

Among the non-forestry economic activities, no sector has had a greater impact on forestry than agriculture, a major competitor for land use. Policies that promote agricultural expansion can, under circumstances described in section 2.2.2, lead to deforestation as forests are converted to agricultural land. Relatively high agricultural prices create incentives for both existing and migrant farmers to clear forests and shift into agriculture. Higher product prices also provide the capital necessary for expanding production. However, the impact can be quite different depending on the relative prices of individual agricultural commodities: if the terms of trade improve for a crop that requires less land, the pressure on forests will be less. While subsistence farmers will in general not respond much to changes in prices (since by definition, they are producing only for their own consumption needs), it may induce them to shift from subsistence to market production and increase pressure on forests.

The impact of a change in agricultural input prices is not that clear and partly depends on the type of input. Some inputs, like fertiliser are used mainly for intensive agricultural production; if the price of fertiliser rises then farmers might switch to extensive production, which will put pressure on forestland. On the other hand, the higher costs of farming (unless accompanied by rising prices for agricultural products) may lead to a shift out of agriculture, reducing pressure on forests. Credit is a particularly important input: if not restricted to intensive agricultural production, it can lead to deforestation, as in Latin America where credit facilitated clearing of forests for livestock grazing. Higher wages and opportunities for

off-farm employment in rural areas may make agriculture and forest activities less attractive, reducing pressure on forests.

Property rights and land tenure can also affect forests. In some countries, title to land can be obtained by clearing forestland. The recognition of rights over forest resources by communities, commercial enterprises, or other groups can support sustainable forest management while lack of rights can result in poor management.

Table 2.1 Direct impact from non-forestry sectors on forestry

Non-forestry sector	Agents	Examples of factors influencing agents
Agriculture	Farmers Agribusiness	Prices of agricultural products Prices of agricultural inputs (fertiliser, seed, tools, credit, labour) Land tenure and property rights
Transportation & infrastructure	Mining (small-scale and commercial) Logging	Accessibility of forestland to migration and settlement
Energy	Households (rural and urban)	Relative prices of fuelwood and alternative energy sources
Tourism and recreation	Commercial tourism Community-based tourism Households	Quality of forest and forest services, Availability of alternative tourism sites
Public/institutional sector	All direct users of forests	Property rights and land tenure

Sources: Adapted in part from Contreras-Hermosilla (2000), De Montalembert (1995), Kaimowitz and Angelsen (1998).

Transportation infrastructure—roads, river transport, and railroads—can have a major impact on forests when increased accessibility attracts land-poor migrants who clear forest for agriculture, as described above. The impact will depend on many factors, such as the fertility of the land, population density, and the extent of poverty and alternative sources of employment and livelihood. Mining and logging are major sources of roads that increase access to forestland.

The use of fuelwood and other forest products is influenced by the relative prices of alternatives. For example, the cost of commercial energy and the associated equipment can have a strong influence on fuelwood use; the cost of non-wood fencing and housing materials can influence the use of wood for domestic construction. Peskin et al. (1992) found significant impact in Tanzania.

Promotion of ecotourism based on forests, which provide recreational hiking, wildlife viewing, trophy hunting, and other services, creates incentives for forest protection. In many

developed countries, both commercial tourism companies as well as individuals benefit from the recreational services of forests. In developing countries, ecotourism has been developed as a major industry, both commercial tourism as well as community-based tourism, which involves rural communities in local tourism activities. With well-defined property rights for the use of forests and forest resources, community-based tourism can be an important component of strategies for poverty alleviation.

2.2.2 Underlying influences on forestry

The classification of underlying influences and the mechanisms by which they work is, due to its more complex nature, not as straightforward as direct influences. Empirical studies suggest that some often mentioned influences on forest use, such as population growth or structural adjustment policy, may not be as strong as expected, or may work positively under some circumstances and negatively under others.

One of the shortcomings of the literature is that the impact of each policy is considered largely in isolation from other policies, even though most countries combine many policies simultaneously. While it is important to attempt to isolate the impacts of each policy, it is also important to understand how they influence each other. The joint outcome of combinations of different policies is very difficult to specify. In this review, each cause will be considered independently, but the possibility of joint evaluation of several policies will be taken up again in section 5.

Researchers have classified underlying influences on forestry by a combination of *economic and institutional factors* and major *economic sector*. Economic factors include government policy interventions at the macroeconomic level and the sectoral levels. The most important sectors include agriculture, mining, transportation infrastructure, energy, and industry. Broad socio-economic or political factors include population growth and density, and distribution of economic and political power, in combination with other influencing factors. Institutions and governance also affect forestry. This review focuses mainly on the economic influences, rather than institutional and political ones because the former are more properly the focus of the SEEA. Some of the most important influences in this section.

Government policy interventions at the macroeconomic level

Most countries, certainly all developing countries, aspire to higher incomes and cite economic growth as a major development objective. However, at least in the short-term, economic growth stimulates demand for agricultural, forest, and mining products, which may result in deforestation via the direct causes described earlier. In the longer term, higher income increases off-farm employment opportunities, which may reduce pressure on forests, and may lead to popular demand for forest protection, as well as increased capacity of government to enforce forest protection measures.

Economic growth with a strong poverty alleviation component may support sustainable forestry where the dependence of rural communities on forests is recognized and protected; without a poverty focus, economic growth may seem to be enhanced by commercial logging or deforestation, especially if non-commercial forest values are not measured. Where forests provide only indirect protection services, poverty alleviation programs may affect forests negatively. For example, mangrove forests in Thailand have been cleared for intensive

shrimp farming (Huitric et al., 2002). As with other macro-economic policies, the specific policy environment, such as tax policies, forest protection and natural resource utilisation policies, property rights, etc., strongly influences how any macroeconomic policy affects forestry.

Trade liberalization and exchange rate policies affect the terms of trade of agriculture. In the discussion of direct causes, it was seen that an increase in the relative prices of agricultural products could result in greater deforestation. Macroeconomic policies affecting the relative price of agriculture include:

- *currency devaluation* usually increases prices of the tradable sectors (agriculture, forestry, mining) relative to prices of non-tradables (services, subsistence production). It also tends to favour sectors that use land and labour rather than imported capital goods, perhaps encouraging extensification of agriculture at the expense of forestland.
- *reduction of tariffs and trade barriers* for manufactured goods increases the terms of trade for agricultural and forestry products
- *increasing tariffs for agriculture* increases the relative price of agricultural products and increases pressure on forests; decreasing tariffs has the opposite effect.
- *reducing agricultural export prices* encourages agricultural expansion and will increase forest clearing unless more intensive uses of land are encouraged

Fiscal and monetary policies that reduce public spending and money supply often lead to economic recession and unemployment, with resulting migration to the agricultural frontier and forestland clearing. At the same time, with a reduced budget, government capacity to manage forests is reduced. Inflationary policies may reduce real wages, increasing agricultural expansion and deforestation, and stimulate land speculation that results in forest clearing.

Policies that encourage labour-intensive activities, including the reduction of subsidies for capital goods, can reduce pressure on forests by providing off-farm employment and increasing wages.

In any discussion of developing countries, two issues invariably arise: foreign debt and structural adjustment programs (SAP). The impact of high levels of debt may be to increase exploitation and export of natural resources, including forests, to pay the debt, but the evidence is uncertain. Similarly, the evidence from SAP is also mixed; in the worst case, SAP promotes the production of tradable goods (agriculture, forestry, mining), which may increase pressure on forests, but does not bring about institutional reform necessary to better manage forests. In addition, the required fiscal discipline may reduce the capacity of governments to protect forests. As mentioned earlier, the impact on forestry of a macroeconomic programme such as SAP depends on the sector-specific policies and regulations, institutions, and property rights in a given country so that it is not easy to generalise about the impact.

Government policy interventions as the sectoral level

Agricultural policies have varying impacts on forests, some of which were discussed in section 2.2.1. Agricultural policies that result in accelerated deforestation include

- Increased credit for ranching, mechanised agriculture and large-scale forest plantations
- Elimination of fertiliser subsidies
- Poverty reduction through service provision in areas bordering forests, which may attract new migrants
- Encouragement of new settlements in forest areas
- Uneven land distribution which creates large numbers of poor, landless households looking to migrate to newly opened agricultural areas on the forest frontier
- Land tenure based on forest clearing

Agricultural policies that reduce pressure on forests include:

- Irrigation investment and support services for intensive-intensive crops in areas distant from forest frontier, reducing migration
- Support to small-scale agriculture in areas with little forest cover
- Land taxes that favour reforestation and intensive land use over extensive agriculture

Opening of new roads and other infrastructure that improves accessibility can promote migration and deforestation, as discussed earlier. In some instances, roads are built to facilitate commercial exploitation of forests and mines, with the unintended effect of migration and deforestation. In other instances, transportation infrastructure is seen as a means to promote economic development of an area, including the better provision of services to people already living there.

This problem is exacerbated when energy policy provides fuel subsidies, making transportation relatively cheap. As mentioned in section 2.2.1, energy pricing policy can have an impact on forestry in some developing countries. Policies to mitigate carbon emissions from fossil fuels are already affecting forests and have the potential to affect forests in a major way in the future, particularly if an international carbon trading program is established with credits for carbon sequestration.

2.3 Economic methodologies for analyzing cross-sectoral impacts on forestry

Empirical economic studies of cross-sectoral policy impacts on forestry have used econometric models and simulation models. Analysis has been carried out at three different scales: micro-level analysis of household and firm behaviour, meso-scale or regional analysis, and macroeconomic level. Both econometric and simulation models use a combination of economic and environmental data, and it is here that the SEEA can make a strong contribution.

Econometric models analyse the statistical relationships among different variables. The dependent variable may be a measure of change in forest cover, while the independent variables may include any of the factors discussed above that potentially affect forest use.

Simulation models, often multi-sectoral CGE models of the entire economy, attempt to recreate the response throughout the economy to a change in policy. Because they represent every sector of the economy and all actors, the simulation models, in effect, replicate the chain of causation described above. They are usually applied at the macro-economic level,

but can be applied at the village or meso-levels as well. The nature of these models is described in more detail in section 4 which describes policy applications of forestry accounts, and section 5 where a SEEA-based framework is developed.

3. Overview of Environmental Accounts

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

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

With regard to forestry, the SNA has treated cultivated forests and natural forests quite differently. For cultivated forests, the SNA records both production and changes in the forest stock so that the consequences of depletion or afforestation are accounted for. For natural forests, however, the SNA records only the income from logging, but not changes in natural forest stocks. This can result in quite misleading economic signals about changes in a natural forest: income from over-exploitation would be recorded as part of GDP, but the corresponding depletion of the forest stocks would not be recorded. Similarly, the benefits from afforestation would not be recorded.

The 1993 revision of the SNA addresses some of these problems, notably by expanding the asset boundary to include a broader range of natural assets such as natural forests. Even with this expanded coverage, significant gaps remain. Non-marketed products are critical to rural livelihoods in developing countries, yet they are often not included in the national accounts. In principle, the SNA includes such products, but measurement difficulties have limited implementation in many countries.

Many of the non-market services from forests are wrongly attributed to other sectors of the economy or omitted. The value of forest services provided as intermediate inputs to other sectors, such as livestock grazing or tourism, are attributed to the using sector, not to forestry, thereby underestimating the economic value of forests. Ecosystem services such as watershed protection and carbon storage may not be represented at all. Land and land use is not represented in the SNA in the detail necessary for effective policy analysis. The SEEA was developed as a set of satellite accounts to the SNA to address these gaps (UN, 1993; 2001).

Environmental and natural resource accounts have evolved since the 1970s through the efforts of individual countries and practitioners, each developing their own frameworks and methodologies to represent their environmental priorities. Since the late 1980s, a concerted effort has been underway through the United Nations Statistics Division, the Eurostat, the OECD, the World Bank, national statistical offices, and other organizations to standardize the framework and methodologies. The United Nations published an interim handbook on environmental accounting in 1993 (UN 1993b), called the *Handbook of Integrated Economic and Environmental Accounting*; this handbook is presently under revision and a new version is expected in 2002.

3.1 Structure of SEEA

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

The SEEA has major four components:

- Asset accounts, which record stocks and changes in stocks of natural resources. Forestry asset accounts typically include stocks of standing timber, forest balance accounts, forest land accounts, land use accounts, and carbon storage in forests.
- Flow or production accounts for materials, energy and pollution, which provide information at the industry level about the use of energy and materials as inputs to production and final demand, and the generation of pollutants and solid waste. Forest flow accounts include supply and use accounts for detailed forest products (wood and non-wood, marketed and non-marketed) by sector, which are linked to the economy-wide supply and use tables of the SNA. These accounts are used to construct input-output (IO) tables and social accounting matrices (SAMs) used in economic models. Forest flow accounts include measures of forest ecosystem services. The forestry accounts also include flow accounts for other resources that may be relevant to forestry management, such as energy accounts, pollution (e.g., acid rain affecting forests) and environmental degradation (e.g., soil erosion from logging) accounts
- environmental protection and resource management expenditure accounts, which identify expenditures in the conventional SNA. For forestry, these accounts include forest management expenditures by government, environmental protection expenditures by public and private sectors, as well as user fees and taxes paid by forest users to the government.

- environmentally-adjusted macroeconomic aggregates, which include indicators of sustainability such as environmentally-adjusted Gross Domestic Product (GDP), Net Domestic Product (NDP), National Savings or national wealth. Forestry accounts include the addition to GDP of unvalued forest goods and services, the subtraction from NDP of economic cost of deforestation or loss of forest services due to a change in management, the contribution of forest assets to national wealth

The SEEA includes both physical accounts and, to the extent possible, monetary accounts. When dealing with non-market goods and services, however, valuation can become difficult. Each component of the SEEA, including valuation methods, is discussed in greater detail in Annex A.

3.2 Advantages of the SEEA

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

In contrast to other environmental databases, the purpose of the SEEA is to directly link environmental data to the economic accounts. The SEEA achieves this by sharing structure, definitions and classifications with the SNA. The flow accounts become, in effect, an extension of the input-output table commonly used for multi-sectoral economic analysis. The advantage of the SEEA is that this kind of database provides a tool to overcome the tendency to divide issues along disciplinary lines, in which analyses of economic issues and of environmental issues are carried out independently of one another.

Although many researchers have constructed databases linking environmental data about forestry with economic information, and have estimated the value of non-market forest goods and services, much of this work has been of an *ad hoc* nature, each researcher constructing a new database using data from very different sources. The advantage of the SEEA over the *ad hoc* approaches is that the SEEA is completely consistent with the economic accounts. Thus, the SEEA provides a tool that macro-economic planners and researchers in other sectors can use to integrate forestry in their own policy analysis.

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

For issues such as forest management, the advantage of the SEEA approach is clear. It is not possible to promote sustainable forestry purely from the narrow perspective of managing forests; rather, an economy-wide approach is needed that can address threats to forests from non-forestry policies. The SEEA makes possible joint analysis of economic policies and their impact on all relevant environmental variables.

3.3 Policy uses of forestry accounts

For all resources, policy analysis and decision-making take place on three relatively distinct levels: the local or company level, the sectoral or industry level, and the macroeconomic (national) or regional level. At the macroeconomic level, policy-makers are responsible for multi-sectoral strategic planning, setting national priorities, and assessing the policies of all sectors based on weighing alternatives and tradeoffs among sectors. The contribution of SEEA to policy analysis has been primarily at the sectoral and macroeconomic levels, especially as a planning tool for coordinating policies across different line ministries and assessing cross-sectoral impacts.

For SEEA forestry accounts provides information for two distinct sets of users: forestry managers and policy-makers in other agencies including managers at the macro-economic level. Sustainability of forests requires cooperation between forestry managers, with expertise relevant to managing forests, and macro-economic managers, who coordinate policies in other sectors that impact on forestry.

The applications of the SEEA will be discussed in greater detail in section 4. However, a short summary is provided here. The contributions of the SEEA fall into two categories: improved measurement of the value of forest ecosystems, and improved management of forestry by modelling economy-wide linkages to forestry.

Improved measures of the economic value of forestry

- Total economic value of forestry and forest land, including the non-market values missing from national accounts
- Cost of deforestation and land conversion
- Distribution of benefits from forestry among different groups in society, e.g., commercial, artisanal, and subsistence users or forests, as well as other users such as tourists, regional interests (local and regional environmental protection services), and global interests (carbon storage, biodiversity protection)
- Economic linkages, upstream and downstream, between the forestry sector and other sectors of the economy

Improved macroeconomic management that takes into account impacts on forestry

- Measurement of the links between economic activities and demand for resources, including forest products, land and energy
- Impact of non-forestry sector policies on forestry
- Impact of macro-economic policies on the forestry sector, both direct and indirect effects
- Measurement of environmental externalities caused by forestry and their impact on other sectors, as well as externalities generated elsewhere in the economy that affect the capacity of forests to provide critical goods and services

4. Use of SEEA for Forestry Policy Analysis

This section discusses the experiences of countries implementing the SEEA and reviews the policy applications of the forestry accounts. Much of the use so far has been limited to an assessment of timber asset value and some valuation of non-timber benefits. In many developing countries, the original motivation for forest accounts was to estimate the cost of deforestation, and to assess whether rapid economic growth in countries like Indonesia was achieved by the liquidation of natural capital. A new interest in forest accounts has emerged from international efforts to reduce greenhouse gas emissions. One greenhouse gas mitigation measure is the creation of a market for carbon sinks in tropical forests. Some countries are already receiving payments for this service, and the market may grow once international agreement is reached.

There are some cases where the forest accounts have been used for analysis of macroeconomic policies or national development strategies, but this is still a relatively new area for the SEEA. Several examples will be described in detail. There is also a long tradition in forestry economics of input-output-based impact analysis to assess cross-sectoral linkages. While these studies are typically not based on the SEEA, they can benefit from the extended data that the SEEA provides. This approach, and how it can be improved with SEEA forestry accounts, is described.

4.1 Country experiences with forest resource accounts

Environmental accounts have been constructed for forest resources more often than for most other resources. The earliest set of forest accounts was constructed by Norway in the late 1970s. At that time only physical asset accounts for standing timber were constructed (Alfsen et al. 1987). A detailed supply and use table for timber and wood products was not constructed. Fuel wood was included in the supply and use table for energy, which is widely used in Norway's multi-sector macroeconomic planning model. Norway also constructed land accounts, which included information about forested land and land use by different sectors. Since that time, many other countries have constructed forest accounts and the accounts have expanded to include monetary asset accounts for standing timber as well as non-timber goods and services.

Table 4.1 shows countries that have constructed forest accounts and the type of amenities included in the accounts. This table is limited to those countries with formal accounting programs sponsored by government agencies or by non-governmental agencies in cooperation with governments. Forestry accounts are more common in developed countries than developing countries. Eurostat has had an ongoing program to develop forest resource accounts since 1995 and many of the participating countries have developed extensive accounts. There are also many additional academic studies and one-off studies by governments or international agencies that are not shown here; some of these will be discussed later in the section on policy analysis. For an exhaustive review of all forest accounting efforts through 1997, see (Vincent and Hartwick, 1997).

The forest accounts for all countries include timber asset accounts in physical and monetary terms. Forests are disaggregated in different ways depending on the policy issues and characteristics of forests in each country. Virtually all forest accounts distinguish cultivated

and natural forests, and disaggregate forests by major tree species. Many developing countries limit the timber accounts to commercial timber production, but are beginning to add non-commercial timber production and use of non-wood products. None of the developing countries regularly construct detailed supply and use tables for timber and wood products.

The non-timber benefit most commonly included in forest resource accounts is carbon storage. Virtually all developed countries include carbon storage accounts, but this practice is less widespread in developing countries. In most instances forest accounts have been constructed as part of a broader environmental accounting effort that includes other natural resources.

Table 4.1 Forest accounts constructed by selected countries

	FOREST ACCOUNTS				FOREST-RELATED ACCOUNTS			
	Timber		Non-timber goods and services		Land	Energy	Water	Pollution and Env Degradation
	Asset accounts, physical and monetary	Supply and use table for wood products	Carbon storage	Other non-timber goods and services				
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		X	
Developed countries								
Under Eurostat program:								
Austria	X	X	X	X	X	X		X
Finland	X	X	X	X	X	X		X
Denmark	X	X	X	X	X	X	X	X
France	X	X	X	X	X	X	X	X
Norway	X	X	X	X	X	X		X
Sweden	X	X	X	X	X	X	X	X
Spain	X	X	X	X	X	X		X
Germany	X	X	X	X	X	X	X	X

Italy	X	X	X	X	X	X		X
Canada	X	X	X	X	X	X	X	X
Australia	X	X	X	X	X	X	X	X
New Zealand	X	X	X	X	X	X		X

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

Forest accounts will be examined in greater detail for two countries: Sweden and South Africa. Sweden's forest accounts are part of a well established and comprehensive program of environmental accounting that includes all the forestry-related resources identified in section 3: detailed land and ecosystem accounts, energy accounts and pollution accounts. The forest accounts in South Africa are part of a new environmental accounting initiative by Statistics South Africa and the Department of Environment and Tourism. Much work is being done on water accounts, which is critical for South Africa. Land and ecosystem accounts, energy and pollution accounts have not been constructed, although there are extensive databases which could be used to construct these accounts.

The Swedish and South African accounts are fairly similar in some ways: both focus on timber accounts, non-timber goods, carbon storage and recreational benefits. But the accounts differ in terms of forest classification and some of the non-timber services of forests.

The Swedish forest accounts include stocks of standing timber and area of forestland disaggregated by characteristics shown in Table 4.2, as well as detailed supply and use tables for timber. Non-timber goods include wild foods, some of which are marketed and some consumed directly by households. Non-timber services include carbon storage, recreation, and several protective functions, as well as two indicators of overall health: defoliation of trees and changes in forest ecosystem land area and productive capacity. Timber and non-timber goods are measured in both physical and monetary units. Carbon storage and recreational services are also measured in both physical and monetary units; some protective services are measured in physical units, some in monetary units. (For a discussion of valuation methodologies, see Norman et al., 2001.)

South African forests (Table 4.3) are classified by three major uses: 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 (Hassan, 2002). Forests in national parks and protected areas have not yet been included in the accounts. Stock accounts for standing timber have only been constructed for cultivated forests. The flow accounts include production, but not detailed supply and use accounts. The information about production of timber and non-timber goods from natural forests and fynbos woodlands is especially useful because many of these values were not previously included in the national accounts of South Africa.

Table 4.2. Forest accounts for Sweden

	Physical	Monetary
Timber and wood products		
Stocks of standing timber by:	X	X
Type of forest: Afforested, Natural, Other		
Availability for wood supply		
Protected, Non-protected		
Major tree species		
Area of forestland by:	X	X
Type of forest: Afforested, Natural, Other		
Availability for wood supply		
Protected, Non-protected		
Flow accounts: detailed supply and use table of timber and wood products	X	X
Non-timber goods		
Wild plants (berries, mushrooms, etc.)	X	X
Game: (elk, hares, etc.)	X	X
Forest services		
Carbon storage	X	X
Recreation:		
Forestland used for recreation, area	X	
Visits by main purpose, number and value	X	X
Protective functions		
Protection of soils, shielding urban areas from noise		X
Maintenance of biodiversity:		
Number of endangered species	X	
Regeneration and extension of forestland, area	X	
Health of trees: defoliation by class of forests and species	X	
Forest ecosystem changes: land area and change in productive capacity	X	X

Source: Norman et al. (2001) and (Eurostat 2000)

Non-timber services include carbon storage of cultivated forests, livestock grazing in natural forests and fynbos, recreational services of fynbos woodlands, and the pollination service provided to agriculture by wild bees in fynbos woodlands. Pollination and livestock grazing are examples of inputs provided to agriculture at no charge and whose value is embodied in the value of agricultural output, rather than woodlands. The forestry accounts measure an important environmental externality: the cost of water abstraction by cultivated forests. Cultivated forest plantations of exotic species (mainly pines and gums) absorb much more rainfall than native species, thus reducing runoff. South Africa is a water-scarce country so

this excess water abstraction has a cost in terms of foregone use of water by downstream users.

Table 4.3 Forest accounts for South Africa

	Physical	Monetary
Timber and wood products		
Stocks of standing timber in Cultivated forest plantation by major species	X	X
Area of forestland: Cultivated forests, Natural forests, and Fynbos	X	
Flow accounts		
Forest plantation: output of commercial timber and other tree products	X	X
Natural forests: own-account harvesting of wood for construction, fire wood, crafts	X	X
Non-timber goods		
Natural forests: wild plants, game, and medicines	X	X
Fynbos: flowers, honey, tea	X	X
Forest services		
Carbon storage in cultivated forests	X	X
Livestock grazing in natural forests and fynbos	X	X
Recreation in fynbos woodlands		X
Pollination service to agriculture by wild bees in fynbos woodlands	X	X
Environmental damage: water abstraction externality of forest plantations of exotics species	X	X

Source: (Hassan, 2002)

4.2 Use of forest accounts for policy analysis

Forest accounts have been used by policymakers to provide a better estimate of the total economic value of forests, and, to a lesser extent, to understand the impact on forestry of other sectors of the economy. The major concerns that the forest accounts have been used to address include the following:

Concerns about the “true” economic value of forests:

1. Is economic growth based on the depletion of forests and other renewable resources?
2. What is the full economic value of forests; do decisions affecting forests take into account all these values?

3. Who benefits from the goods and services provided by forests?

Concerns about the impact on forests of non-forestry policies

4. How will economic growth, macroeconomic policies and other policies affect forests?

The use of forest accounts to address each of these issues is discussed below.

4.2.1. Policy issues related to the total value of forests

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

In the past, loss of natural forest was not included in the national accounts. 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 4.4. 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 crude estimate of forest depletion (timber value only) in its indicator of sustainable development, Genuine Savings (Kunte et al., 1998). Genuine Savings attempts to adjust conventional Net Domestic Savings for environmental depletion and for investment in human capital. It subtracts from Net Domestic Savings an estimate of depletion of forest and minerals, adds expenditures on education (viewed as investment in human capital) and subtracts a notional damage charge for carbon emissions. In the World Bank estimates, forest depletion reduced Net Domestic Savings by 20% in low-income countries, mostly in Asia (Hamilton, 2001).

Table 4.4 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

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

There is increasing interest in measures of total wealth (produced capital plus natural capital and human capital) as an indicator of sustainable development (see for example, Dasgupta and Maler, 2000). Some countries, such as Australia and Canada are beginning to publish figures for total national wealth that include non-produced assets such as natural forests. In

Australia and Canada, the total economic value of natural capital has been quite small, and the share of natural forests, valued for timber only, was extremely small (Lange, 2001a, 2001b). However, in some developing countries, such as Malaysia (Vincent, 1997, 1999) and the Philippines (NSCB, 1998; Lange, 2000) the asset value of forests can be significant.

What is the full economic value of forests?

Forest management and decisions about forestland conversion, especially in developing countries, are often based on a limited range of economic values, mostly timber value. Better understanding of the full range of goods and services supplied by forests is essential for optimal utilisation of forests, and may provide an economic rationale for conserving forests. This was one of the motivations for the South Africa forestry study. Some have argued (e.g., Pearce et al., 1999) that the value of non-timber goods and services is small relative to timber value. The estimated values for Sweden and South Africa (Tables 4.5 and 4.6) indicate that non-timber values can be greater than the value of commercial timber harvest.

A short time series of forest values is available for Sweden and it shows remarkable stability over a six-year period. Only one year's values are available for South Africa, so it is not possible to assess what may be happening to these forests over time. There are similarities and differences between the forest values of Sweden and South Africa. The differences reflect, in part, the different uses of forests in developed and developing countries.

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 timber². Non-timber goods are less than 5% of the total value of forests, and the forest protective services for soils and noise abatement are negligible. Of course, there are some forest services that could not be valued (See Table 4.2), but these accounts provide a reasonable estimate of the magnitude of non-timber forest values.

In South Africa, commercial timber harvest accounts for well under a third of forest value. The largest single forest value is non-market goods from natural forests, which are used mainly by traditional rural communities. Combined with livestock grazing, the goods and services in natural forests account for over half of total forest value. In contrast to Sweden, recreational use of forests is very small and limited to fynbos woodlands; tourism in cultivated forests and natural woodlands is negligible. Natural forests provide also cultural and aesthetic values to traditional communities, but there has been no estimate of this value. The recreational value of forests in national parks and protected areas, which are major domestic and international tourism sites, have not yet been included in the forest accounts. Environmental degradation, in the form of a water abstraction externality by cultivated forests of alien species, accounts for about 12% of the value of commercial timber harvest. In South Africa, this externality is being treated quite seriously. The new South African water policy has proposed charging forest plantations for this water abstraction externality.

² Several methods were used to value carbon storage. The value reported here is one of the lower values and is the one favored by the authors.

Table 4.5 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	20	20	20
Carbon storage	1050	630	810
Subtotal	3440	3020	3200
Total value of forests	5793	5793	5795

Source: Norman et al. (2001).

Table 4.6 Value of forest goods and services in South Africa, 1998
(millions of rands)

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

NA: not applicable

NAV: not available

Source: (Hassan, 2002)

Who benefits from the goods and services provided by forests?

The question of who benefits from forests is increasingly important for development policy. This issue has two dimensions, an inter-generational one and an intra-generational one. Inter-generational equity concerns the forest wealth left to future generations —whether

society is liquidating its natural capital to pay for current consumption or using it sustainably. This has already been discussed above.

Intra-generational equity concerns the distribution of benefits among different social groups in the present generation. For example, commercial timber mainly benefits large- and small-scale commercial timber producers. In developing countries non-marketed goods and services may be critical to rural livelihoods, even when the economic value of such products may be low relative to commercial timber. The services of forests may benefit local or regional communities (e.g., livestock grazing, flood protection, prevention of soil erosion), and even national and international communities (carbon storage, biodiversity protection). In the South African study, the non-marketed value of natural woodlands make a contribution to rural livelihoods that is greater than the value of commercial forest plantations.

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). Some observations can already be made on the basis of the Swedish and South African forest accounts. The forest accounts indicate that households are major direct beneficiaries, rather than commercial operators. In Sweden, one cannot determine from the information available which social groups benefit most. In South Africa, the poor rural households depend on forests for subsistence livelihoods.

4.2.2 Influence of macroeconomic and non-forestry sector policies on forests

The majority of forest accounting initiatives aim to improve the understanding of the value of forests, but there are few examples of the use of environmental accounts to analyze the impact of economic development and non-forestry policies on forests. Some of these analyses extend the valuation of forest goods and services to evaluate trade-offs among competing uses of forests; others embed the forestry accounts in economy-wide models.

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. In one example, Shahwahid et al. (1999) analysed 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 make use of the SEEA, they are examples of the kind of policy analysis that the SEEA can support. The SEEA provides 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.

Modeling the economy-wide impact of non-forestry policies

Two different methods have been used for forestry analysis: regression analysis and simulation modeling. At the micro and regional levels, regression analyses can make use of detailed spatial information and data from agricultural censuses; at the macroeconomic level, more aggregate indicators are used. The SEEA has not been used specifically for regression analysis, although it can provide much of the required information about forest and land use used. Annex B describes the relationship between the SEEA and forestry indicators that can be used for regression analysis. Economic simulation models provide another approach to understanding cross-sectoral impacts and it is here that the SEEA can make, perhaps, the greatest contribution. Several versions of simulation modeling are reviewed here, from relatively simple forestry multiplier analysis to more complex general equilibrium analysis based on hybrid forestry IO/SAM models.

Forestry multiplier and impact analysis

There is a long history in regional and forestry economics of applying input-output (IO) multiplier analysis to evaluate the employment and income effects of forestry on a local economy³. 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 a change in forestland management affect the local economy? Will the loss of jobs in one sector (e.g., logging and 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 (see Table 4.7). This allows the calculation of ‘upstream’ and

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

‘downstream’ linkages from one sector to all others in the economy. The upstream linkages for logging, for example, include the direct inputs purchased by the logging sector such as fuel and materials, plus the indirect inputs needed to produce the direct inputs to logging. One can trace the impacts of logging on the economy by traveling downstream as well: the use of timber as input to sawmills, the use of sawn wood by other wood processing sectors, the use of these wood products further downstream, etc. At each stage, upstream and downstream, employment and income is generated. A small change in logging creates multiplier effects throughout the economy, affecting upstream and downstream industries and the employment and income associated with them.

Virtually all industrialized countries use these IO multiplier models, or more complex general equilibrium models based on a Social Accounting Matrix (an IO table extended to trace the flows of income), for forestry impact assessments (e.g., Ashton and Pickens, 1992; British Columbia Ministry of Forestry, 1999; Macaulay Land Use Research Institute, 1999; Public and Corporate Economic Consultants, 1999; Welsh Economy Research Unit, 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 partial forestry IO models in conventional multiplier analysis, but such analyses usually include only the use and supply of wood products in physical units.

The SEEA allows construction of a full hybrid forestry IO model that extends the IO tables constructed from the SNA with the SEEA satellite accounts for non-market goods and services related to forestry. Hybrid forestry IO models include the use of forest products (detailed supply and use table in monetary and physical units), use of non-timber products, land use, and other environmental factors that may affect forests in a given area: energy, pollution, soil erosion, etc. The model thus includes physical and monetary data about all the forestry-related resources needed for sustainable forestry management and for assessing cross-sectoral impacts on forestry

Table 4.7 shows the kinds of resources and environmental impacts that might be included in the forestry IO table. Each of the resources shown, such as non-wood products or land, would be further disaggregated by characteristics relevant to the economy and forest.

Table 4.7 Hybrid forestry input-output table

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											
Pollution/soil erosion											

Hybrid forestry IO models created from SEEA

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

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

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

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

A Swedish study (Nilsson and Huhtala, 2000) analyzed the advantages to Sweden of purchasing carbon-trading permits as an alternative to implementing measures to reduce domestic levels of carbon emissions in order to meet Sweden's carbon target under the Kyoto Protocol. The analysis estimated a ‘reservation price’ indicating the maximum amount a country would be willing to pay for carbon storage in tropical forests. Analysis of forest and land accounts in tropical countries have estimated corresponding reservation prices—the

minimum payment the country would be willing to accept to provide carbon storage rather than use forestland for other purposes. A study by Castro and Cordero (2001) estimated the minimum farmers in Costa Rica would have to be paid to switch from agriculture to planting forests as carbon sinks. The study estimated the reservation prices in 8 regions of Costa Rica (which have different opportunity costs and carbon productivity) for 27 different agricultural activities. The reservation prices were lowest for livestock and rice, and highest for export crops like coffee and pineapples.

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

The Philippines: environmental-economic modeling and forestry

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

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

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

Their analysis provided quite detailed results regarding the impact of SAP on the environment. Regarding forests, there was initially concern that SAP would encourage

increased exploitation of forests; in fact, output from forests declined, partly due to the collapse of the domestic economy and domestic demand for forest products, but also in response to falling world market prices. Despite declining timber production, deforestation increased because of land clearing by impoverished households. While migration of poor people to forest lands as shifting cultivators trying to earn a subsistence livelihood was already occurring, the increased unemployment and poverty that resulted from SAP accelerated migration and the resulting deforestation.

The environmental-economic model also showed that the negative impact of SAP could have been reduced if environmental concerns had been incorporated in the SAP and safeguards had been put in place to protect forests and other resources.

Indonesia: environmental-economic modeling and forestry

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

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

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

4.3 Summary

This section has reviewed how the forestry accounts have been implemented in different countries and how they have been used. In most countries, the forest accounts have been mainly used to assess forest asset values and the value of forest goods and services, providing a better indication of the benefit of forests and what would be lost from deforestation. This

information can be useful in cost-benefit analyses to assess the economic benefits and trade-offs from alternative uses of forests.

Few countries have taken full advantage of the opportunities provided by the forest accounts for analysis of the linkages between forestry and other sectors of the economy, or macroeconomic developments. Part of the problem is one of information. Detailed information is needed about the flows of forests goods and services to each sector of the economy, as well as the use of land and other resources by each sector of the economy. As seen in Table 4.1, only developed countries compiled such detailed accounts on a regular basis. The developed countries have used parts of their environmental accounts for policy modeling, but have not much used the forestry accounts for modeling. This may appear surprising since forestry impact analysis is well established. It may be precisely because forestry impact analysis is well established that the forestry accounts have not been much used—researchers already developed the necessary data sources before the SEEA was available.

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

5. Framework for Analysis of Cross-sectoral Policy Linkages

5.1 SEEA-based framework

Based on the experiences with forestry accounts reviewed in section 4, a generalised SEEA-based framework for analysing cross-sectoral linkages can be proposed. Some policy issues can be addressed by a relatively narrow forestry accounting framework, while others require more comprehensive accounts for forests and related resources. There are three major kinds of issues this framework can be used for:

1. Assessment of the impact of forest use on macroeconomic performance
2. Assessment of trade-offs among competing uses of forests and how this may lead to deforestation or forest conservation
3. Assessment of economy-wide impacts of non-forestry policies on forest use

Each application, and the components of the SEEA on which it is based, are discussed below. Table 5.1 summarizes the components of the SEEA required for each application.

Impact of forest use on macroeconomic performance. At the macroeconomic level, the SEEA provides indicators of total forest value and the cost of forest depletion which can be used in macroeconomic planning, such as

- GDP that includes the production of all forests benefits, market + non-market, not just those values included in the SNA
- NDP that includes the cost of forest depletion and environmental degradation
- National savings and wealth adjusted to include the value of both cultivated and natural forests, and the capitalized value of all forest goods and services, not just timber

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. While these measures do not, themselves, show the complex relationship between non-forestry policies and deforestation, they are able to show the impact of deforestation on the economy. This macroeconomic indicator framework is used to integrate the results from more detailed analysis, such as simulation models, with measures of national economic performance.

The components of the SEEA used for this use include

- asset accounts, physical and monetary, for forests and land, which provide the cost of depletion, and forest values for national wealth and savings
- flow accounts for production of forest goods and services as well as environmental degradation which provide figures for total forest production for GDP; detailed supply and use accounts are not required

Trade-offs among competing uses of forests. Forest accounts address one of the often cited indirect causes of pressure on forests: the absence of market prices for non-timber benefits. The SEEA provides information for a cost-benefit approach that can be used for local/regional land-use and development planning to determine optimal forest use, ensuring that all forest values are taken into account. This analysis compares the economic tradeoffs among competing uses of forest, such as logging, subsistence use of forests, recreation and tourism, conversion to agriculture, etc. Analysis does not require economy-wide modeling if the alternative uses of forestland and their potential impacts on other sectors of the economy are reasonably limited in scope.

Table 5.1 Major applications of the SEEA for sustainable forestry

		Components of SEEA used
1. Impact of forest use/deforestation on indicators of macroeconomic performance		
	Measure of impact of deforestation or land-use change on aggregate indicators of macroeconomic performance	Forest and land asset accounts. Flow accounts for value of total production of forest goods and services, environmental degradation.
2. Assessment of trade-offs among competing uses of forests		
	Economic value of alternative uses of forest and optimal mix of forest use for local/regional land use and development planning.	Forest flow accounts provide values for production of all forests goods and services, market and non-market, as well as environmental degradation. Flows can be capitalized into forest and land asset values under scenarios for alternative uses.
3. Economy-wide impacts of non-forestry policies, macroeconomic and sectoral		

	Traces the full chain of causation from macroeconomic policy and non-forestry sector policies to decisions about land use and deforestation	Complete set of detailed asset and flow accounts for forests, land and other relevant resources Input-output table or Social Accounting Matrix
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The examples from Malaysia and Alaska in section 4 show how land use conversion and deforestation could result from a lack of information about all the goods and services provided by forests to other sectors of the economy, and a lack of institutions or regulations to monetize these services, so that forest owners are compensated for the services forests provide. The components of the SEEA used for this application include the flow accounts, especially the non-timber values such as

- Subsistence livelihoods (non-market goods provided as well as services used as input to livestock production)
- Recreation and tourism industry, biodiversity (in its own right and as part of a tourism industry)
- Services used as input to agriculture (livestock grazing, pollination, etc.)
- Protective services to:
 - River water quality affecting activities as diverse as hydroelectric power generation, irrigation supply to agriculture, fishing
 - Global climate (carbon sequestration value)

In a more extensive analysis, the value of forests under an alternative mix of uses can be capitalized into SEEA forest and land asset values to measure how different forest-use and land-use policies affect national wealth.

Economy-wide impacts of non-forestry policies on forestry. Indirect causes of deforestation are related to a range of macroeconomic, sector-specific, and institutional policies that have far-reaching effects throughout the economy on unemployment, wages and income, relative prices, and other factors that ultimately affect decisions about use of forests. Two economic approaches are used to measure the impact of indirect causes: regression analysis and simulation analysis. Regression analysis uses a fairly small amount of information because it only attempts to establish a correlation among variables. Simulation analysis is much more ambitious because it 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. Consequently, simulation analysis requires much more data about the economy, the use of natural resources, and the impact on the environment of economic activities. As the more demanding of the two approaches, the data requirements for simulation models are discussed here.

At the end of section 4, two studies were described for the Philippines and Indonesia that used environmental-economic models to analyze the impact of macroeconomic and sectoral policies on forestry. The models extend the IO/SAM multiplier models traditionally used in forestry to include natural resource and environmental components provided by the SEEA. The combined database of an IO/SAM and SEEA can trace the interdependencies of the economy and the environment, and the chain of effects of economic policies on the natural resource base. Repetto and Cruz call for the construction of environmental accounts to

provide the environmental and natural resource component of economy-wide models, hybrid forestry IO/SAM models.

The components of the SEEA that would typically be required for analysis of the sort carried out for Indonesia and the Philippines are shown in Table 5.2. They include forest accounts, land accounts, and other related accounts depending on a country's specific characteristics and policies.

Forest asset accounts include timber and non-timber values, forestland and carbon sequestration. The asset accounts record the state of forests and their changes in a given year. Forest balance accounts are constructed from a combination of the forest asset and flow accounts. Forest flow accounts include the use of commercial wood products, non-commercial wood products, and non-wood goods and services throughout the economy. These accounts are included to trace the affect on forests of changing demands for forest products due to changes in policy. The demand and supply of commercial wood products are often included in analytical models; the SEEA provides the same information for non-wood forest products and forest services. Environmental degradation that results from specific uses of forests and the impacts on other sectors of the economy would also be included.

Table 5.2 Components of the SEEA used for simulation models

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

SEEA accounts used for simulation models also include those resources that are closely related to forest use and deforestation, most importantly, land. Since there is general

agreement that most deforestation occurs through conversion of forestland for other uses, accounts for land use are critical in monitoring changes in forestland and the status of forests. Land accounts have been constructed using many different types of classification depending on the purpose for the land accounts. For forestry issues, land could be classified by ecological characteristics such as type of land cover, agricultural potential, and slope and soil erosion potential. Land accounts can also be classified by economic or institutional characteristics such as degree of forest protection, accessibility to settlers, economic user of the land (with detailed accounts for users like agriculture and infrastructure, which put the most pressure on forestland). Finally, other accounts, such as pollution, energy and water, may be useful depending on the causes of deforestation in a particular country.

5.2 Strengths and limitations of the SEEA framework for forestry

The SEEA provides a very powerful tool for analyzing policy impacts on forestry. One of its major advantages is the integration of environmental information with national accounts. However, there are two kinds of limitations of the SEEA that warrant some discussion. The first concerns the data requirements for the SEEA and its applications, especially the simulation models. The second concerns the spatial disaggregation of the SEEA; while official forestry accounts are usually compiled at the national level, local level accounts may be more useful for policy analysis.

Data requirements of the SEEA and its policy applications

The first two applications of the SEEA to sustainable forestry—assessing the contributions of forest goods and services to GDP and the cost of changes in forestland use, and assessing trade-offs among competing uses of forests—do not require a great deal of data. The basic forestry accounts are required, and these can be constructed fairly easily. Most of the physical data are already available from other sources. The major challenge is the economic valuation of the physical accounts.

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

Spatial characteristics of the SEEA

Researchers have noted that forest management is often a relatively localized phenomenon; a nation often has separate forests with different uses and economic values. Even when changing economic pressure and incentives originate from macroeconomic policies, the effects on use of forests can vary enormously depending on local conditions. However, the SEEA is most often constructed at the national level.

In both the Philippine and Indonesian studies this weakness was overcome by disaggregating the forest and land accounts by geographic and ecological characteristics. The national-level framework of the SEEA 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.

For local level analysis, there are an increasing number of applications of the SEEA to sub-national regions or to specific forests. For example, a collection of six case studies of forest accounts compiled for individual forests in Spain, the USA, Costa Rica is provided in Campos (2001). The combined SEEA and SAM-based framework can be used for simulation analysis at the local level. There is a literature of village and regional SAMs and CGE models, which can be linked to environmental accounts at the same spatial scale.

6. Concluding Remarks

The SEEA accounts for forests and related resources can provide policy-makers with a useful framework for assessing the impact of policies that originate outside forestry. The SEEA provides a framework for assessing the total economic value of forests, as well as a framework for linking information about forestry to the use of other resources and to the broader economy, integrating forestry policy with national development, and monitoring interactions and feedback across different industries. Thus, the SEEA forestry accounts can be useful for two sets of resource managers: forestry managers responsible for sustainable management of the resource, and managers concerned with the macro-economy.

Forestry managers may gain important information from the SEEA about the total economic value of forest resources, especially the inputs provided to sectors not part of the traditional forestry sector. Perhaps more importantly, the SEEA puts the information they normally produce and work with in the context of the national economy. The SEEA provides them with a tool 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 outside the forestry sector benefit from the SEEA in several ways: more accurate GDP that reflects all the contributions of forests, better indicators of sustainable economic development that include forestry and forestland resources, a tool for comparing policies across different natural resources including the extent to which the ‘user pays’ principle is applied, but perhaps most importantly, a method to integrate forestry into macro-economic policy and planning tools.

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 and 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, policy may have been formulated with little concern for impact on forestry, even though these policies may have had major impacts, indirectly, through changes in land use. The SEEA provides a tool for coordinating policies across the economy, anticipating cross-sectoral policy impacts and designing more effective policies.

Forest valuation and cost-benefit analysis of alternative forest uses benefit from use of the SEEA framework because it links these analyses to the national economy. This makes it possible to evaluate local and regional land-use decisions in terms of how it affects the

national economy. However, economy-wide modeling of cross-sectoral policy impacts on forestry, particularly simulation modeling, requires the SEEA. Where environmental accounts have not existed, researchers have had to construct, *ad hoc*, accounts similar in structure to the SEEA.

While there is a tremendous potential to use the SEEA forestry accounts for understanding cross-sectoral policy impacts on forestry, many developing countries have not yet constructed accounts, or have not constructed detailed enough accounts to take full advantage of the SEEA potential. There are several observations about the forestry accounts currently being constructed:

1. Some countries have begun to compile forestry resource accounts, notably developed countries, but there are relatively few developing countries that compile forest accounts on a regular basis. Because the importance of tropical forests has been recognized worldwide, there is a great deal of information that can be used to construct forest accounts, even in countries with relatively limited data collection resources. Physical accounts can be constructed, even if monetary valuation cannot be fully implemented right away.
2. Much of the forest valuation has focused on commercial timber values and carbon storage values, with limited treatment of other non-commercial values of forestry. In most instances, this neglect is due to measurement problems, especially regarding forest services. Increased efforts to measure the value of non-commercial forest goods and services will help improve local and regional land-use and development planning by providing information that can be used to determine the optimal mix of forest uses.
3. Policy-makers are not yet utilising the full potential of the SEEA framework to address forestry management through economy-wide environmental-economic modeling. Such a tool can provide a better understanding of the pressures on forest and forestland, and for anticipating impacts on forestry of non-forestry policies. For developing countries, this situation reflects, in part, a lack of detailed forestry accounts and economic accounts (SAM/IO) necessary to construct economy-wide simulation models, and sometimes a lack of experience in using such models.
4. Because forest utilization tends to be a local or regional issue, there is a need for more disaggregated forest accounts, rather than purely national forestry accounts. There are an increasing number of case studies that apply the SEEA framework to individual forests.

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ANNEX A. Environmental accounts for forests and related resources

To analyze cross-sectoral policy linkages, information is required about the economy and the environment. The national accounts provide extensive information about the economy so will not be discussed here. This chapter focuses on the information about the environment provided by the SEEA. It provides a detailed description of the physical and monetary accounts for natural resources that are relevant to forestry issues, mainly forestry, land and ecosystem accounts. Other accounts may be relevant only for a few countries and are described more briefly, e.g., pollution and energy accounts.

The description is organized around the four components of the SEEA:

- Asset accounts for natural resources
- Flow accounts for the used of materials and energy as well as the emission of pollution and resource degradation
- Environmental protection and resource management expenditure accounts
- Environmentally adjusted macroeconomic indicators

Physical accounts are relatively well defined for much of the forestry-related accounts, although degradation of land and forests can be difficult to measure. Monetary valuation of market resources, such as cultivated forestland and timber, is also fairly well defined. However, valuation of non-market goods and services, especially ecosystem services, is relatively new and there is no consensus yet on the methods of valuation. Nonetheless, there have been efforts at valuation and these will be discussed in this section and the next.

A.1 Forest resource accounting

Forest resources include the stock of forest and the flow of goods and services from forests. The conventional national accounts of the SNA include some forests, those forests such as forest plantations whose growth is managed and controlled, as produced assets. The flow accounts of the SNA include economic activities related to forests, mainly commercial timber and related products. Natural forests have been omitted from the SNA asset accounts, and many non-commercial goods and services are also omitted. In principle, the SNA is now usually interpreted to include most natural forests in the asset accounts⁴ as well as a range of non-timber forest goods and services. In practice, however, these are usually omitted for several reasons.

Some of the omitted economic benefits of forests are conceptually a part of the national income accounts but may not be fully included because of measurement problems. Examples include services and goods collected on a non-commercial basis mainly for own-use or informal markets, such as fuel wood, recreational use of forests, traditional medicines and foods. The statistical offices of developed countries often make efforts to estimate these

⁴ Forests that have no present economic value would not be included. Examples include forests that are too remote for economic exploitation.

goods and services, but in many developing countries, where tropical forests occur, statistical offices often do not have the resources to make these estimates.

Some forest services are included in the national accounts, but are incorrectly attributed to other sectors. Such services are inputs to other productive activities, but this input is not recorded so its value accrues to the using sector rather than forestry. For example, the provision of grazing by natural woodlands to livestock production, is not explicitly represented as an intermediate input from forests to agriculture, hence, the value of grazing is incorrectly included in the value of livestock production. Other forest benefits, mainly ecosystem services such as carbon sequestration, are not even included conceptually in the national accounts.

The SEEA provides a measure of forest values that is more comprehensive than the SNA in two respects, 1) the SEEA includes both cultivated and natural forests in the asset accounts, and 2) the SEEA attempts to include all forest benefits, market and non-market, in the flow accounts. Accounts are constructed wherever possible in both physical and monetary units. However, it is often difficult to determine an economic value for some non-market benefits, hence the coverage of non-market benefits varies a great deal from country to country.

Table A.1 shows the forest resource accounts that are recommended by the SEEA. Some countries have implemented these guidelines fully. Other countries have implemented only that part of the guidelines that is most relevant to their policy concerns and the available data. The next chapter will review the accounts constructed by different countries. A brief overview of the forest accounts is provided here, followed by a more detailed description of each component.

The SEEA asset accounts emphasize three aspects of forests: standing timber, forestland, and carbon storage. The asset accounts include changes in quantity and forest degradation. Although the production of other forest goods and services is included in the flow accounts, there has not yet been an attempt to capitalize these goods and services into an expanded forest asset value, mainly because of measurement problems. The asset accounts also include as memorandum items the manufactured assets used for forest-related activities. The manufactured assets are taken from the SNA and are intended to provide a more comprehensive picture of forest asset accounts when the forest accounts are viewed alone.

The flow accounts include production of market and near-market goods whose physical volume and monetary value can often be measured fairly reliably. Commercial timber, which is included in the SNA, is valued at market prices, for example, while non-market goods such as subsistence fuelwood, edible plants and game are valued using prices of closely related market goods and services, or other valuation techniques. Physical accounts for forest services can be constructed but their economic value is more difficult to quantify because there are usually no market or near market prices. For some services, such as biodiversity protection, valuation is especially difficult and the status of such services is often represented qualitatively with physical indicators derived from the SEEA.

The SEEA flow accounts also include environmental degradation due to forestry activities, such as soil erosion from logging. The memorandum items for the flow accounts include other information useful for forestry policy analysis, such as employment, income and exports related to forestry. Accounts for expenditures for forest management and protection

distinguish government and private sector expenditures. Macroeconomic aggregates include the value of forest assets in measures of total national wealth, and include measures of forest depletion in national aggregates of savings, depreciation and depletion, and adjusted Net Domestic Product. Additional memorandum items include information about rights of forest exploitation and about taxes and stumpage fees paid.

Table A.1 Components of the SEEA forestry accounts

<p>1. Forest-related asset accounts</p> <p>Standing timber: volume and monetary value of by main species, natural and cultivated forest land, available for wood supply or not available, etc.</p> <p>Forestland accounts: land area and economic value by main species, natural and cultivated forest land, available for wood supply or not available, etc.</p> <p>Carbon storage: volume and economic value related to tree biomass and forest Ecosystems</p> <p>Memorandum items: Manufactured assets like roads, buildings and equipment for forestry, logging, tourism and other uses of forestry</p>
<p>2. Flow accounts: forest goods and services</p> <p>Timber products (volume and economic value for market and non-market production)</p> <p>Non-timber products (volume and economic value) Output of game, edible plants, medicinal plants, etc. Supply and use tables for wood products, forestry and related industries</p> <p>Forest services (volume and economic value, where possible) Recreational and tourism use of forest Intermediate inputs to other sectors, e.g., livestock grazing Protective services: biodiversity protection and other protective services such as prevention of soil erosion</p> <p>Degradation of forests due to forestry or non-forestry activities, such as defoliation</p> <p>Environmental degradation caused by forest-related activities, e.g., soil erosion from logging, water and air pollution from wood processing industries</p> <p>Memorandum items (examples) Employment, income, exports from non-timber goods and services Number of households dependent on non-timber forest products</p>
<p>3. Expenditure on forests management and protection Government expenditures Private sector expenditures</p>
<p>4. Macroeconomic aggregates Value of forest depletion and degradation Measures of national wealth, national savings and Net Domestic Product adjusted for forest depletion/accumulation</p>
<p>Other memorandum items (examples) Rights of forest exploitation</p>

A.1.1 Physical and monetary asset accounts for forests

Physical Assets

Forest assets are measured first in physical units, most commonly volume of woody biomass and area of forest cover, then in monetary units. Data for physical accounts are often obtained from national forest inventories or land-use statistics, sometimes updated by aerial photography or satellite images. Forest accounts are usually disaggregated by species (e.g., conifers, broad-leaved) and by the age distribution, or by other structural parameters relevant to policy.

Forest asset accounts follow the general structure of asset accounts in the SNA, with entries for opening stocks, closing stocks, and changes during the year (Table A.2). The changes that occur during the period are divided into those that are due to economic activity (e.g., felling of timber), and those that result from other causes. Net natural growth is defined as growth minus natural mortality. Other changes include changes due to unusual events such as fires or storms. While the accounts generally describe what has happened to a given forest area over a year, changes in forest accounts may also come about due to changes in the definition of land covered by forest. For example, if formerly agricultural land is abandoned and becomes forest, it is included under the category ‘Changes in land classification.’ The monetary accounts for resources have an additional component, like manufactured capital, for revaluation.

Table A.2 Structure of forest asset accounts

	Physical Accounts (cubic metres of woody biomass)	Monetary Accounts (currency units)
Opening Stocks	X	X
Changes in Stocks		
Fellings	X	X
Net Natural Growth	X	X
Other Changes	X	X
Changes in land classification	X	X
Revaluation (monetary accounts only)		X
Closing Stocks	X	X

Accounts for standing timber can be classified according to several major categories, such as major tree species, or protection status (using IUCN categories). Forest-related asset accounts include forestland accounts and carbon storage accounts. Forestland accounts are a subsector of the land accounts, addressed more fully later in this section. The forestland accounts can be disaggregated by category of forestland, such as cultivated and non-cultivated, available for wood supply or not available, by major ecosystem type, etc. The carbon storage accounts have the same structure as the forest accounts and are measured in

tons of carbon. The carbon accounts may be further disaggregated to indicate where the carbon is stored, e.g., in woody biomass, soils, ground vegetation, etc.

A simplified example of the physical accounts for forestry is given in Table A.3 of one possible set of disaggregation of forest asset accounts: standing timber (Table A.3a), forestland (Table A.3b) and carbon storage (Table A.3C). Standing timber, measured in millions of cubic metres, is disaggregated by major tree species. Forestland accounts, measured in hectares, distinguish the availability for wood supply and further distinguish cultivated from natural forests. Carbon accounts, measured in tons of carbon, are disaggregated by major tree species for forestland available for wood supply. These categories are generally further disaggregated in the actual accounts constructed by each country, depending on the relevant characteristics of forest and forestland.

Table A.3 Examples of asset account for standing timber, forestland, and carbon storage

a. Asset account for standing timber (millions of cubic metres)

	Conifers	Broadleaved	Total
Opening stocks	1502	323	1824
Fellings, of which			
Harvested timber	-202	-45	-247
Timber left in forest	-14	-11	-24
Net natural growth	280	80	360
Changes in land classification	-8	-2	-10
Closing stocks	1558	346	1904

b. Asset account for forest and wooded land (thousands of hectares)

	Forestland available for wood supply			Forestland not available for wood supply		
	Cultivated forest	Non-cultivated forest	Total	Cultivated forest	Non-cultivated forest	Total
Opening land area	75	25	100	10	75	85
Changes in land area						
Land clearing	-10	-3	-13		-3	-3
Afforestation	10		10	2		2
Change in land classification	5		5			
Other causes	-2	-1	-3		-2	-2
Closing land area	78	21	99	12	70	82

c. Asset account for carbon storage (million tons of carbon)

	Forestland available for wood supply		
	Conifers	Broadleaved	Total
Opening stocks	511	134	645
Fellings	-73	-23	-96
Natural growth	95	33	128
Changes in land classification	-3	-1	-4
Closing stocks	530	143	673

Note: blank indicates zero.

Depletion is defined as the loss of timber or forestland due to economic activity. Thus, depletion of timber would include fellings that exceed net natural growth, but would not include loss of timber due to storms or fires. Depletion of forestland would similarly refer to a permanent change in land use due to economic activity. In some instances, the asset accounts may include indicators of forest quality and degradation, such as loss of foliage. Most countries do not include forest quality in the asset account because the information requirements are too demanding. However, forest degradation may be included in the flow accounts as a loss of services.

The SEEA also includes the monetary value of other assets related to forests: roads and infrastructure, non-residential structures and equipment for forestry and logging, and accommodations for tourists or other forest users.

Valuation of forest asset accounts

The value of any asset, including forests, is the discounted present value of the economic benefits it will generate in future years. In principle, asset value should include both timber and non-timber values, but in most countries, only timber values are used for asset valuation, mainly because of measurement difficulties. Estimating the non-timber component of forest asset value requires projections about future flows of non-timber benefits, but at this time, the valuation of non-timber benefits is still rather experimental, so this approach has not been recommended in the SEEA.

When there are well-developed markets, the sales price of standing timber is the best indication of its value. However, there are several problems that arise. Sales may not occur often enough for competitive market prices to emerge, so that the sales value may not provide a good indicator of value. In addition, forest sales often include the value of the land as well as the timber and distinguishing the two values may be quite difficult. A widely used alternative valuation method is to calculate rent as the difference between revenue and harvesting cost, equivalent to stumpage value. For forest asset value, the rent is then adjusted for the age structure of forests and the time to harvest-age. (A brief presentation of the mathematical formulation for forest asset valuation is given in the appendix. See UN, 2001 for further discussion of valuation issues).

There are a number of problems with the market price approach to valuation, whether it is based on stumpage fees or sales of standing timber. The estimate of rent is based on the *private costs* of timber harvesting, but the *social costs* may be higher for several reasons.

One source of divergence between private and social costs occurs when government pays for part of the costs of logging. For example, government may provide some of the infrastructure necessary for resource exploitation, such as roads, or subsidize inputs such as water and electricity supply. In such cases, the private cost of logging will be less than the social cost of logging, and the stumpage value over-estimated. In other instances, logging may cause damage that results in loss of other forest benefits, such as soil erosion, sedimentation of streams, loss of wild plants and game, loss of carbon etc. Including those costs would further reduce the stumpage value. Finally, even when other forest benefits are recognized, they are may not be included in forest asset valuation because it is often difficult to value them. Consequently, the true value of forests is underestimated.

In the early years of environmental accounting, measuring the cost of deforestation—depletion of forest assets—was a primary motivation for constructing accounts for forests as well as for other natural resources. By the 1990's, however, a number of alternative approaches to valuing depletion have emerged, which result in very different estimates. There has been no agreement about which method to use; the SEEA does not recommend a particular method and Eurostat does not recommend attempting to measure forest depletion. Consequently many countries do not attempt to measure it. Two of the more widely used approaches to measuring forest depletion are provided in the Appendix.

Monetary accounts for forestland are based on the estimated market value of the land separate from the standing timber, and face the same difficulties as valuation of forests.

Carbon storage is the non-timber value for which accounts have been most often constructed. Valuation of carbon storage, where undertaken, has usually taken one of two forms: either the price people are willing to pay per ton of carbon for forest-based carbon storage (estimated in a variety of ways), or the estimated value of damage from climate change averted by reducing atmospheric emission of carbon. There is no consensus about which methodology to use and the values are often very different.

A.1.2 Forest resource flow accounts

The forest flow accounts include production, use and trade, as well as the environmental impact of forestry and related industries, in both physical and monetary units. Timber and commercial tree products often dominate the forest flow accounts, but many countries have attempted to include other benefits in their environmental accounts, especially the gathering of wild foods, game, recreational services, and biodiversity protection.

Physical accounts

The most detailed description of flows is provided by the supply and use table. The supply and use tables show the origin of different forest products, the processing of raw forest products into other products such as sawn wood and fire wood, and the use of each product by every sector of the economy as well as final users (households, government, capital formation and exports). The national accounts provide monetary supply and use tables for forest products. The SEEA provides the corresponding physical supply and use tables. The two tables are linked to each other and the rest of the economy through the use of a common industrial and commodity classification. From these tables, commodity balances for forest products can be constructed, as well as an input-output (IO) table or social accounting matrix (SAM) in which the production of forest products is represented in physical terms.

Table A.4 provides a schematic example for the supply and use of nine different wood products, including two waste products. Part A shows the main wood products and the industries that provide them. Standing timber is provided only by the forestry & logging industry; all other products can be supplied by a number of industries, or imported. Total supply equals domestic output plus imports.

Part B of Table A.4 shows the use of these wood products as intermediate inputs to industry and use by final users, households, government, exports and capital formation. The intermediate use of wood products is concentrated in several related industries: forestry, manufacture of wood products, pulp, paper, printing, and recycling. Final consumption is generally restricted to three products: fire wood, manufactured wood and wood products such as furniture or construction timber, and paper. Any product except standing timber can be exported. Only standing timber and certain manufactured wood products are treated as capital goods.

The supply and use tables for wood products show how much timber is processed into different wood products, and how much is used by each sector of the economy. When the tables are linked to the IO tables, they can be used for trend analysis of input coefficients in wood processing industries (monitoring material efficiency) and, combined with macroeconomic models, for estimating future demand of forest products. These tables make it possible to trace upstream and downstream linkages to forestry in the economy, and also the direct and indirect impact of changes in the economy. For example, an increase in health spending will affect the demand for construction timber, furniture, and paper products, and ultimately affect the demand for forest products. This will occur both because of the direct impact of an increase in health spending, but also as an indirect impact of the increased demand for other health-sector inputs, which themselves require wood products, and so on. Similarly, the impact of economic growth, changes in exports and imports, etc. can be measured.

In principle, these detailed supply and use tables can be extended to include other, non-wood forest products. In practice, however, such extensive tables are often created only for wood products because the use and transformation of non-wood products by other sectors is usually quite limited. For such goods and services, the SEEA often includes only production accounts and limited information about use.

Table A.4 Physical supply and use table for wood products
(thousands of cubic metres)

a. Supply of wood products

Wood product	Output of products by ISIC industry										Total supply	
	Forestry & logging	Manu. Of wood products	Pulp	Paper	Printing	Recycling	Other	Total industry supply	Imports	Total supply		
Standing timber	X										X	X
Sawn logs	X						X				X	X
Fire wood	X							X			X	X
Pulp wood	X							X			X	X
Manuf. of wood & wood products		X									X	X
Paper pulp			X								X	X
Paper				X							X	X
Wood waste as product		X						X			X	X
Paper waste as product				X	X		X				X	X

b. Use of wood products

Wood product	Intermediate consumption by ISIC industry										Final users			Total use
	Forestry & logging	Manu. Of wood products	Pulp	Paper	Printing	Recycling	Other	Total intermed. use	Final Consumption	Exports	Capital formation			
Standing timber	X							X			X		X	
Sawn logs		X						X				X	X	
Fire wood							X	X	X				X	
Pulp wood			X					X		X			X	
Manuf. of wood & wood products							X	X	X		X		X	
Paper pulp				X				X		X			X	
Paper					X		X	X	X				X	
Wood waste as product		X	X					X					X	
Paper waste as product			X			X		X					X	

The output of some forest services cannot be easily measured and physical indicators of function may be used instead. These include recreation, maintenance of biodiversity, and various protective functions such as protection of soil or water resources, or protection from storms and other events. For biodiversity, useful indicators include the percentage of species that are endangered, or changes in numbers of key species. (Table A.5 provides an example.) For recreation, the indicator may be numbers of visitors. For protective services, it may only be possible to indicate the area of forested land providing these services. Without a physical measure of output, it is usually very difficult to measure the economic value of the service.

Table A.5 Example of indicator of biodiversity: number of endangered species

	Total number of known species		Number of endangered forest species	
	1995	2000	1995	2000
Vascular plants (trees & flowers)	1350	1500	34	38
Non-vascular plants	13700	14000	207	330
Vertebrates	373	373	17	19
Invertebrates	25000	25300	200	300

Environmental degradation

Forest degradation measures the decline in productivity of a forest resulting from economic activity. For timber values, examples of degradation include defoliation resulting from air pollution originating from non-forestry sectors, or degradation of standing timber due to harvesting practices. Degradation also occurs when one use of a forest affects the capacity of the forest to provide services to other industries. Logging of forests, including construction of forest access roads, or conversion to other land uses, can result in loss of forest services to tourism and biodiversity. Certain methods of timber harvesting may cause soil erosion that increases stream siltation. Siltation can harm fish and wildlife habitats, as well as hydroelectric dams. In the next chapter, an example will be given of the excessive abstraction of rainfall by exotic forest plantations in South Africa, a water-scarce country, which has reduced runoff and the water available to downstream users. The spread of exotic species throughout South Africa has led to a public programme to uproot exotics in order to protect the water supply.

All these forms of environmental degradation are included in the forest accounts. The more broadly defined forest-related accounts also include the pollution associated with the processing of wood and wood products.

Monetary accounts for forest goods and services

For market goods and services, the SNA provides complete monetary accounts, which are included in the SEEA forest accounts. In principle, the SNA also includes some near-market goods and services, that is, products that are similar to marketed products but which are collected 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. Many countries have included some estimate of these resources in their national accounts. In other countries however, these near-market products may be

missing or not measured very accurately, especially in developing countries with limited resources for constructing national accounts. In such cases, the SEEA estimates the values.

Some forest services, notably the protective services of forests, are difficult to value. There are a number of well-established valuation techniques that are mentioned in the SEEA Handbook. However, as mentioned earlier, there is no single standardized approach recommended by the SEEA at this time. Some countries have attempted valuation while others have not. The one exception is carbon storage—most forest accounts have attempted to estimate a value, or a range of values for this service.

Valuing environmental damages and forest degradation

Effective policy is based not only on an understanding of the *volume* of degradation, but also an understanding of the *economic* implications. The SEEA takes two different conceptual approaches to valuing environmental degradation: the maintenance cost approach and the damage cost approach. Maintenance cost is based on the *cost* of actions that would have to be taken to prevent or remediate degradation, for example, the cost of changing logging practices so that they are less environmentally damaging, or the cost of removing silt from a dam. Damage cost is based on the damages or loss of function from degradation. Damage valuation includes, for example, the loss of ecotourism income due to forest damage or loss, the loss of fish production and harvest due to damage of river spawning grounds, or the loss of hydroelectric capacity due to siltation.

In the absence of efficient markets, these measures are likely to be quite different. The damage cost is the theoretically correct approach for measuring changes in economic well-being, but both measures provide useful information for environmental management.

A.1.3 Environmental protection and resource management expenditures for forestry

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

A.1.4 Forestry accounts and macroeconomic indicators

The forest accounts provide essential information for the calculation of improved macroeconomic aggregates such as national wealth, Gross Domestic Product (GDP), Net Domestic Product (NDP) and national savings. In conventional measures of national wealth, or the consolidated balance sheet, only cultivated forests were included. With information from the SEEA, the value of natural forests can be included as well. A more comprehensive measure of GDP is obtained by adding the production of non-market forest goods and services. NDP and national savings can also be revised by including the value of deforestation or afforestation.

A.2 Land and ecosystem accounts

The primary threat to tropical forests is from land conversion, so comprehensive land accounts are essential for a framework to evaluate the impact of non-forestry policies on forest conservation. In the SNA, land is represented as a non-produced asset, disaggregated into several types:

- Land underlying buildings and structures
- Land under cultivation
- Recreational land and associated surface water
- Wooded land and associated surface water
- Major water bodies
- Other land and associated surface water

Only land over which ownership rights are established and which yields direct use benefits is included in the SNA. The SEEA has adopted a broader definition, encompassing all land on the grounds that, if indirect benefits are included, all land has some economic value or is likely to at some time in the future. SEEA land accounts take into account both the use of land by different economic activities and the potential uses of land from an ecological perspective. The ecological perspective takes into account, for example, the extent and quality of different habitats or soil and climate characteristics.

Land and ecosystems are closely related environmental assets because the value of land, derived from the services it provides, often depends on complete ecosystems, rather than individual characteristics of land. This is readily apparent for agricultural, recreational or forestland, but is often less true of urban industrial land. Although land statistics have long been constructed, the SEEA land and ecosystem accounts have the following distinct uses:

- Provide a complete picture of land cover and land use, as well as trends over time
- Link changes in land use, land cover, habitats and biodiversity to the driving forces that bring about those changes
- Assist in the economic evaluation of changes in land use

Land use accounts are constructed at the national, regional watershed, or landscape level and are often geo-referenced. Land accounts distinguish between *land use* and *land cover*, and are generally constructed for both. Land cover usually refers to the use of land for human purposes, e.g., dwellings, industrial use, transportation, recreation, etc. Land use usually refers to biophysical aspects of land and is most closely related to ecosystems, e.g., built-up areas, grassland, forests, lakes, etc.

Both land use and land cover can be further disaggregated depending on the policy issue at hand. Moreover, accounts can be cross-classified by both land use and land cover, and land cover is related to both natural processes and land use. For example, land cover may change from forest to grassland due to change in land use. Land cover provides a single, exclusive and exhaustive classification for all land, but land use is more complex, because land can have multiple functions. For example, a land may be used for crops during one season and grazing in the next; forestland may be used simultaneously for timber, recreation, and carbon storage.

Table A.6 shows the broad classifications used for land and ecosystems. These classifications are further subdivided according to criteria relevant for a particular country. For example, the land underlying buildings and structures may further distinguish residential land use, industrial-commercial land use, roads and infrastructure, etc. Wooded land can be further disaggregated according to dominant species, ownership (public, private, or traditional tenure). Similarly, agricultural land can be disaggregated by dominant crop or product, land quality characteristics, ecosystem type, and ownership. These accounts, while typically constructed at the national level, can be disaggregated to smaller districts and regions within a country, using GIS and other spatial databases. Other land may include dedicated recreational land, land set aside for mining, etc.

Table A.6 Classification of land and ecosystems in the SEEA

EA.2 Land and surface water

- EA.21 Land underlying buildings and structures
within urban areas
outside urban areas
- EA.22 Agricultural land and associated surface water
cultivated land
pasture land
other agricultural land
- EA.23 Wooded land and associated surface water
cultivated forest
non-cultivated forest
- EA.24 Major water bodies
- EA.25 Other land and associated surface water

EA.3 Ecosystems

- EA.31 Terrestrial ecosystems
- EA.32 Aquatic ecosystems
- EA.33 Atmospheric ecosystems

Note: EA is Environmental Asset

Each set of accounts establishes exclusive and exhaustive categories of land use. The exclusive characteristic, that land is assigned to only one, primary classification, is problematic because land is often subject to multiple uses. The classification indicates the primary use; additional accounts can be created to indicate other uses.

There are many types of land use accounts that can be constructed. The four basic sets of land accounts are shown below:

Stock accounts for land cover by land use

Reading down column 1 of Table A.7a shows the amount of land underlying buildings and structures by land cover. Out of a total of 131 thousand hectares, 108 thousand hectares of this land is in urban ecosystems, none is in agricultural ecosystems, 6 thousand hectares are

in forest ecosystems, 15 thousand in prairies and grassland ecosystems, and 1 thousand in dryland ecosystems.

Stock accounts for land use by economic activity

Table A.7b shows that of the 280 thousand hectares classified by use as forestland, 160 thousand is used by the agricultural sector (which includes forestry), 10 thousand hectares are used by government, 30 thousand hectares are used by households, and 80 thousand hectares are not directly associated with an economic activity.

Change in stock accounts: land cover/use in initial state and in final state

Table A.7c shows that the amount of land underlying buildings and structures, 15 thousand hectares, remained unchanged between the two periods, while the total amount of forestland declined from 20 thousand hectares to 18 thousand hectares due to the conversion of 2 thousand hectares of forestland was converted to agricultural uses.

Change in stock accounts: change in land cover by major cause of change

Table A.7d attributes the net changes in land area, classified by land cover, to economic and non-economic causes. Economic causes are further disaggregated into urbanization, changes in agricultural practices, and restoration/remediation.

Land use accounts can be constructed for the amount of land classified by use or by cover. Accounts for 2 periods can be combined to show the transition from one type of land to another over time, which is one way of recording conversion of forestland. The forestland component of the land accounts can also be constructed in great detail to record the amount of tree cover and changes in tree cover for each type of land, as described in Section A.2.

Table A.7 Example of land accounts (thousands of hectares)

a. Stock of land: land use by land cover

	Land underlying buildings and structures	Agricultur al land	Forest land	Major water bodies	Other land	Total
Terrestrial ecosystems						
Urban	108	2	1			111
Agr., forestry, fishing		326				326
Forest	6	25	278			309
Prairies & grassland	15	133				148
Dryland	1				9	10
Other					75	75
Aquatic Ecosystems	1	4	1	14	1	21
Total	131	490	280	14	85	1000

b. Stock of land: land use by economic activity and households

	Land underlying buildings and structures	Agricultural land	Forest land	Major water bodies	Other land	Total
Agriculture	21	470	160	2	2	655
Mining	1				4	5
Manufacturing	10					10
Construction	4					4
Trade	6					6
Transport, communication	3			4		7
FIRE	3					3
Education, health, other services	4					4
Government	1		10			11
Private households	74	3	30	2	1	110
Subtotal	127	473	200	8	7	815
No direct use	4	17	80	6	78	185
Total	131	490	280	14	85	1000

c. Change in land use over time

Land use in period 1	Total land, period 1	Land use in period 2			
		Land underlying buildings and structures	Agricultur- al land	Forest and wooded land	Other land
Land underlying buildings & structures	15	15			
Agricultural land	60	2	56	1	1
Forest and wooded land	20		2	18	
Other land	5				5
Total land, period 1	100				
Total land, period 2		17	58	19	6

d. Change in land cover by source of change

	Initial stock	Net changes due to economic decisions			Net changes due to other causes	Final stock
		Urbanisation	Changes in agr. practices	Restoration		
Terrestrial ecosystem						
Urban	111	10				121
Agriculture	326	-4	10	3		335
Forest	309	-3	-23	5	-1	287
Prairies & grassland	148	-1	1	1		149
Dryland	10	-1	2	1		12
Other	75					75
Aquatic Ecosystem	21					21
Total	1000	1	-10	10	-1	1000

Valuation of land and ecosystem accounts

Land asset accounts are measured first in physical units, usually hectares or square kilometers. The monetary accounts value land at market prices; this is the practice for land included in the SNA asset accounts. However, valuation is very difficult for many categories of land:

- Land may not change hands very often
- Land may not be sold as a separate asset, but in combination with buildings, with agricultural improvements, or with standing forest
- Land may incorporate other attributes that affect its market value, such as a view, access to water, potential for tourism, etc., but are not easy to estimate when there are few transactions
- Land may have values that are not reflected in market transactions, mainly ecosystem services such as recreational services, carbon storage or environmental protection services.

While there are a number of techniques to estimate the economic value of land when market prices are not available or do not reflect the full value of land, these techniques require a great deal of data and may be impractical to implement nation-wide. This is especially true for ecosystem accounts, where the emphasis is on the role of land in providing ecosystem services. There is no consensus on methods for estimating the total value of an ecosystem so ecosystem accounts are usually compiled only in physical accounts. Physical indicators for aspects of ecosystem services are provided, as well as economic value for those ecosystem services that can be reasonably estimated.

A.3 Other components of the SEEA relevant to forestry

Additional components of the SEEA are relevant to understanding deforestation and forest degradation in specific countries.

Forest degradation due to air pollution

In some countries, air pollution has been responsible for serious degradation of forests and the SEEA pollution accounts can be useful for addressing this problem. The pollution accounts are part of the flow accounts and report the amount of pollution, by type of pollutant and by sector of origin.

Fuel wood use and deforestation

In parts of some developing countries use of fuelwood can be a contributing factor to deforestation, especially in densely populated areas and around large cities. Energy policies may have a strong impact on the choice of fuel, wood v non-wood fuels; where non-wood fuels are imported, macroeconomic policies affecting exchange rates are also likely to affect fuel choice. To assess the impact of energy policies, or macroeconomic policies affecting the relative prices of different fuels, the SEEA energy accounts are required. Fuel wood is included in the SEEA forest accounts. The energy accounts include supply and use tables for all energy products that have the same structure and general purpose as the supply and use tables for wood products.

A.4 Limitations of the SEEA forest and related accounts

Forest use and management are often relatively localized phenomena; changing economic pressure and incentives may originate from macroeconomic policies, but the effects on use of forestland are often played out at a more local level. The review of deforestation studies by Kaimowitz and Angelsen pointed out the need for more spatial disaggregation of economy-wide studies.

One of the limitations of the SEEA forest accounts is that they are designed for national level accounting, while decisions about forests and forestland are taken at the regional and local levels. Many of the national forest accounts, however, are compiled from more spatially disaggregated data and case studies, which can be used to construct accounts at the regional and local levels. In addition, the need of policy-makers for more spatially disaggregated forest accounts is driving the application of the SEEA framework to sub-national regions or to specific forests (see for example, Campos (2001)).

Appendix. Measuring forest asset value and depletion

Forest asset valuation

The general expression for the value of an asset, V , is simply the discounted net economic benefits it yields over its lifetime.

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

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. While forest asset valuation should include all the goods and service generated by the forest, asset valuation is most commonly applied to timber values. However, this very general expression does not take into account the age-class structure of forests. The formula was modified by Vincent (1997) to take into account the age structure.

The total value of second-growth forestland, V , is the sum of v_τ the value per hectare of forestland of age class τ , weighted by A_τ , the total area in age-class τ . (The following presentation abstracts from other important characteristics that affect forest value such as species, region, site quality, etc, for ease of reading.)

$$V_t = \sum A_{t,\tau} v_{t,\tau} \quad \text{for } \tau = 1, \dots, T-1 \quad (2)$$

$$v_{t,\tau} = \frac{p_t q_T}{(1+r)^{T-\tau}} \quad (3)$$

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, $T-\tau$. This expression for forest asset valuation can be further refined to reflect both the timber value and the value of the bare land, p_L ,

$$v_{t,\tau} = \frac{p_t q_T + p_{L,t}}{(1+r)^{T-\tau}} \quad (4)$$

$$p_{L,t} = [-C_t^s + (p_t q_T)(1+r)^{-T}] / [1 - (1+r)^{-T}] \quad (5)$$

where C^s is full rotation management costs.

Monetary value of forest asset depletion

The early approach to valuing depletion, including deforestation is illustrated by the environmental accounts constructed by Repetto and his colleagues (1987, 1989) in Indonesia and Costa Rica, and environmental accounting case studies sponsored by the United Nations and the World Bank in Mexico (Van Tongeren et al., 1991) and Papua-New Guinea (Bartelmus et al., 1992). Depletion, D , was calculated as the volume of harvest above net growth times, $Q - G$, times the stumpage fee, p :

$$D_t = p_t(Q_t - G_t) \quad (6)$$

Of course, this figure could be positive if net growth were greater than harvest.

This approach was popular because it was quite easy to calculate. However, it was later recognized that this concept, which corresponds nicely with ecological concepts of sustainability, was not consistent with the economic concept of depreciation used in the SNA. (For further discussion, see (Davis and Moore 2000, Vincent 1999). The revised SEEA proposes a concept of depletion cost more consistent with economic depreciation: the change in the asset value from one period to the next. However, several alternative ways to measure this cost have been proposed and no consensus has yet been reached. The following equation

$$D_t = V_t - V_{t+1} \quad (7)$$

where V_t , V_{t+1} are defined using equation 2 represents one approach developed by Vincent (1999) specifically for forests. The change in asset value takes into account both physical changes in the asset as well as value changes, capital gains or losses, which is consistent with the method of calculating depreciation of manufactured assets in the SNA.

ANNEX B. The SEEA and sustainability indicators for forestry

In recent years, there have been a number of efforts to develop criteria and indicators for sustainable forestry, based on economic, social, ecological, and institutional statistics. There is considerable overlap between work on sustainability indicators and the SEEA, although these two efforts have proceeded, for the most part, independently of one another. One of the advantages of the SEEA is that it produces both indicators as well as the detailed statistics needed for analysis. The relationship between the SEEA and two sets of indicators of sustainability is described below. The first set, the Montréal Process indicators provides a fairly well developed set of indicators for forests. The second set is based on the UN's Driving Force-State-Response system for sustainability indicators.

B.1 SEEA and the Montréal Process indicators

The Montréal Process represents one such attempt to develop and implement internationally agreed criteria and indicators for the conservation and sustainable management of temperate and boreal forests. (See their website <http://www.mpci.org> for more information.) The Montréal Process has identified a set of *criteria*: categories of conditions or processes by which sustainable forest management may be assessed. Each criterion is characterized by a set of related *indicators*, quantitative or qualitative variables which can be measured or described and which, when observed periodically, demonstrate trends. Table B.1 shows the relationship between the Montréal Process criteria and indicators, and the information provided by the SEEA; many of the Montréal Process indicators are provided by the SEEA.

Table B.1 Correspondence between sustainability indicators and the SEEA

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

	biodiversity protection, physical
b. The status (threatened, rare, vulnerable, endangered, or extinct) of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment	Forest service accounts for biodiversity protection, physical
Genetic diversity	
a. Number of forest dependent species that occupy a small portion of their former range	Could be calculated from changes in forest service accounts for biodiversity protection
b. Population levels of representative species from diverse habitats monitored across their range	Forest service accounts for biodiversity protection, physical

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

Criterion 3: Maintenance of forest ecosystem health and vitality	
Indicators:	
a. Area and percent of forest affected by processes or agents beyond the range of historic variation, e.g. by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinisation, and domestic animals	Only that part attributable for economic activities, such as land clearance and salinisation
b. Area and percent of forest land subjected to levels of specific air pollutants (e.g. sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem	Forestland accounts, land accounts, pollution accounts (physical)
c. Area and percent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g. soil nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)	Forest degradation accounts (flow and/or asset), physical

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

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

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies	
Indicators:	
Production and consumption	
a. Value and volume of wood and wood products production, including value added through downstream processing	Forest wood flow accounts, supply and use table, physical & monetary
b. Value and quantities of production of non-wood forest products	Forest non-timber flow accounts, physical & monetary

c. Supply and consumption of wood and wood products, including consumption per capita	Forest wood supply and use accounts, physical
d. Value of wood and non-wood products production as percentage of GDP	Forest flow accounts for goods and services, monetary
e. Degree of recycling of forest products	Forest wood supply and use accounts, physical
f. Supply and consumption/use of non-wood products	Forest non-timber flow accounts, physical
Recreation and tourism	
a. Area and percent of forest land managed for general recreation and tourism, in relation to the total area of forest land	Forestland asset accounts, physical
b. Number and type of facilities available for general recreation and tourism, in relation to population and forest area	Forest asset accounts memorandum items for fixed capital
c. Number of visitor days attributed to recreation and tourism, in relation to population and forest area	Forest flow accounts for services, physical
Investment in the forest sector	
a. Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism	Forest flow accounts + Environmental expenditure and resource management accounts for forests
b. Level of expenditure on research and development, and education	Environmental expenditure and resource management accounts for forests
c. Extension and use of new and improved technologies	Memorandum items to the asset accounts (fixed capital in the forest sector)
d. Rates of return on investment	Calculated from forest flow accounts, monetary
Cultural, social and spiritual needs and values	
a. Area and percent of forest land managed in relation to the total area of forest land to protect the range of cultural, social and spiritual needs and values	NA
b. Non-consumptive use forest values	Forest flow accounts for services, physical
Employment and community needs	
a. Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment	Forest flow accounts, memorandum items
b. Average wage rates and injury rates in major employment categories within the forest sector	Wages: Forest flow accounts, memorandum items
c. Viability and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities	NA
d. Area and percent of forest land used for subsistence purposes	Forest flow accounts, memorandum items

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

B.2 SEEA and the Driving Force-State-Response indicators

Indicators for forestry that can be derived from the SEEA can be grouped for convenience within the Driving Force-State-Response Framework (DSR) adopted in 1995 by the UN Commission on Sustainable Development. In the DSR, *driving force indicators* represent human activities, processes and patterns that have an impact on sustainable development; they provide an indication of causes of changes both positive and negative in the state of sustainable development. Driving force indicators can pertain to various levels and issues such individual companies, sectors and demographic and social trends. *State indicators* can pertain to qualitative and quantitative dimensions of sustainable development including abundance of natural resources, level of education, average lifespan, etc. *Response indicators* provide an indication of the willingness and effectiveness of society in providing responses to sustainability issues. Conceptually, no unique attribution of sustainability indicators into one

of these three categories appears warranted as one and the same indicator could serve as a driving-force indicator as well as a state or response indicator.

The following list provides examples of indicators that can be derived from the SEEA; many additional indicators could also be obtained from the SEEA.

Table B.2 Examples of indicators provided by the SEEA for the DSR framework of indicators

1. Driving force indicators

Indicators provided by physical accounts for assets and material flows

Ratio of closing stock to opening stock to assess deforestation, nationally and by sub-national region where forest stocks and forestland are classified by the characteristics mentioned in section 2

Supply of forest goods and services, marketed and non-marketed

Use of forest goods and services by all sectors of the economy

Environmental degradation and pollution caused by timber harvesting and processing, and by other uses of forests.

Environmental degradation and pollution per unit of value added and per person employed by forestry-related sectors.

Indicators provided by monetary accounts for assets and material flows

National wealth and depletion

Total national wealth including manufactured and natural capital

Share of forest assets in total wealth

Trends in per capita national wealth over time

Cost of degradation of forest resources

Conventional and environmentally-adjusted gross and net value added and their components for the forestry sector (e.g. capital depreciation; wages and salaries; interest payments; profits) and ratios between

Value of forests under present and alternative management

Value of total flow of forest goods and services, marketed and non-marketed

Value of non-marketed goods and services as a share of total forest production

Ratio of the value of current mix of goods and services provided by forests to the potential value under alternative mix of forest uses

Amount of resource rent generated by forestry activities compared to resource rent generated by other natural resource sectors

Amount of rent recovered through stumpage and other fees compared to the costs of forest management, public and private

Note that for all these indicators, trend analyses are possible based on time series data over successive accounting periods.

2. State indicators

Indicators provided by physical and monetary asset accounts

Physical stocks and economic value of forest and land

Physical stock and economic value of carbon in forests

Indicators provided by physical and monetary flow accounts

Inputs of forest services to other sectors (tourism, agriculture, etc.)

Number of persons employed and person-years of employment in forestry and related sectors.

Number of households dependent on forests for formal sector employment and for subsistence

3. Response indicators**Indicators provided by flow accounts, resource management accounts and memorandum items**

Forest resource management costs incurred by government and private sector

Environmental protection expenditures incurred by government and private sector to remediate or prevent damage to forests

Ratio of management costs and environmental protection costs to income (value-added) generated by forests

Subsidies, taxes, or user fees for forest use including charges for environmental degradation

Ratio of user fees and taxes to public management costs to determine whether the industry is paying the full costs

Ratio of user fees and taxes to resource rent to determine if government is recovering rent

ANNEX C. Terms of Reference

Overview Paper on the Potential Use of the SEEA for Measuring Cross-sectoral Linkages⁵ in Forestry

1. Context

The influences of other sectoral policies on the development of the forestry sector have been recognized for many years. One of the basic principles of the Tropical Forests Action Programme in 1985, and later on, National Forest Programmes, was a holistic and intersectoral approach. In other words, forests need to be considered in the context of sustainable land management, environment and social stability. The Forest Principles agreed upon at UNCED in 1992, called for intersectoral means of dealing with pressures and demands imposed on forest ecosystems and resources from influencing policies and factors outside the forest sector. Discussions on the causes of deforestation and forest degradation in the context of the works of the Intergovernmental Forum on Forests (IFF) and currently the United Nations Forum on Forests (UNFF), have also referred to external influences.

Considering the increasing interest and awareness of the influences of external policies on the development of the forestry sector, at the global, national or local levels, and the lack of formal and systematic information on these policies or their impacts and the need for increased intersectoral coordination, FAO Forestry Department decided to include in its Medium Term Plan (2002-2007) the Major Output “Strengthened cross-sectoral linkages between forestry policies and other national policies”, with a view to:

- improving understanding among government institutions/staff and public of the relationships and impacts of different sectoral policies,
- improving formulation/implementation of forestry policies and plans,
- improving institutional linkages/partnerships among related sectors,
- developing mechanisms to evaluate externalities/internalities of sectoral policies.

Major expected outputs of this effort are:

- production of a preliminary background/conceptual paper in 2000-2001,
- preparation of country case studies in 2001-2002,
- organization in mid 2002 of an expert meeting to discuss main findings and conclusions of background/conceptual paper and country case studies,
- production of a FAO Forestry Paper on the subject in 2003.

The FAO Forestry Policy and Institutions Branch (FONP) has commissioned in 2000-01 the preparation of a background/conceptual paper on Cross-sectoral Linkages in

⁵ Cross-sectoral linkages are defined as impacts of external policies on forestry and vice-versa.

Forestry. An intermediate output is the production of a catalogue of examples of cross-sectoral policy impacts from within and outside FAO. In addition, it is proposed to prepare in 2001-2002, a limited number of country case studies. The purpose of these case studies will be to focus on specific regional or local ecological and socioeconomic context.

The present consultancy is concerned with the production of an overview paper on the potential use of the System of integrated Environmental and Economic Accounting (SEEA) for policy analysis in particular with reference to measuring the impacts of external policies on forestry⁶ and vice versa.

2. Mandate

Under the overall guidance of the Director of FAO Forestry Policy and Planning Division, the supervision of the Chief of FAO Forestry Policy and Institutions Branch and the direct supervision of the technical monitoring team, the national institution/consultant will:

- prepare an overview paper on the potential use of the SEEA for policy analysis in particular with reference to measuring impacts of cross-sectoral policies;
- provide country examples of applications of the SEEA for the measurement of policy impacts on forestry and vice versa (e.g. natural resources);
- discuss the advantages and disadvantages (limitations) of using the SEEA in policy analysis and for measuring policy impacts;
- submit a preliminary draft report with summary findings, conclusions and recommendations on future actions;
- prepare a final draft report on the basis of comments received.

The consultant is also requested:

- to submit a detailed outline of the report **at the beginning of the consultancy** (during the first month) for comments by the technical monitoring team;
- to submit from time to time draft chapters of the report as they are becoming available with a view to facilitating an on-going technical monitoring dialogue;
- to submit a final draft report and subsequently a final report.

3. Profile of Author

Economist or Policy analyst with more than ten years of experience in policy analysis and planning at national and sectoral levels, as well as in policy measures or instruments for effective conservation and management of forest benefits towards sustainable development.

⁶ This study is principally concerned with the impacts of public policies on sustainable forest management which may be defined in terms of 1. the conservation of biological diversity, 2. maintenance of ecosystem condition and productivity, 3. conservation of soil and water, 4. maintenance of global ecological cycles, 5. provision of multiple benefits, 6. responsibility to forest users and dwellers.