Economic and Environmental Accounting for Forestry: Status and Current Efforts

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August 1998
FOREWORD

In its 1997 report to the Commission on Sustainable Development, the Intergovernmental Panel on Forests indicates that sustainable forest management may be inhibited by an undervaluation of forest goods and services. This undervaluation occurs because many of the goods and service provided by forests are not traded in markets. Without markets to signal scarcity and channel investment, it is unclear that there is sufficient investment in forest conservation and management. In particular, a number of economists and conservationists have argued that the United Nations System of National Accounts (SNA) systematically understates the contribution of natural resources. More importantly, critics of the SNA suggest that because it only partially counts natural resource systems such as forests as capital, the system of accounts inherently favour economic activities that produce traded goods even if they deplete a country’s natural resources.

To examine this question and suggest remedies, the Policy and Planning Division of the FAO Forestry Department, under the responsibility of Yves C. Dubé, Forestry Officer (Planning), and in consultation with other FAO Technical Departments in particular the Economic and Social Department (Pratap Narain, Statistics Division), commissioned a paper by Jeffrey Vincent and John Hartwick in 1997, to review country experiences and identify a conceptual framework to better account for forest resources benefits. Four country case studies (Brazil, Chile, Philippines and Zimbabwe) were also commissioned, two of them having been sponsored by the World Bank through the Danish Trust Fund on Environmentally and Socially Sustainable Development. Two expert meetings (June 1997 and February 1998) recommended to use the input from Vincent/Hartwick’s report to adopt standards and procedures of the System of National Accounts (SNA) and its proposed extension, the Integrated System of Environmental and Economic Accounting (SEEA), as the generally accepted accounting framework by most countries. Based on this, FAO decided to prepare a report on the status and current efforts with regard to economic and environmental accounting for forestry. This was done through the FAO Academic and Research Institutions Partnership Programme (David Jackson, U. of Montana) and in close collaboration with UN Statistics Division (Alessandra Alfieri), Eurostat (Gérard Gie) and the World Bank Environmental Economics and Indicators Unit (John Dixon/Michael Linddal).

The report is intended to inform on challenges, opportunities and limitations of incorporating forest resources in SNA. It is hoped that it will be reviewed by a wide and diverse audience with a view to improving its contents and helping identify the next most important steps to maintain and increase forestry investment to achieve sustainable forest management.

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1 Introduction

1.1 Background

The United Nations System of National Accounts (SNA), which are utilized by most countries in compiling data for macroeconomic policy analysis, have undergone changes in recent years to more broadly include natural resource assets and environmental phenomena. Likewise, since the United Nations Conference on Environment and Development in 1992, there has been greater and greater emphasis in forestry on "sustainable forest management". Concomitantly there have been corresponding increases in both the appreciation of the broad array of forest benefits and more widespread recognition of inappropriate or wasteful forest uses. As these changes in the forest policy environment have occurred, there has been an increasing demand for new macroeconomic policy analysis data and methods as countries seek ways to reconcile conflicts and find balancing points between the ecological, socio-cultural and economic matters which envelop forestry in the late twentieth century. In order to more adequately address these issues, forest economists and national economic policy analysts will need revised conceptual models and new numerical foundations in forest sector analysis.

Conventional national income accounting procedures (UN, 1993) include aggregate measures of forest sector activities. However, the forest sector account focuses on forests in a very narrow sense of the word. Only forest assets that have commercial timber value are included in the forest sector. As a result, the important linkages between forest production and wood product conversion are not included in estimates of valued added. Furthermore, many important forest sector activities are noncommercial in the sense that they lack market exchange values. While there are forests that should be classified as “non-commercial”, these assets are still likely to be important environmental assets which provide many valued services such as fish and wildlife habitat protection, recreational use opportunities, watershed protection services, and climate modification functions that may result from carbon take-up and storage. Finally, some important forest products and services are typically reported in other economic sectors. For example, the value of wild berries, forest grazing, and game may be reported in the agriculture sector.

The result of the broad approach to forest sector reporting is that policy analysts and policymakers who rely on national income accounts are not easily able to get a comprehensive and detailed picture of the contributions of forests, both positive and negative, to societal well-being. As was just suggested, this is due primarily to the very nature and role of forests in any economy and the necessary lack of detail in SNA. Forest values are many. Several important values are not typically traded in the marketplace. And many values are reported in other economic sectors. But, in recent years, as the level of timber harvesting has escalated in many areas of the world to the point that sustainable long-term economic development is threatened, it has become clear that national income accounts could do a better job of helping to analyze sustainable development. Because stock estimates of forest land, timber and other valuable forest assets have not traditionally been included in the list of a nation’s assets, depletion of forest assets can be severely understated. Furthermore, verification or investigation of sustainable development from the standpoint of long-term wealth

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1 The impetus for national income accounting accelerated in the 1950s following closely on the heals of the Great Depression and World War II. The most recent changes were instituted in 1993. See UN, 1993a and 1993b for more detailed description.
2 See for example, Mr. David Harcharik’s address to the Eleventh World Forestry Congress (Harcharik, 1997) where he indicates that the future of world forestry is "sustainable forest management". Sustainable Forest management is seen as a synthesis of ecological, socio-cultural and economic matters into decision-making.
accumulation is beyond the scope of macroeconomic analysis if the nation’s natural wealth endowment is not included in national income accounts. Likewise, important environmental indicators such as the rate of deforestation or forest degradation are not reported so that these phenomena are easily overlooked.

In recent years, there have been substantial changes in the System of National Accounts (SNA) which allow more detailed analysis and improved reporting of natural resource assets and environmental accounting (1993a, 1993b). These changes also provide for the introduction of satellite accounts or Systems of Environmental and Economic Accounts (SEEA). The existence of an SEEA for the forestry sector in an economy will allow even more precise macroeconomic analysis.

1.2 Objectives

This report presents and discusses the evolution and current status of forest sector satellite accounts in economic and environmental accounting. These accounts are presented in terms of their relationship to SNA. With a better knowledge of expanded forest sector national income accounting capabilities, attention is given to their potential uses in forest sector policy analysis. The report has two intended audiences. First, we address policy analysts and policy makers with expertise in the forestry sector of an economy. Second, we address national income accountants and applied economists who may work at adopting or using satellite accounts. The objective of the introductory chapter is to establish the contemporary context for utilizing satellite accounts for the forest sector. What problems can they be expected to solve? The second chapter reviews forest accounting in the 1993 SNA as a basis for introducing the satellite accounting information presented in Chapter 3. Chapter 4 reviews a broad set of case studies, forest sector accounting trials and policy studies that utilize forest sector account information. Here are examined patterns of use, approaches to valuation, potential problems and limitations in the use of this important policy information system. Finally, action steps to improve the status and use of this evolving information system are discussed.

1.3 Challenges and Issues in the Forest Policy Dialogue

There are a number of challenges to national income accounting which emanate from the environmental dialogue surrounding contemporary forest management issues. It is important to enumerate these issues before looking at specific ways to adapt and utilize the SNA in meeting these analytical challenges. A list of major forest policy challenges would certainly include the following.

1.3.1 An Expanded Accounting of Forestry Benefits

The problem of forestry is well summarized by Vincent and Hardwick (1997). Forestry is an example of an activity whose contribution to the economy in a welfare sense is unlikely to be measured well by value added in the production account. Forests contribute directly to welfare through the provision of amenity values, which may not satisfy the SNAs’ definition of

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3 The World Bank has been undertaken important work in recent years to both expand the definition of a nations wealth and to undertake new analytical approaches in evaluating sustainable development. See for example: Serageldin (1993) and World Bank (1997).

4 The changes in SNAs and introduction of SEEA has been referred to by Hamilton and Lutz (1996) as the “greening” of macroeconomic analysis. It is not clear that this kind of labeling will increase or decrease the wood production from forests since the green benefits may work in contradictory directions.
‘production’ They also provide other industries with services such as watershed protection, whose value the SNA records as part of the operating surplus of the recipient industries instead of as services furnished by forests. For these reasons, the SNA likely understates the economic contribution of forests.

In summary, an overarching challenge is to use macroeconomic policy analysis models that reflect the genuine contribution of the forest sector to national well being.

1.3.2 Assessing the Sustainability of Forest Management

The importance of sustainability was recognized at the Eleventh World Forestry Congress in a call for the development of forest survey capacities in the poorer countries (Lanly, 1997). Without proper survey data and associated environmental monitoring programs, much of the level of harvesting may be unsustainable either from the view of sustainable timber yields or from a more conservation-based perspective of sustainable forest ecosystem management. Because forests may be managed sustainably, it should be possible to examine rates of accumulation and depletion as a direct indication of sustainability. This would mean that current rates of net accumulation (depletion) would be reported relative to long term rates of sustainable use. Of course, this implies that any wealth accruals associated with high and unsustainable levels of harvesting are potentially short-term in nature with the heightened likelihood that a nation could fall back into a low-income development situation as its forests become depleted. The usual view of the SNA is that it is not particularly well-suited to identifying problems of resource depletion and sustainability and thus, the second challenge is to adapt national income accounting procedures which will readily allow analysts to identify these kinds of problems.

1.3.3 Evaluating Deforestation and Changes in Land Use

Another important issue is how to include deforestation and associated land use changes in forest sector national income accounts. Irrespective of whether the land is a commercial asset or not, there are typically many important environmental aspects associated with deforestation. Associated with deforestation is the issue of identifying land use changes and sustainability indicators. Therefore, another challenge to national income accounting principles is to identify and keep track of timber harvesting and potentially related problems of deforestation, desertification and land use changes as they occur. The purpose is to identify these problems in their infancy rather than to delay identification until a time when forest land and timber liquidation is essentially irreversible. This kind of national income statistics can lead to policy decisions which are more stable both from the standpoint of ecosystem phenomenon and wood using industries.

1.3.4 Evaluating Forest Degradation

The quality of forests throughout the world appears to be subject to an increasing number of environmental stresses. These stresses may result from inappropriate management or from activities that originate outside forests. Another important challenge is to develop indicators of forest degradation that can be included in national accounts. The purpose of these

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5 The approach to wealth and sustainable development taken by the world bank is as follows. A nation’s wealth is the sum of its produced physical capital stock, its natural capital, its human capital and its social capital. Sustainable development is the accumulation of all capital. It is possible to accumulate total capital while depleting capital in one of the components. See Dixon and Hamilton (1996) and World Bank (1997).
indicators is to better report changes in forest quality due to exogenous and endogenous stresses.

1.3.5 Accounting for Non Market Forest Amenity Values

Numerous approaches have been developed and used to estimate nonmarket values. The development and application of these concepts is extremely important because forest ecosystems comprise a broad array of nonmarket and market phenomena. The challenge is to utilize nonmarket values in the forest sector, which are estimated in the macroeconomic or general equilibrium context of analysis. The values must be consistent and comparable with market values in the larger system of accounts so that the forest sector is truly integrated into the larger economic system. Often nonmarket values are estimates of consumer’s surplus for nonmarket goods and services. It must be kept in mind that prices for market goods are treated as parameters in the policy analysis. If this were not the case, consumer’s surplus would also be included in the value of market goods and services as well. Thus, one important issue to resolve is how to estimate values.

1.3.6 Adjusting National Income for Household Consumption of Nonmarket Forest Products

In many economies, there are significant levels of household consumption of non-timber forest products. One of the most important and best known examples is the gathering of fuelwood. In some economies fuelwood is the most important source of domestic energy and excessive levels of fuelwood collection and use may not be sustainable. The fact that fuelwood production and consumption activities are not market transactions means that the value of these activities are not recorded in national income accounts and actual levels of fuelwood production are often unknown. Again, since household consumption of products such as fuelwood is not known, policy makers can not easily evaluate the importance of these kinds of activities. Fuelwood is but one of these kinds of forest products that are important to households and which are not recorded in the transactions of an economy. In spite of the nature of these forest uses, it is important that they be recognized as a component of social wealth so that appropriate decisions may be made about the production and allocation. Thus the challenge is how to estimate the value and sustainability of forest products which are consumed directly by households.

1.4 Policy Uses of Forest Sector National Income Accounts

Of course it is truly impossible to imagine the total number of different kinds of policy analyses made possible by an integrated set of Forest Sector SNAs and SEEAs. The following list represents a starting point and resulted from both brainstorming and from examining a list developed by Hamilton and Lutz (1996). In summary form, we suggest the following possible uses.

1.4.1 Improved Monitoring of the Forestry Sector Performance

Because savings and investments play a very important role in developing countries, approaches to gauging the economic performance of an economy that ignore the depletion or accumulation of natural capital can yield very erroneous insights into the functioning of the economy. Developing national accounts for natural resource assets inclusive of their quality, quantity, rates of use and net investment can be a most important step in examining
sustainable development where sustainable development is simply defined as the continued accumulation of all forms of wealth.

1.4.2 Accounting for Total Forest Production in National Economic Aggregates.

Given the discussion of the production relationships between the forest sector and other related sectors (agroforestry, hydropower, fisheries, and manufacturing), developing appropriate production relationships between the forest sector and the related sectors will help create far better insights into how the management of forests contributes to total economic well-being. Examining budgets for forest activities or examining the effects of macroeconomic or trade policies on the forest and related sectors are two extremely important ways that the green SEEA can be effectively utilized.

1.4.3 Accounting for Management Costs and Habitat Protection Costs.

Establishing habitat protection zones or bioreserves is an important element of sustainable development. In some important respects these kinds of decisions represent decisions to reallocate wealth between important sectors of the economy. In other words, because capital can be somewhat fluid, these decisions imply the substitution of one form of wealth for another with aggregate income and distribution effects. Examining these kinds of decisions is an important potential use of forest sector specific SEEA.

1.4.4 Monitoring the Relationship between Forest Sector Activities and Pollutant Flows.

By establishing the appropriate links between forest sector activities in input/output tables with other sectors, physical waste flows may be traced as pollution flows to other industries and activities. Beyond this, pollution reduction policies such as emissions regulations and pollution taxes can be evaluated and monitored.

1.4.5 Assessing the Effectiveness of Government Policies such as Taxes and Subsidies on the Forest Sector.

Many new policies, which are designed to maintain or improve environmental quality, will be considered in the future. The development of a forest sector SEEA should allow better capacities to evaluate the effectiveness of these kinds of policies.

1.4.6 Monitoring the effectiveness of broad macroeconomic policies of such as trade policies on the forestry sector.

Many broad economic policy instruments have differential effects on particular sectors of an economy. Development of a forest sector satellite account (SEEA) should allow more precise analysis of these kinds of policy instruments on the sustainable development.

1.4.7 Monitoring the Implementation of International Treaties.

Many international environmental issues will be solved through international treaties which could influence forest land use, or timber harvesting by the establishment of such agenda
items as carbon sink requirements, special habitat areas or related approaches. A forest specific SEEA would help in monitoring these treaties.

1.4.8 Land Uses.

Because of the concern with deforestation, desertification and land depletion, a critical policy issue well suited to a forest sector specific SEEA is the examination of genuine savings and depletion in the nations land account. While, land of course is fixed in it physical proportions, the productivity of land can be enhanced or degraded by human activities. Furthermore, some forest practices may ultimately lead essentially to the abandonment of potentially valuable forest land assets. By developing different land use accounts, a nation can keep track of the sustainability of its forests by keeping track of its land uses. In addition, the nation will also help track long term biodiversity implications.

1.4.9 Biodiversity Trends.

There are a number of ways to examine asset depletion in a nation's wealth of flora and fauna. Broad trends in depletion are indicated by rates of change in the number of extinct species. Perhaps more importantly from the standpoint of the forestry sector is need to identify spatially important areas of exceptional species richness and then monitor maintenance of this richness.

1.5 Forests and Broad Economic Values

Forests are multiple-value resources. It is important to examine forest values in a broad way so that national income accounts and related satellite accounts may be more clearly understood. In order to make certain that the multiple resources of forests are valued consistently and comparably some of the broad values may be excluded from satellite accounts. That means that some analyses may be conducted with incomplete information.

Several authors have proposed a scheme for valuing total forest benefits. Kengen (1997), Gregersen, et al. (1995, 1997), and Kumari (1995) all draw from the work done by Pearce (1993, 1990). Total economic value consists of the sum of five kinds of values: direct use value, indirect use values, option values, existence values or quasi-option values. Because forest management has consistently and traditionally examined the direct use values, other values are often ignored.

Direct uses of the forest are ones in which there are specific consumers of forest goods and services. These consumers may or may not pay market-clearing prices for the rights to use these forest goods and services. These users could be recreation users, timber

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6 We quote a footnote from UN (Undated). “Contingent valuation, for instance, faces free rider attitudes, short-sightedness or ignorance of consumers about long-term environmental impacts, and effects of income levels and distribution when questioning individuals (in opinion surveys) about their preferences for environmental quality and related social values. Also, contingent valuation is inconsistent with the predominant national accounts application of market prices, since it includes consumers surplus [emphasis ours] which is appropriate for welfare measurement but incorrect in recording national accounts transactions.” Of course many of the same information problems apply when a person buys a gallon of gasoline. We agree about problems of consumers surplus for the value of “fixed sites”. There are methods for evaluating the change in consumers surplus reported in Bowes and Krutilla (1989). There is of course consumers surplus issues when one examines outputs at the economy level where output changes correspond with price changes with market goods and services.

purchasers, water users who either benefit or suffer from forest management activities, or economic agents who graze domestic stock on forest land.

*Indirect uses* of the forest essentially occur because of the broad nonspecific environmental services provided by forests. For example, carbon uptake and storage helps reduce the deleterious impacts of global climate change brought on by massive fossil fuel consumption in the industrialized economies. At the current time, these services are nonspecific to any particular people or nation. Other important environmental services provided by forests include broad maintenance and stabilization of the earth’s water and nutrient cycles as well as providing areas which collect, filter, and otherwise store toxic pollutants.

*Option values* have been increasingly recognized as being important to protecting forest dependent life forms. Even if there is no known direct or indirect use value of various life forms, people recognize that some unknown use value may arise so that a value for potential uses may be important. Option values are more common than many people may first recognize. For example, citizens may be willing to pay a tax to keep bus service to their neighborhood in spite of typically using an automobile for primary transportation. Paying to keep bus service protects option to use buses that aren’t expressed in the usual transactions based demand analysis.

*Bequest values* are related to option values but add an element of intergenerational concern. Recognizing that actions of one generation may close options for future generations, a bequest value represents the willingness to pay to provide and maintain options for future generations that aren’t able to express their values in current markets or political arenas.

*Existence values* are the values people place on forests regardless of use. These values may be placed simply on forest landscapes or on forest-dependent species. For example, people may be willing to 1) support political agenda to maintain forests, and/or; 2) join groups to support those kinds of agenda, and/or 3) pay to protect forests or forest dependent species. In any case the three examples represent forms of resource allocation to secure the existence of something of value.

**Table 1** Classification of Forest Uses by Type of Total Economic Value

<table>
<thead>
<tr>
<th>Use Value</th>
<th>Non-use Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Value +</td>
<td>Indirect Value +</td>
</tr>
<tr>
<td>1. Timber Products</td>
<td>8. Climate modification</td>
</tr>
<tr>
<td>3. Recreational Uses</td>
<td>10. Watershed Protection</td>
</tr>
<tr>
<td>4. Human Habitat</td>
<td></td>
</tr>
<tr>
<td>5. Water Products</td>
<td></td>
</tr>
<tr>
<td>6. Grazing Uses</td>
<td></td>
</tr>
<tr>
<td>7. Research/Education</td>
<td></td>
</tr>
</tbody>
</table>

The components of total economic value are used to classify major classes of forest goods and services in Table 1 above. Unlike Gregersen et al. (1995, 1997), Pearce (1990) or Kumari (1995), we have made some double entries in the table to more adequately indicate some of the complexities in accounting for forest sector benefits. For example, water products are entered as direct benefits while watershed protection is seen as an indirect benefit. While this may at first be confusing, it is possible to influence the level, timing and

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8 This was essentially taken from Pearce (1990 and was reported and utilized in Kumari (1995). Unlike those sources, water products and grazing were added as a direct uses. Biodiversity was added as an indirect uses since some of the strongest arguments for maintaining biodiversity are to maintain system stability and that can be seen as a form of indirect use.
quality of water products in a basin (direct benefits), while at the same time contributing in some less known way to the likelihood and damage levels of floods (Flood prevention is an indirect service). Likewise biodiversity is a double-entry forest good and service. Maintaining biodiversity to maintain a stable ecosystem can be seen as an indirect benefit of forest management. The fact that people may be willing to pay simply to know that wild forests exist is an existence value of forests.

There have been many studies designed to develop both the theory and practice of valuation for the kinds of forest values listed in Table 1. We will briefly allude to some of the problems and complexities of value estimation. Some of the direct use values have actual cash prices. Of these, a subset might be considered as competitive prices. Prices for much of the timber logged around the world is paid for under negotiated rates rather than through the competitive play of market forces. Furthermore, where common access exists for timber or other scarce forest resources, there is by definition, no price. In the case of unpriced resources, two kinds of outcomes pertinent to environmental accounting in the forestry sector can occur. In one case, the unpriced resource is combined with other factors of production and then sold. In the other case, the resource is not sold at all. Both of these problems in valuation have severe microeconomic implications, as well, because in neither instance is the forest management organization compensated for the value of its products and as a result the incentive structure for efficient management is deficient.

The remaining values in Table 1 are nonmarket in nature. Kengen (1997) summarizes many of the valuation techniques for the various kinds of market and nonmarket forest benefits. From a practical point of view, it is doubtful that all of the total forest values will be entered into forestry sector satellite accounts. There are a variety of reasons for this. Option values, bequest values and existence values pertain to virtually all of the goods and services produced in an economy and are not included in transaction values which are the standard fare values making up revenue flows in the economy. Thus for reasons of comparability, it would make little or no sense to add these three kinds of values to forestry sector activities while not adding them to the values in other sectors of the economy. It would make even less sense to add these values to only certain elements of the forestry sector while leaving them out of other sectors. For example, wood quality of some forms of old growth timber is essentially irreplaceable. High quality stringed musical instruments are made from slow growing high elevation old-growth Englemann Spruce trees. One would expect that there are option values, bequest values and existence values that are not reflected in the stumpage prices for old-growth spruce timber. In summary, it is important that values for the various forest benefits examined in forest sector satellite accounts are comparable. In making a decision for comparability, some values will be excluded. This means that the analyst should carefully examine analytical results to be assured that left-out values won’t “upset” the results of the policy analysis.


10 The United Nations Statistics Division recognizes both of these problems (UN, undated). They refer to correcting these problems as “adjusting the national accounts”, and see the development of satellite accounts as helping enormously in this regard.

11 Stumpage values reflect cutting rights with a limited contract duration. Rights to buy and hold timber are not sold as “stumpage”. Typically if one wanted to hold quality “old growth” timber, one would have to buy site rental services as well as timber cutting rights. Futures markets for standing timber are unheard of. There have been limited futures markets for lumber and plywood in the United States. The future price trade dates do not extend for more than a year.
1.6 Linkages to Other Economic Sectors

The system for classifying forest values in Table 1 is also useful for broadly examining economic activities and the interaction within subsectors of forest accounts and between broader economic sectors. When people consume final economic goods and services, their actions represent a final step in many connected activities that take place in making the good available for consumption. Production activities often span many sectors of an economy and the activities that take place between sectors are called *linkages*. Linkages are very important in several ways. If linkages are not well defined for the forest sector, then the impacts of changes in outputs of forest sector activities on regional or national aggregates will not be properly quantified and the development role of the sector will likely be understated.

Table 2: Typical Forward and Backward Forest Sector Linkages

<table>
<thead>
<tr>
<th>Use Activity</th>
<th>Forward Linkages</th>
<th>Backward Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber products</td>
<td>Wood Processing Activities*</td>
<td>Equipment, Transport*</td>
</tr>
<tr>
<td>Nontimber Products</td>
<td>Food Processing, Furniture*</td>
<td>Equipment, Transport#&amp;</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>Pharmaceutical, Agrichemical##</td>
</tr>
<tr>
<td>Recreational Uses</td>
<td>N/A</td>
<td>Equipment, Travel,#</td>
</tr>
<tr>
<td>Human Habitat</td>
<td>Food, Transport#</td>
<td>Construction Activities#&amp;</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>Forage, Fencing, Veterinary&amp;</td>
</tr>
<tr>
<td>Livestock Uses</td>
<td>Catchment Improvements&amp;</td>
<td>Industrial, Household, Agric.,</td>
</tr>
<tr>
<td>Water Products</td>
<td>Hydro, Recreational&amp;</td>
<td></td>
</tr>
</tbody>
</table>

* Denotes acknowledged ISIC codes for these accounts
# Denotes major problems in unreported activities
& Denotes major problems in misreported activities

*Forward linkages* represent forest sector goods and services that either become factors of production for other intermediate and/or final goods and services. *Backward linkages* represent purchases of goods and services that are utilized in the production of the forest goods in question. These linkages are viewed as flows between sectors of an economy.

Table 4 summarizes some key expected linkages in forest sector activities. The term expected is an important one because many of the linkages are not often easily discerned. Based on experience in Finland, Simula (1997) recommends that a cluster analysis be done to more carefully quantify linkages.

The entries for Table 4 are limited to the direct uses in Table 1 because the direct use linkages are better understood than the indirect ones. It may be possible to model residual flows in an economy. If that is the case, then such factors as pollution flows between economic sectors may also be included in the table as well. This leaves the door open to including indirect use values. Options values, bequest values and existence values and their respective “activity levels” present more serious analytical difficulties. SNA is a report for a reference period such as a year. If there is in fact no option, bequest or existence activity for an environmental resource in the reference period, and no money has been exchanged it appears impossible to make a national income account entry for these values. Furthermore, there could in principle be option, bequest, or existence values for market as well as non-market goods. Since these values are typically excluded from exchange values in market goods, it would be prudent to totally exclude them to make values comparable.

While some important valuation concepts may be left out of income accounts for reasons of comparability, it is also important to recognize that the measures of many important forest ecosystem components is also often highly imprecise. For instance, there are no doubt, 12 Final goods and service such as recreational uses of land or land for residential uses has no forward linkages.
important and as yet undiscovered biochemical compounds linked with the indefinable and indescribable gene pools of the world’s forests. In lieu of actual inventories of all life forms, Canada (1997) has developed a complex and detailed set of Criteria and Indicators (C & I). The process of developing C&I was launched by the Canadian Council of Forest Ministers, an extremely important step since the provinces control the vast majority of the commercially important forest lands in Canada.\(^{13}\)

Before leaving the discussion of linkages, it is important to mention one other problem associated with forest sector accounting. One of the most common uses of forest sector income accounts is to study and evaluate the impacts of policies on employment. Traditionally, the employment activity analysis has focused on both forest activities (forestry, logging and related service activities) and wood processing sectors (pulp and paper, lumber, panel products, and roundwood products). Poschen (1997) reports that on a global basis, total forest employment far exceeds recorded employment. The traditional definition of employment as participation in the paid labour market is not really adequate for capturing the reality of most persons for whom forests are the main source of livelihood. For the majority of these persons, the distinction between wage employment, self-employment and work for subsistence production is not meaningful. There are different ways of making a living that are often interchangeable. The same person may harvest wood for fuel for home consumption, make simple wood furniture for sale as a self-employed and work as a daily wage labourer planting trees.... While the problem of invisible forest sector employment is now being documented, just what to do about it in the sense of employment analyses, is far less clear at this time.

1.7 Sustainability and Satellite Accounts

The term, sustainability has at least three relevant and important meanings in the context of forestry. Traditionally, the term meant perpetuation of timber supplies. In recent years, the focus has turned to sustainable forestry, sustainable ecosystem management and sustainable development. These changes in what is to be sustained reveal a broader forest management focus toward many uses and values as opposed to dominant timber production. The changes reflect growing concerns with avoiding environmental and social irreversibilities. While these different approaches to what is to be sustained may seem to be in conflict with each other, we shall see that forest sector satellite accounts, if constructed wisely, may be helpful to proponents of any of the various sustainability schools of thought.

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\(^{13}\) The Council consisted of a forest minister from each of the nine provinces, a minister from each of the two territories along with the Minister of Natural Resources Canada. Canada is important in another respect since the country ranks third among countries in terms of the total forest land base.
2  Forest Resources in National Accounting

2.1  Introduction

A proper system of economic accounts for forestry should provide policy-makers with information that gives a more complete picture of the net benefits derived from forests than is the case at present. Such information should include wood as well as non-wood products; goods as well as services or functions; and benefits from marketed as well as non-marketed goods and services. While developing the system it may be kept in mind that a clear boundary line between forestry practices and agricultural or horticultural practices, although essential for developing an accounting framework, remains very difficult in actual practice. A lot more depends on data collection systems in specific countries. However, while developing the system, a clear mission should be that the total value of forests includes agro and social forestry values, which should be adequately credited to the forest sector. This will produce a far more comprehensive perspective for taking account of varying practices followed in different countries.

The starting point for a forest sector SEEA is the treatment of forest activities in SNA. Without a firm understanding of how forests are treated in the broader accounting aggregates of SNA, it is truly impossible to develop a reliable forest sector SEEA. This understanding is founded in the physical and monetized stocks and flows for forest activities in SNA.

The purpose of this chapter is to outline what information is already included in the conventional SNA and how it may be interpreted in terms of policy making. Furthermore, it is important to review the information on SNA to better understand how to integrate economic and environmental accounts into SNA. Discussion of the integration of satellite accounts is postponed until the next chapter.

2.2  SNA and Forestry Sector Accounts

The SNA includes both flows of goods and services and stocks of assets used in the production of goods and services. The objective of the national accounts is not only to measure the flows of goods and goods and services resulting from capital investment and consumption (GDP and NDP) but also the accumulation/depletion of capital stock including natural capital. By utilizing ISIC (industry codes) and CPC (product codes) the rows and columns of Table 3 can be used to identify the different products produced by various industries and the uses of these products in final consumption. The asset accounts for economic produced and non-produced assets (see box 1 for SNA classifications of assets) are also compiled by industry (ISIC) and describe the stocks at the beginning and end of the accounting period and all changes therein.
### Table 3  SNA/SEEA: Flow and Stock Accounts with Environmental Assets

<table>
<thead>
<tr>
<th>OPENING STOCKS</th>
<th>Economic assets</th>
<th>Environmental assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Households/ Government</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest of the World</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUPPLY OF</th>
<th>Economic assets</th>
<th>Environmental assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Production</td>
<td>Import thereof for environmental protection</td>
<td></td>
</tr>
<tr>
<td>thereof for environmental protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic cost</td>
<td>Final consumption</td>
<td>Capital thereof for environmental protection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF NATURAL ASSETS</th>
<th>Economic assets</th>
<th>Environmental assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental cost of industries</td>
<td>Depletion and degradation</td>
<td></td>
</tr>
<tr>
<td>Environmental cost of households</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>Economic assets</td>
<td>Environmental assets</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTHER CHANGES IN ASSET VALUE</th>
<th>Economic assets</th>
<th>Environmental assets</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CLOSING STOCKS</th>
<th>Economic assets</th>
<th>Environmental assets</th>
</tr>
</thead>
</table>


### Box 1 Classification of Assets in the SNA

**Economic assets** are assets owned by institutional units from which economic benefits are derived by their owner(s) by holding them, using them over a period of time or selling them. Economic benefits recognized by SNA are incomes derived from production; holding gains; and receipts from the sale of assets.

Economic assets may be produced or non-produced. **Produced assets** are those assets that come into existence as a result of a production process. **Non-produced assets** consist of assets that are needed for production but have not been produced. No input has been used in their creation.

Economic assets can also be classified as fixed assets, valuables and inventories. **Fixed assets** are only those produced assets that are used repeatedly, or continuously, in processes of production for more than one year. **Inventories** consist of output produced by an enterprise, but not yet finished (work-in-progress) and stocks of product intended to be used for intermediate consumption or resale without further processing.

It is possible to use the supply and use table to identify forest sector components of value. In other words, it is possible to identify sector output, intermediate consumption, compensation of employees, taxes and subsidies. The forest sector includes timber, logging, growing of standing timber in plantations (produced assets) forestry and logging services activities, gathering of wild growing forest materials, such as cork, resins, lichens, etc. Note that gathering of mushrooms, berries and fuelwood, for sale and own-consumption is considered as output of the agriculture industry, not the timber industry. In chapter 3, we will discuss

14 Timber growth in natural (uncultivated) forests is not treated as a process of production and therefore is excluded. It is instead as treated as other changes in assets.
disaggregation of activities related to forests but included in other industries (i.e. agriculture, mining, etc.).

The asset accounts for produced assets include the stock of man-made capital at the beginning and end of the reference period and all changes therein. The stock of produced capital for the forestry industry consists of machinery used for planting, thinning and transporting logs and the value of the stock of timber in plantations. Changes in stocks include capital formation, consumption of fixed capital and other changes in volume of assets and revaluation. Capital formation includes the investments made by the forestry industry in machinery as well as all costs of reforestation and afforestation of produced and a non-produced forests and natural growth of forest. Other changes in volume include reductions and additions to the volume of the stock caused by economic decisions (i.e. changes in classification of timber from non-produced to produced asset), or natural causes (i.e. forest fires, diseases, etc.) or other causes. Reevaluation includes changes in prices of the assets. For timber stocks the change is usually calculated as a balancing item and therefore might include statistical discrepancies as well.

Non-produced assets include land and natural “economic” forests or forests that are likely to be exploited. However, it is difficult to identify forest land in the SNA, as no explicit reference is made to land cover in the land classification. With regard to non-cultivated forests, the asset accounts include the value of the stock of forest at the beginning and end of the accounting period and all changes therein. The major difference between the asset accounts for cultivated and non-cultivated forests is revealed by the different ways that natural growth is reported. In the case of cultivated forests, natural growth is considered a process of production and it is, therefore treated as output, in the production accounts, and capital formation, in the capital account of the forestry industry. For non-cultivated forests, natural growth is considered as a result of a natural process and therefore recorded in the other changes in volume accounts, outside the production accounts. In practice, it might be difficult to distinguish cultivated from non-cultivated forests, because there is typically degrees of human intervention in either instance. The question is how much input is needed to classify the forest as produced or non-produced?

2.3 Forest Production in SNA

According to SNA, “certain natural processes may or may not be counted as production depending upon the circumstances in which they occur. A necessary condition for an activity to be treated as productive is that it must be carried out under the instigation, control and responsibility of some institutional unit that exercises ownership rights over whatever is produced.” Thus, it should be noted that the growth of crops, trees, or livestock that is organized, managed and controlled by institutional units constitutes a process of production in an economic sense. Growth is not to be construed as a purely natural process, which lies outside the production boundary. However, an accounting decision must be made concerning those forests, which are not under economic use in order to clarify what portion of total forest growth is “produced”.

The measurement of forest output is complicated by the fact that the process of production may extend over many years. Thus standing timber has to be treated as work-in-progress -- that is, as output which is not yet sufficiently processed to be in a form which is ready to be

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\[\text{15} \] It has been argued that tree planting is not sufficient to create a forest classified as “produced” if there are no other tending activities.

\[\text{16} \] In cultivated (economic) forests, natural growth is considered as work-in-progress. It is included in inventories as a part of capital accumulation.
marketed. When trees are felled, the process of production is completed and the work-in-progress is transformed into inventories of finished products ready for sale or other use. Conceptually, therefore, timber production can be measured in exactly the same way as other types of production that require long production periods. Output should be recorded as being produced continuously over the entire period of production and not simply at the moment of time when the process is completed.

In actual forest activities, output of natural and plantation forests may include all the related commodities and amenities such as food, fuel, fodder, shelter, fibre, medicines and recreation. These products and activities may be monetized but are also reported in physical terms such as the number of hectares of forests or volume of standing timber. Also included in the idea of forest activities are royalties collected, taxes, the expenditure incurred on maintenance and research, and changes in aggregates such as the rates of deforestation. This broad idea of forests and forest activities is far more inclusive than the traditional SNA forest production account. Thus standard production accounts may not meet the need of policy-makers. The SEFA (system of economic accounting for agriculture), therefore, recommends accounts for the forestry sector as a whole as well as activity accounts for different forests classified according to their management aspects. The goods and services account is compiled only for the products of forestry as a whole and, the capital account in the system is intended to cover the forestry sector as a whole.

2.3.1 Asset Boundaries, Produced and Non-produced Forest Assets

The SNA distinguishes between produced (human-made) and non-produced (natural) assets. Based on SNA terminology, all produced assets are “economic” and are included in the economic accounting system. A qualification is made regarding non-produced assets which is made clear from the quotation below.

Effective ownership is the requirement for a natural resource to be included as an economic asset and not the fact that economic benefits might be derived from the asset. For example, open access high seas fisheries are an economic asset if there is the potential for a nation to claim and enforce exclusive access rights. This point is further highlighted in SNA 1.26 in reference to defining the asset boundary:

“Balance sheets are compiled for institutional units, or sectors, and record the values of the assets they own or the liabilities they have incurred. Assets as defined in the System are entities that must be owned by some unit, or units, and from which economic benefits are derived by their owner(s) by holding or using them over a period of time. Financial assets and fixed assets, such as machinery, equipment and structures which have themselves been produced as outputs in the past, are clearly covered by this definition. However, the ownership criterion is important for determining which naturally occurring--i.e. Non-produced assets are included in the System. Naturally occurring assets such as land, mineral deposits, fuel reserves, uncultivated forests or other vegetation and wild animals are included in the balance sheets provided that institutional units are exercising effective ownership rights over them--that is, are actually in a position to be able to benefit from them. Assets need not be privately owned and could be owned by government units exercising ownership rights on behalf of entire communities. Thus, many environmental assets are included within the System. Assets that are not included are those such as the atmosphere or open seas, over which no ownership rights can be exercised, or mineral or fuel deposits that have not been discovered or that are unworkable--i.e. incapable of bringing any benefits to their owners, given the technology and relative prices existing at the time.”
2.3.2 Other Changes in the Volume of Assets Account

2.3.2.1 Economic appearance of non-produced assets (transfers of other natural assets to economic activity)

Economic assets are entities over which ownership rights are enforced by institutional units and from which economic benefits may be derived by their owners. Naturally occurring resources that qualify as economic assets are those that are under the direct control, responsibility and management of institutional units. Economic appearance occurs when an asset becomes classified as economic.

For other natural assets, the first substantial market appearance, generally involving commercial exploitation, is the reference point for recording in this account. For virgin forests, gathering firewood is not commercial exploitation, but large-scale harvesting of a virgin forest for timber is, and brings the forest into the asset boundary.

2.3.2.2 Natural growth of non-cultivated biological resources

The natural growth of non-cultivated biological resources -- natural forests, fishstocks, etc. -- may take various forms. A stand of natural timber may grow, or fish in the estuaries may become more numerous. Although these resources are economic assets, growth of this kind is not under the direct control, responsibility and management of an institutional unit and thus is not production. The increment in the asset must then be regarded as an economic appearance, and it is recorded in the other changes in the volume of assets account.

In principle, natural growth should be recorded gross, and the depletion of these resources should be recorded as an economic disappearance. This recording would be consistent with the separate recording of acquisitions and disposals described in the capital account. In practice, however, many countries will record natural growth net because the physical measures that are likely to be the only basis available for the recording are, in effect, net measures. These measures may be used in conjunction with a market price for a unit of the asset to estimate the value of the volume change to be recorded.

2.3.2.3 Other changes in the volume of assets account (Economic disappearance of non-produced assets /Depletion of natural economic assets)

The depletion of natural deposits covers the reduction in the value of deposits of subsoil assets as a result of the physical removal and using up of the assets. In principle, the depletion of natural forests and other non-cultivated biological resources included in the asset boundary as a result of harvesting, forest clearance, or other use should be included here.

2.4 Extension from SNA to SEEA

Many methods have been put forward for including environmental accounting in the framework of national accounts. Such methods have different levels of consistency with the SNA. The SEEA supplements the SNA in the following ways.

a) The SEEA separately identifies, in the supply-use table, activities related to the forests that not recorded in the SNA forestry industry and the associated expenditures related to
forest protection and management. The SEEA, as a result, describes a far more realistic array of forest sector net benefits.

b) The SEEA expands the asset accounts beyond “economic” (in the SNA sense of the term) to include “environmental” forests. All forests provide environmental services. Some of the forest are primarily used for economic purposes (i.e. timber and non-timber productions, etc.) and are labeled “economic”. “Environmental forests”, on the other hand, includes forests whose main function is providing environmental services.

c) The SEEA introduces sectoral impacts, in physical and monetary terms, on natural (economic and environmental) forests caused by production and consumption activities of industries, households and the government in the production and asset accounts. This allows tracking of such phenomena as “acid rain”.

d) By linking physical accounts with monetary environmental accounts and balance sheets, the SEEA is an integrated extension of the SNA so there is accounting consistency.

e) The SEEA may include elaborated environmentally adjusted indicators for deducting the costs of forest depletion or degradation from NDP and capital formation.

As mentioned earlier, several non-timber products are recorded in industries different from the forestry industry. Activities related to the production of non-timber products in the forest can be separately identified to assess the contribution of forest to the economy.

Expenditures by the forest industry are likely aimed at increasing or maintaining timber production. In most countries, the government is the prime actor in environmental protection, but industries and to a lesser extent households have been prompted more and more to respond directly to the environmental impacts they cause, according to the polluter/user pays principle.

Also mentioned previously, asset accounts for produced and non-produced economic forests are already included in the SNA asset boundary. The SEEA also allows for the inclusion of “environmental” forests within its asset boundaries, to provide a better understanding of the national wealth and conservation of the forest. The lack of understanding about the details of ecosystems’ functions makes the valuation of the “environmental” forests very controversial. The SEEA, therefore, focuses on the compilation of the asset accounts for “environmental” forests in physical terms only. Valuation of depletion and degradation of “environmental” forest is, however, possible through maintenance costing, that is the cost that would have been incurred if the environment had not been used to impair its future uses.

Environmental impacts (depletion and degradation) on forests are valued and shifted to the production accounts, as opposed to the SNA that reports them in other changes in volume, outside the production accounts. Such costs are allocated to the industries and consumers causing the environmental depletion and degradation. Depletion and degradation caused by households is treated as cost of household production activities, identified as a separate industry in the SEEA. Environmental degradation caused by government is recorded as cost of the government industry. In consistency with the conventional accounts, changes in environmental assets that cannot be attributed to production and consumption, such as natural disasters and natural growth, are recorded in “other changes in volume of assets”.

17 Fuelwood, mushroom, and berry gathering are defined as agricultural production. If depletion results from overuse, costs should be subtracted from agricultural value added.
The costs of depletion and degradation of the forests can be regarded as consumption of natural capital. This suggests that asset use should be subtracted, along with the consumption of produced capital, from the gross value added of the pollution causing industry. This adjustment from GDP, and GFCF (gross fixed capital formation) would yield Environmentally-adjusted Net Value Added (EVA), Environmentally adjusted net Domestic Product (EDP) and Environmentally-adjusted net Capital Formation (ECF) figures. Calculations have also been made of the counterpart of ECF, “genuine” or net saving (World Bank 1995). Environmentally adjusted indicators would give more realistic information on the overall performance of the economy and its production and consumption patterns.

Environmentally adjusted indicators are calculated on the basis of sustainability criteria. Only permanent losses of the income generating capacity of the forests from their uses are considered in the construction of environmentally adjusted indicators. Depletion of timber, for example, is defined as the part of logging that exceeds sustainable wealth accumulation. Each nation must develop a set of expectations about the acceptable rates of use in terms of long term wealth accumulation. This would set a boundary on rates of accumulation/depletion. Similarly, for forest asset degradation, emissions, which have negative wealth effects, are termed as unsustainable emissions.

One point that should be noted is that monetary figures on depletion depend on two quantities: the physical quantity of the resource use, and the resource’s market price. Market prices can change markedly from year to year, for reasons unrelated to physical scarcity. Therefore it is quite possible; when the physical use of a resource has gone up but its price has gone down, that the costs of depletion would be shown as decreasing despite the fact that more resource has been extracted. Similarly, degradation costs might be decreasing, despite increased emissions. This is due to reduced maintenance costs as a result of improved technology at lower costs. Physical data are an integral part of the accounts and should always be reported to avoid misinterpreting the results of the accounts.

Another point that has been raised relates the inclusion of degradation costs in the production accounts. Conventional economists and national accountants argue that, contrary to depletion, where an allowance, for running down the resource stocks, is included in the business accounts, degradation costs have not been internalized. Maintenance costs can be seen as weights for the aggregation of the environmental impacts from the economy. This would provide an indication of which costs should have been internalized by the activity that caused them (Bartelmus 1998). European countries have, instead, opted for aggregating the impacts in physical terms. Pollutants emitted are allocated to different environmental “themes”, greenhouse gas, acidification, ozone layer depletion, eutrophication and waste. The allocation of the pollutants to the “themes” consists of a weighted average of the pollutants with weights proportional to the potential relative stress of each substance on the environment.

A detailed breakdown of environmentally adjusted indicators by economic sectors may play an important role in policy making. These indicators could portray structural distortions of the economy from under-priced use of environmental resources and suggest initial estimates for the appropriate level of environmental cost internalization (i.e. taxes and subsidies, etc.) into the budgets of households and enterprises. Given the inefficiencies of command-and-control measures in environmental protection and natural resource conservation, the application of market instruments has been greatly advocated. Economic instruments are usually applied to those who can be held responsible for natural resource depletion and environmental degradation, according to the user/polluter-pays principle.

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18 The difference between ECF and genuine saving is that the latter can be financed by foreign sources of capital finance. Both indicators are modified, in principle, by the same amount of environmental cost.
2.5 Valuation

Because it is anticipated that some economic goods and activities, which have no observable price, may never the less be valued in the SEEA, it is important to use the valuation approach of SNA as a starting point. Direct impacts of economic activities on the environment are accounted for through market based valuation which relies on readily observable prices. An alternative valuation method, consistent with the SNA, which attempts to capture both direct and indirect impacts, is maintenance cost. Each valuation method yields an imputed cost of “protecting” the forest. Quality aspects which, could be a result of economic activities from previous accounting periods or from other countries within the same or previous periods are not directly valued. Aspects of environmental activities that affect the quality of the forests are often brought about by logging (loss of habitat for biodiversity, loss of watershed protection, etc.) or by airborne industrial and consumer emissions that cause acidification. Also, natural and man-caused forest fires, insect infestations, windstorms and/or plant diseases can bring about significant changes. Forest degradation is reflected in the SNA (in monetary terms) only in so far as it reflects direct impacts of economic activities or through maintenance cost valuation.

In instances, where no market transaction is available, (e.g. household consumption of self-produced goods) the convention applies to value these goods at the prices which would have been obtained in the market had the goods been sold. This is a straightforward valuation method. For example, the value of household collected and consumed wild fruit would be the market price of the same or highly similar products.

2.5.1 Imputed Environmental Costs

The SEEA offers different concepts from SNA for the calculation of environmental costs. Its focus is on the cost-caused concept or the economic activity that causes the environmental cost. Applied to the use of forest resources, two categories of environmental costs are distinguished: depletion costs and degradation costs. Depletion costs refer to the quantitative depletion of the stock by the economic activity. Degradation of the resource, on the other hand, reflects the qualitative deterioration of the natural environment by the economic activity.

SEEA proposes to estimate degradation costs either at the level of the causing economic activity or at the level of those industries and households that need to bear such costs. In the first case, imputed costs would show an estimate of the costs incurred in preventing or mitigating the deterioration and thus of maintaining the environment (i.e. maintenance cost valuation concept). In the second case, actual costs may be estimated by calculating the loss in production of the affected industries and, in the case of households, their ‘willingness to pay’ for not bearing the degradation.

Both the cost-caused and cost-borne concepts create conceptual and practical estimation difficulties. The cost caused approach may result in significantly underestimating the ‘real’ welfare cost associated with environmental degradation because the prevention or mitigation costs could be much less than the costs borne.

The cost borne concept, on the other hand, assumes that all productivity losses can be estimated into the future and assigned to a particular economic activity. Some of these losses may be borne by economic units other than those of the country where the degrading (or depleting) activity originates.
Household welfare losses due to environmental degradation are normally estimated using contingent valuation methods (willingness-to-pay approach). There are various problems associated with this valuation method including the observation that the stated willingness-to-pay may be higher than ‘true’ willingness (free-rider problem) and the fact that the income of a person will place a constraint on her/his ability and, thus, willingness to pay. The latter is highly significant because poorer people are often in conditions where they need to shoulder the brunt of environmental degradation (e.g. location of slums in the most polluted, noisiest and disaster-prone areas).
3 Augmenting SNA Forest Sector Accounts with Satellite Accounts

3.1 Introduction

Having discussed the basic Forest Sector reports in a nation’s standard SNA, the purpose of this chapter is to show how the SNA can be augmented and expanded by utilizing what are commonly referred to as satellite accounts. The purpose of developing these accounts is to better identify more detailed information, which is often obscured by the aggregate nature of the broad classification system utilized in SNA. After discussing the relationship between the SNA and the SEEA, specific features or capabilities of satellite accounts are presented and discussed. The features or capabilities include the following.

- The capability to disaggregate and reformat national accounts related to forest activities in order to: 1) identify economic activities which represent inter-industry/inter-sectoral linkages; and 2) identify forest management expenditures for stand cultivation, forest protection and forest maintenance activities. These capabilities will ultimately allow policy analysts to use input/output models for forest sector policy analysis.
- The capability to develop specific accounts for: 1) forest land, 2) timber, and 3) carbon, to more readily allow examination of important issues such as sustainability and carbon sequestering.
- The capability to analyze the environmental effects of other industries on forests.
- The capability to examine the environmental effects of forest sector activities both on the forest sector itself as well as on other economic sectors.

3.2 The Relationship Between SNA and SEEA

One important distinction between SNA classifications and the potential classifications developed in satellite accounts comes from the basic idea of assets used in SNA. Only economic assets, i.e. assets owned by some entity or unit from which economic benefits are derived by their owner(s) by holding them, using them over a period of time, or by selling them, are within the asset definition or boundary of SNA. Economic benefits recognized by SNA are incomes (derived from production) and holding gains and receipts from the sale of assets. Thus, “noneconomic” forests are not included in SNA but may be included in a detailed satellite account. Noneconomic forests may include areas that are unprofitable to log, or lands that are protected with no commercial gains accruing to the owners.

A second important element associated with the idea of economic assets is derived from that basic classification of assets being either produced or non-produced. Non-produced economic assets are those assets that are not the result of a production process, in the sense that no inputs have been used for their creation. SNA treats land as non-produced in all cases. Land may be cultivated or non-cultivated. In the case of forests, the term cultivated means that some work or capital has been used for producing the output grown on land. Products grown on cultivated forest land are generally treated as produced; products grown on non-cultivated land are treated as non-produced. The distinction of produced versus non-produced products coming from cultivated versus non-cultivated forest lands utilized in the SNA/SEEA framework is analogous to the FAO approach of natural versus plantation forests.

Another important facet of the SNA/SEEA relationship lies in asset classification. Assets may act as fixed assets, valuables or inventories. In SNA although all economic assets are
expected (by definition) to produce economic benefits to their owners, they do not all act as “fixed” assets. Fixed assets are only those produced assets that are used repeatedly or continuously in production processes for more than one year. Because standing cultivated timber typically yields a product far less frequently than a year, it is classified as inventory (work in progress) rather than a fixed asset. These categorizations of forest assets are summarized as follows.

<table>
<thead>
<tr>
<th>Non produced</th>
<th>Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>Timber</td>
</tr>
<tr>
<td>Non-cultivated</td>
<td>Cultivated</td>
</tr>
<tr>
<td>Inventories of timber grown on cultivated land</td>
<td></td>
</tr>
</tbody>
</table>

Rather clearly the SNA classification system must be adjusted in SEEA to better describe important forest values. If, for example, timber sequesters and stores carbon annually and this form of annual service takes place on noneconomic forest land as well as economic lands, these kinds of forest functions and values won’t fit the SNA asset classification system and must be modified in the satellite account.

In order to clarify the relationship between SNA and SEEA in the accumulation and balance sheet accounts, the following key forest sector items found in these account are examined.

- Opening and closing stocks
- Gross fixed capital formation
- Changes in inventories, which is the balance of natural growth and fellings for cultivated timber.
- Consumption of fixed capital
- Acquisitions less disposals of non produced assets
- Additions, i.e. natural growth for non-cultivated timber
- Depletion, i.e. fellings from non-cultivated timber
- Degradation of forest land due to acidification
- Catastrophic losses of timber (forests fires)
- Changes in classification and in particular changes from forests land to other land.

These key items are shown here in the structure of accumulation and balance sheets used in SNA. Again, it should be clear that these classifications are for economic assets so that further detailed accounting for noneconomic forest assets must be done in the SEEA.

There are two complementary and interrelated descriptions of economic forest-related flows and stocks that are integrated into SNA forest sector accounts.

- **Current (production, distribution and use of income) accounts** describe forest-related economic transactions in terms of activity flows that generate products and incomes.
- **Balance sheets** describe the stocks of assets at the beginning and the end of a reference period (typically a year). All of the changes that affect the opening value of stocks from the beginning to the end of the accounting period are **Accumulation accounts and balance sheets** describe forest-related assets in terms of described exhaustively in order to fully account for changes in asset values.
Table 4  Structure of accumulation accounts with balance sheets

<table>
<thead>
<tr>
<th>Produced</th>
<th>Non produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>Inventories (cultivated timb)</td>
</tr>
<tr>
<td>Fixed</td>
<td>x</td>
</tr>
<tr>
<td>Gross capital formation</td>
<td>x</td>
</tr>
<tr>
<td>Changes in inventories</td>
<td>x</td>
</tr>
<tr>
<td>Fixed capital</td>
<td>x</td>
</tr>
<tr>
<td>Net acquisition of non-produced assets</td>
<td>x</td>
</tr>
<tr>
<td>Consumption of fixed capital</td>
<td>x</td>
</tr>
</tbody>
</table>

Other changes in volume of assets account

<table>
<thead>
<tr>
<th>Produced</th>
<th>Non produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additions (natural growth)</td>
<td>x</td>
</tr>
<tr>
<td>Depletion (fellings)</td>
<td>x</td>
</tr>
<tr>
<td>Degradation</td>
<td>x</td>
</tr>
<tr>
<td>Catastrophic losses</td>
<td>x</td>
</tr>
<tr>
<td>Other volume changes</td>
<td>x</td>
</tr>
<tr>
<td>Changes in classifications</td>
<td>x</td>
</tr>
</tbody>
</table>

Revaluation account

<table>
<thead>
<tr>
<th>Produced</th>
<th>Non produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding gains/losses</td>
<td>x</td>
</tr>
<tr>
<td>Closing stocks</td>
<td>x</td>
</tr>
</tbody>
</table>

Balance sheets are related with economic activity flows through the capital account. Coupling the activity flows with other changes that affect asset values such as "other changes in volume" or the “revaluation” accounts allows an exhaustive manner of relating how production, consumption, accumulation and depletion affect capital assets over time. Because these accounts concentrate on economic assets in SNA, the SEEA will allow a broader array and manner of integrating forest capital and activity flows.

3.3  Disaggregating and Reformating National Accounts

3.3.1  Linkages with ISIC

According to the international standard industrial classification (ISIC), the forest industry consists of all units whose main activity is to grow timber in plantations, fell and harvest wood and other forest goods such as cork and gum etc. and produce services related to forest management, protection and maintenance. However, data may often be reported in such a way that actual forest activities are reported in other industries. For example, an integrated company with woodlands and sawmills or pulp mills may have some or all of its activities erroneously reported in the wrong industry. Therefore in order to identify all output related to forests and estimate the corresponding values it is necessary in a first stage to scan all relevant positions of the ISIC and identify all forests-related output produced as secondary activity. In national accounts, the output is deemed to cover all goods, including goods produced for own final use or those goods produced and consumed in the same sector. However, in many countries, limitations in data reporting imply that some output is unreported. Some of these, frequently acknowledged unreported forest sector activities are fuelwood, game meat, medicinal plants and other foodstuffs. The value of this output should be estimated and included in national account figures. The SNA recommends that output produced for own final use be valued at the average (basic) prices of the same goods (and services) sold on the market (provided they are sufficient quantities sold to enable reliable
estimates). If there is unreliable product price data, goods for own consumption should be valued at the total cost of production per unit internally consumed. Because unpaid labour may account for a large part of the inputs, it is important to make some estimate of its value using wage rates paid for similar kinds of work in the local labor market.

The output from forests as modified from SNA may be presented in a supply table such as the following.

<table>
<thead>
<tr>
<th>Output by product</th>
<th>Agriculture</th>
<th>Forestry</th>
<th>Industries</th>
<th>Other wood industries</th>
<th>Public administration</th>
<th>Other industries</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural growth (cultivated timber)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logs, pulp and fuel wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other goods related to forest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cork, gum, etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Services incidental to forestry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other forest-related services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total forest related output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition to help identify all outputs in relation to forest, this table could be used to examine inter-industry/intersectoral linkages and their policy implications for sustainable forest management.

In a second stage value added and all factors’ incomes corresponding to the output must be assessed. In many cases, as inputs for secondary activities are not explicitly described, estimations are necessary.

<table>
<thead>
<tr>
<th>Value added and incomes from forests</th>
<th>Agriculture</th>
<th>Forestry</th>
<th>Industries</th>
<th>Other wood industries</th>
<th>Public administration</th>
<th>Other industries</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest related output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate Consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross value added</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption of fixed capital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net value added</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net taxes on production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compensation of employees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net oper.surp./mixed income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total forest related output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As a complement of output and incomes assessment, and for sake of consistency, it is necessary to identify the uses of the output: intermediate or final consumption, capital formation, exports, etc.

3.3.2 Forest Land Account

The purpose of the forest land account in the SEEA is to describe changes in land use in both physical and monetary terms. Since the SNA includes only economic forest land without explicit reference to forest cover, noneconomic forest land is added to the forest land satellite account. A matrix could be constructed in the satellite account to report both total land areas
for items in the classification system as well as changes between classes when land is allocated from one use to another within the accounting period.

The land classification used in SNA relies on the following broad categories

- Land underlying buildings and structures
- Land under cultivation, including land under plantations
- Recreational land, amenity land, parklands and pleasure grounds
- Other land not elsewhere classified

Rather clearly, forest land and grazing land are indistinguishable in SNA so a satellite account may be developed to better enable policy-makers to keep track of these environmental/economic assets. SEEA reorients the SNA classification towards environmental concerns by distinguishing forest land as an item of economically used land. In order to describe all land, it also integrates non-economic land. Non-economic forest lands include lands withdrawn from commercial exploitation and land economically inaccessible for logging and development purposes.

The following suggested forest land classification system integrates categories from SNA, SEEA, FAO and UN-ECE.

**Forest land** (UN-ECE classification of land)

- Economic forest land (forest land recorded in SNA balance sheets)
  - Cultivated (plantations and semi natural forests in FAO classification)
  - Non cultivated (natural forests and secondary forests in FAO classification)
- - Non economic forest land
  - Protected
  - Non protected

**Other land** (land underlying buildings... agricultural land, etc.).

Several additional approaches for classifying land may be desirable. For example, lands designated as critical wildlife habitats or land classifications based upon cover or habitat types maybe of sufficient importance to include in satellite accounts. Likewise, classifications of forests based upon functions, health status or management regimes may also be included in a satellite account.

### Table 7 Changes in land use/cover: basic physical table

<table>
<thead>
<tr>
<th>Forest land</th>
<th>Cultivated Forests</th>
<th>Non-cultivated Forests</th>
<th>Other</th>
<th>Tot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Economic</td>
<td>Non-economic</td>
<td>Tot</td>
<td>Economic</td>
</tr>
<tr>
<td>Opening stocks</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Changes due to economic use or decisions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deforestation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Afforestation</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Change in cultivation status</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Change from non economic to economic</td>
<td>+</td>
<td>-</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Protection and changes to non economic</td>
<td>-</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Non referable changes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural colonization or regression</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Other non referable changes</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Closing stocks</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
Because a forest land account is a form of fixed asset account, it includes an accounting of the changes between opening and closing land stocks. Balance sheet changes in land use (or cover) are (even if only partially, and/or indirectly) related to economic activities. These changes are recorded as occurring outside the production boundaries (other volume changes in SNA and other accumulations in SEEA). Areas affected during the period by catastrophic events (fires, windstorms, insect infestations, etc.) which do not modify the classification of land may be recorded as a “memoranda” item, and linked with timber balances.

The mentioned table allows for the description of the main changes that may affect forest areas:

- **Changes in area due to deforestation and afforestation, natural colonization or regression**: are environmentally significant from many perspectives. For example, these changes can be linked in the SEEA to changes in biodiversity, carbon uptake and storage, or erosion.
- **Changes in cultivation status**: may be linked to other SEEA accounts both in terms of changes in timber production as well as potential changes in biodiversity.
- **Changes in economic status**: may occur when a remote natural forest initially considered as non-exploitable changes as a result of technological change, resource prices or infrastructure investments such as ports, rail accessibility or road developments. Conversely protection of a forest area may change its status to “non economic”, if severe restriction are imposed. Decrease in prices may have the same effect.

The idea of economic appearance and disappearance of economic assets was discussed in section 2.3.2 of this report. A similar approach to the appearance/disappearance of noneconomic forest resources, which have environmental significance, could also be included in the SNA. This could be applied to the listing, delisting, recovery or extinction of species. It might also be important in the area of noneconomic lands as well.

Similar tables may be drawn, in accordance with other environmental concerns. For example, balance sheets could be constructed for important forms of forest degradation indicating the area affected and changes in area from previous periods.

**Forest Land Valuation**

Under the SNA, the value of land is separated from the value of standing timber and the extension of the separation of asset values is a logical extension in forest sector satellite accounts. As a general rule, forest land is comparatively low in value relative to other land uses. This land value is derived from the capacity of land to produce crops of timber. Often forest land ownership carries with it the right to allocate land to other uses so that ownership may be seen as reflecting a variety of land use options which are also of value. Ideally, forest land values in SEEA are based on actual land transactions. However, forest land transactions often include land and standing timber in a transaction “package” so that values of the two assets must be separated for the different entries in the SEEA. If there is inadequate data to separate the asset values, SNA procedures recommend that the combined value be entered into the asset account for the highest valued asset.

**The value of cultivated forest land.** This value may be estimated by utilizing yield productivity estimates coupled with management regimes, production costs and an optimal rotation age using the SNA indicated discount rate. Results should be compared whenever possible with actual land prices as well as with prices of marginal agricultural land.

**Value of non-cultivated forest land** can in general be expected to be even lower than that of cultivated forest land. Growth in natural forests may also be low. The main value of non-
cultivated land lies in the potential to change its use from non cultivated land under natural forests to another use (agriculture, including forestry or built-up land). Of course the possibility also exists to reclassify this kind of land as some form of protected land.

The earlier discussion of forest asset balance sheets focused exclusively on physical estimates of land. The table below represents a monetized balance sheet for economic and noneconomic land.

**Table 8  Changes in land use/cover: basic monetary table**

<table>
<thead>
<tr>
<th>Forest land</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Other</th>
<th>Tot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Economic</td>
<td>Non-</td>
<td>Tot</td>
<td>Economic</td>
<td>Non-</td>
<td>Tot</td>
</tr>
<tr>
<td><strong>Opening stocks</strong></td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>0</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Gross fixed capital formation</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Consumption of fixed capital (land improvement)</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Changes due to economic use or decisions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deforestation</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aforestation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Change from non economic to economic</strong></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td><strong>Protection and changes to non economic</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Non referable changes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Natural colonization or regression</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>Other non referable changes</strong></td>
<td>+/-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>Changes in classification</strong></td>
<td>+/-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>Holding gains/losses</strong></td>
<td>+/-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>X</td>
</tr>
</tbody>
</table>

Note that land is the only non-produced asset for which investments in the land are added to the value of the stock. In contrast, timber investments such as for reforestation is recorded as capital formation for the forest industry and hence is not added to the value of the timber stock.

All changes in value are recorded in the column corresponding to the category of the opening balance sheet. When land moves from one category to another during the period, the row "changes in classification" records the shift of values between categories.

When forest land is deforested and the land is allocated to a higher value use, the increase in value is registered in the "deforestation" row. In this case, it could be argued that one has also to take into account the value of the decrease of carbon binding capacity (or loss of biodiversity, etc.). Present benefits (first the benefits from selling the timber, second the benefit from changing the use of the land, expressed by the higher value of the land) are exchanged against the future losses, including the decrease in the carbon binding capacity. The nature and the value of this additional item is however controversial. If the present value of the benefits were lower than the discounted value of future losses, it would be preferable not to deforest. If, however, discounted benefits were less than discounted costs, the balance would tilt toward deforestation. The issue is complicated by the choice of discount rates, problems in valuing nonmarket phenomenon and possible irreversibilities in biodiversity.
3.3.3 Forest Management/Protection/Maintenance Expenditures Account

Before discussing satellite account entries for forest management expenditures, it should be useful to briefly examine the nature of forest uses and costs as they relate to various previously discussed classes of forest lands.

Table 9 Forest Costs, Land Types and Activities

<table>
<thead>
<tr>
<th>Management Activity</th>
<th>Economic Forest Land</th>
<th>Non-economic Forest Land</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cultivated</td>
<td>Non-cultivated</td>
</tr>
<tr>
<td>Timber Investment</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Forest Protection</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Inventory</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Grazing Management</td>
<td>Sometimes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Wildlife Habitat Mgt.</td>
<td>Sometimes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Recreational Mgt.</td>
<td>Sometimes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Administration Exp</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transportation Exp</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Very often a single forest management entity has both economic and noneconomic forest land. For example, even a timber corporation may own areas covered with water or rocks and ice in addition to cultivated and non-cultivated forest land. Furthermore, many public forest land agencies throughout the world manage their lands around the principle of multiple-use. Thus, for example, considerable time and effort often is devoted to producing high quality recreational experiences on public lands as well as the more commonly expected forest products. To some extent, the multiple uses are “joint products” (a sheep rancher produces meat and wool so that production costs may be allocated somewhat arbitrarily to more than one cost center). When economic and noneconomic forest lands are spatially intermingled, forest protection activities such as insect control or fire suppression have distinct neighborhood qualities. For example, failure to control a wilderness fire may mean that valuable nearby plantations or other nonforest assets are at risk. And while timber management invariably requires some means of transporting logs to mill sites, recreational lands also have transportation networks of roads and trials.

Forest sector expenditures which have the purpose of securing expanded benefit flows typically include inventory, research efforts, biodiversity protection, fire protection, resource planning, transportation expenditures (construction and maintenance), facility construction and maintenance as well as the usual silvicultural expenditures. Costs of these activities are not included in the intermediate consumption of forest products and must be treated as additional intermediate consumption in order to calculate net value added.

Table 10 Forest Management Expenditures and Net Value Added

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net operating surplus of forest industry</td>
<td>500M$</td>
</tr>
<tr>
<td>Government timber supply expenditure:</td>
<td>250M$</td>
</tr>
<tr>
<td>of which administration</td>
<td>40M$</td>
</tr>
<tr>
<td>Aviation and fire control</td>
<td>20M$</td>
</tr>
<tr>
<td>Resource access</td>
<td>5 M$</td>
</tr>
<tr>
<td>Forest management</td>
<td>185M$</td>
</tr>
<tr>
<td>Rent</td>
<td>250M$</td>
</tr>
</tbody>
</table>

Source: Valuing Ontario’s Timber Resources in Environmental Perspectives. Statistics Canada
The importance of these costs in terms of their role in calculating value added can be better seen by examining summary data from the Canadian Province of Ontario.

If substantial amounts of the forest management expenditures in the above table are designed to secure favorable flows of nonwood forest products and services, then it would be prudent to allocate some of these costs to other forest product accounts.

Recreational activities are indirectly included in the SNA as tourism expenditures. The question of which expenditures are considered as integral parts of recreational expenditures is very relevant. Many studies have indicated that recreationists are willing to pay more for site access than they are frequently required to actually pay. Willingness to pay for the recreational experience has been estimated in countless cases. Several caveats are worthy of mention as a set of precautions in using willingness to pay estimates in satellite accounts. Willingness to pay is a formal way of estimating consumer surplus. There is also consumers surplus for market goods but the usual assumption of recreation value studies is that the impact on market goods prices and resulting consumers surplus when forgoing the production of market goods in allocating a site to nonmarket use is sufficiently small that it is negligible. SNA does not include consumer surplus for market goods and services. Rather, the price of the good or service does not change with the activity level. Since SNA is a macro or regional level of analysis, and one could analyze the level of production of recreation activities, it would appear that recreational values should be consistent with values in other sectors being analyzed. Thus, willingness to pay based on the consumer’s surplus associated with a single fixed site may not be an appropriate value in a forest sector satellite account.

3.4 Timber Account

Timber accounts are generally first drawn in terms of physical volume estimates such as cubic or board measures. They describe all timber, whatever the economic classification. An example of a simplified timber account is presented below (Spruce volume from Nordic natural resources accounting). It should be noted that all volume estimates are not estimates of biomass but rather are estimates of a useable portion of the wood stem. Each volume measurement has some assumptions about the minimum log length, stump height and minimum small-end diameter of the log. These merchantability standards can change over time so there may also be entries in timber accounts that capture changes in growing stock owing to changes in measurement standards.

### Table 11 Timber Account

<table>
<thead>
<tr>
<th></th>
<th>Timber (Mm³, inc. bark)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opening stocks</strong></td>
<td>2194.6</td>
</tr>
<tr>
<td>+ annual growth</td>
<td>85.4</td>
</tr>
<tr>
<td>- fellings</td>
<td>64.4</td>
</tr>
<tr>
<td>Of which net removal</td>
<td>60.9</td>
</tr>
<tr>
<td>Of which silvicultural waste</td>
<td>3.5</td>
</tr>
<tr>
<td>- natural losses</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Closing stocks</strong></td>
<td>2213.4</td>
</tr>
<tr>
<td>Changes in stock</td>
<td>18.8</td>
</tr>
</tbody>
</table>

---

19 The World Tourism Organization is working on developing satellite accounts which could be used for eco-tourism.
This simplified account may be complemented by specific tables describing the uses of timber removed from forests as intermediate consumption by the various wood industries and as final consumption (mainly fuel wood) by the households.

Concerning the valuation of timber stocks and changes in stocks, two cases are to be theoretically distinguished: produced timber and non-produced timber.

In valuing produced timber, two questions arise, how much is the standing timber worth and what is the value of the annual growth increment? The value of the annual growth or increment is estimated by distributing the value of the finished product (mature standing timber) in proportion to the costs incurred in each period. Added to the costs is a mark-up for the estimated operating surplus or mixed income? From a practical perspective, assumptions must be made concerning the future value of standing timber, at the time it will be felled as well as about the total costs which will be incurred throughout the life of the timber. Although present prices are used, this calculation is rather uncertain. Several methods have been employed to assist in this calculation. The simplest approach involves multiplying the stocks and flows in physical quantities by the stumpage price (see below). Based on the present value principle, this simplification assumes that as a first approximation the need for discounting future receipts is counterbalanced by the future growth of the timber. However, as shown by Vincent and Hartwick (1997), in most cases it is theoretically inconsistent and introduces a bias. It may be preferable to make explicit assumptions about the likely felling date and to discount the anticipated receipts.

Valuing non-produced timber is somewhat different from valuing produced timber. Recall that growth of non-produced timber was not considered a product of management. As a result, it is unnecessary to estimate the value of the growth increment of timber on uncultivated forest lands. Were this not the case, the accounts would yield the false impression that timber investments were more productive on non-cultivated lands than on cultivated ones since growth would be acquired without any distributed cost outlay. Stocks can be valued either by multiplying volumes by stumpage prices or by calculating a present value with the same assumptions about future harvest dates, as is the case of fellings from cultivated lands. Depletion (the decrease in value due to fellings) is given by the value of the fellings; the change in the net present value of the stock of timber between the beginning and the end of the period, is given results from depletion and holding gains.

In all cases the most important information to be collected is the value of fellings or stumpage price. In a surprising number of instances a competitively determined stumpage price is not available because markets are ruled by administered prices or because of other institutional arrangements which limit the generation of accurate stumpage value information. In instances such as these, stumpage must be calculated rather than collected. The residual value approach to appraisals may be useful in these instances because it estimates stumpage value by starting with the value of products produced and reduces this amount by the costs of converting standing timber into wood products. (A normal profit and risk margin is also normally subtracted from product values as well). The left over “residual” is the estimated value of timber. The process may be simplified somewhat if good roadside prices are available. Prices have to be calculated or collected for the various species of wood. Corrections may be necessary in order to take into accounts exceptional events, such as tempests, fires etc, before arriving at a significant market price for standing timber, and hence the value of fellings.

One must keep several things in mind when estimating the value of the entire economic timber stock. When using stumpage prices to estimating the value of timber stocks, there are normally substantial differences in the qualitative characteristics between mature timber being sold and growing timber that will be harvested in the future. Perhaps most clearly, mature timber is typically larger with fewer logs per unit of volume. The costs of logging
typically are less per unit of volume for larger trees than for smaller ones since there are simply fewer pieces to handle. Also larger trees are typically manufactured into more valuable products than are smaller ones. Thus, if stumpage prices are used to value the entire economic stock, diameter adjustments can be used to avoid overstating the value. Jackson and McQuillan (1979) demonstrated how to do this with statistical appraisals. Logging costs can be adjusted in the residual value appraisal system for the number of logs per unit of volume logged. This in turn can be used to adjust the value of standing stocks to reflect broad qualitative differences from the typical timer being sold.

3.5 Carbon Account

In this section we turn to an important example of integrating non-SNA items with basic SNA information in a forest sector satellite account. Forests provide socially important climate modification services by binding carbon released by other sectors in the economy. These services serve at least in part to curb global warming because carbon dioxide is one of the most important greenhouse gases. Various studies show that young forests bind the most carbon but older forests store the most carbon. As forests mature, decay of stored carbon increases so that eventually some form of rough balance between carbon uptake and release eventually occurs. As an example, some authors consider see climax forests as carbon reservoirs but not necessarily net carbon sinks. Carbon balances for the stocks of trees are generally calculated on the basis of the forest balances or stocks and stock to carbon coefficients. An example using spruce inventory data from Nordic forests is presented below.

The dry matter content of spruce is estimated in 387 kg/m³ wood. The carbon content in the dry matter has been estimated in 0.519. The volume of standing timber is converted to carbon content by using a conversion coefficient of 0.2 between cubic meter and tons of carbon.

<table>
<thead>
<tr>
<th>Timber (Mm³, inc. bark)</th>
<th>carbon (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening stocks</td>
<td>2194.6</td>
</tr>
<tr>
<td>+ annual growth</td>
<td>85.4</td>
</tr>
<tr>
<td>- net removal</td>
<td>60.9</td>
</tr>
<tr>
<td>- silvicultural waste</td>
<td>3.5</td>
</tr>
<tr>
<td>- natural losses</td>
<td>2.1</td>
</tr>
<tr>
<td>Closing stocks</td>
<td>2213.4</td>
</tr>
<tr>
<td>Changes in stock</td>
<td>18.8</td>
</tr>
</tbody>
</table>

Major uncertainties affect the description of carbon binding and storage. Carbon binding should not be reduced to a simple transformation of the standing timber stock since the amount of stored carbon is not a simple linear transformation of the standing stem volume.

a) Standing volume is an estimate of the commercial product content of the standing tree and excludes small trees, branches, roots, or other forest plants that together with the decaying litter constitute the stored carbon.
b) There are carbon transfers between the over-ground forest biomass and the soil. A portion of the carbon bonded in above ground vegetation as well as roots become organic soil as plant parts die and decay. Carbon is stored in the soil for time periods. Various authors suggest that the share of carbon bonded in stem of the tree is no more than 15% of the total amount of carbon bonded within the entire ecosystem. The major part (73%) is bonded in the soil (at a depth from 0 to 30 cm).

<table>
<thead>
<tr>
<th>Ecosystems (from Nordic Natural Resource and Environmental Accounting)20</th>
<th>Distribution in % of the Total Amount of Carbon Stored in Forests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem timber</td>
<td>15</td>
</tr>
<tr>
<td>Branches</td>
<td>4</td>
</tr>
<tr>
<td>needles and leaves</td>
<td>1</td>
</tr>
<tr>
<td>Roots</td>
<td>6</td>
</tr>
<tr>
<td>ground vegetation</td>
<td>1</td>
</tr>
<tr>
<td>Soil</td>
<td>73</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

c) Finally some of the carbon bonded through forest growth stored in the forest ecosystem is removed when trees are felled and logs are removed from the forest. The longer the life of this wood and processed wood products, the bigger the carbon reserves they represent. The carbon is preserved best in sawn goods and building material for which the decomposition cycle is around 80 years. The carbon content in paper products and board is on average released within two years. Certain paper and board products will however, are kept for centuries, amongst other places in libraries and archives.

As a conclusion, it is difficult to make an exact assessment of the annual net carbon binding by the forests and of the extent of changes in the overall reserve of carbon in forests and wood products. It is also difficult to give any reliable estimates of factors, which increase or decrease this carbon reserve.

Valuing carbon-sequestering services presents some interesting challenges. The cost of abating or avoiding CO₂, N₂O and CH₄ emissions which are the pollutants causing acidification damages of forests is estimated using end of pipe technology, or substitution costs. These costs should be deducted from the value added of the causing industry. Another approach values the future damages "avoided" through a net present value calculation. This method assumes that the impacts of temperature increases based on the emission of one supplementary ton of CO₂ during the period are known, and that a value (a cost) can be attributed to them. It also assumes that a discount rate has been chosen. A comparison of three such costs computations has been performed by Nordhaus (1993). Should the carbon dioxide concentration double as it is expected to by the year 2030 (unless today's rate of increase slows) the average temperature on Earth is expected to rise 1-3° above today's level. Some studies calculate that climate change costs will rise to 1.0-1.3% of GDP annually. A corresponding value with this change in GDP for carbon is US$ 3.3/t CO₂. In other words, carbon value through this method is approximately 10 US$/t carbon. This falls in the low end of the range of values found in the literature, namely from 5 to 125 US$/t of carbon emitted.

In these conditions, the value of the sequestration by forests of a ton of carbon depends on the set of assumptions made regarding the physical effects of sequestration and their economic expression. Of significant importance are the rate of discount utilized, and the anticipated level of GDP in the future in a particular geographic areas. The estimated carbon sequestering.value of forests are therefore quite imprecise. However imprecision is not an excuse of failing to agree on an approach for estimation.

3.6 Environmental Impacts on Forests caused by Forest Activities

Forests are multifunctional ecosystems. Several economic activities take place in the forest that have direct and indirect impacts on the ecosystem itself, as well as on human well being. Direct impacts are closely linked to the use of forests. Indirect impacts relate to qualitative aspects of forests, as providers of environmental services and amenities.

Table 14 Environmental Activities and Forest Impacts

<table>
<thead>
<tr>
<th>Economic activities</th>
<th>Direct impacts (quantitative use)</th>
<th>Indirect impacts (qualitative use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber production activities that include timber growing and timber harvesting</td>
<td>• Accumulation and Depletion of Timber</td>
<td>• Changes between kinds of ecosystems (Forest/Non-forest)</td>
</tr>
<tr>
<td></td>
<td>• Changes in land use</td>
<td>• Changes in health and vitality of forest ecosystems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Changes in Biodiversity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Soil erosion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Changes in carbon uptake and storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Changes in recreational services</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Changes in watershed protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Changes in availability of non-timber products</td>
</tr>
<tr>
<td>Production of non timber products (berries and mushrooms, game-related products,</td>
<td>• Accumulation and Depletion of Non-timber products</td>
<td>• Changes in Biodiversity</td>
</tr>
<tr>
<td>species used for pharmaceutical purposed, peat extraction)</td>
<td>• Hydrological runoff changes</td>
<td>• Loss of watershed protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Changes between kinds of ecosystems (Forest/Non-forest)</td>
</tr>
<tr>
<td>Recreational activities/tourism</td>
<td></td>
<td>• changes in health and vitality of forest ecosystems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Loss of biodiversity</td>
</tr>
</tbody>
</table>

Table 14 lists economic important activities and their direct and indirect impacts on the forest.
3.6.1 Direct Impacts

Direct impacts are usually measured in physical and monetary terms. The valuation used, as mentioned earlier, is market based. Monetary values are obtained by multiplying the physical quantities by a per unit value. Direct impacts include the following items:

Depletion/Accumulation of timber is defined as the changes in economic and non-economic stocks. Non-economic stocks are included because of, for example, illegal logging in protected forests. Furthermore, non-economic forests often continue to be used for non-timber products. The depletion can also be noted as exceeding sustainable harvests. This leaves the issue of “hard sustainability” to policy makers in each respective economy. Governments often estimate sustainable timber harvests on the basis of the regenerative capacity of the forest for timber production. Depletion caused by the above activities may constitute a significant part of the overall depletion and it should be estimated and its cost deducted from the value added of forestry and agriculture industries, respectively.

Depletion/accumulation of non-timber products is harder to measure. Production of non-timber products is included in the production boundaries of the 1993 SNA (i.e. berries and wild mushroom constitute output of agriculture, peat production output of mining, game related products output of hunting). As mentioned earlier, depletion measures the loss of the income generating capacity of the resource. Conceptually, depletion of non-timber products should be measured both in physical and monetary terms and treated as consumption of natural capital, as it is the case of timber. In practice, however, data on stocks and as a result, sustainable yield are usually not available. In some areas of the world, there is a significant inverse relationship between timber stocks and hydrological runoff such that logging may augment hydropower production. This would be a separate fossil fuel offset since hydropower production does not require the burning of fossil fuels.

Given the difficulties of certifying the sustainability of forest management operations, some countries are developing Criterion and Indicators (See Canada Council of Forest Ministers, 1997). These indicators can be included in the SEEA at least in terms of physical inventories and gains or losses.

3.6.2 Indirect Impacts

Forest uses can cause ecological damage. Actual expenditures made to protect the forest and to rectify the damage are included in the SNA and can be separately identified to obtain an indication of the impact on the environment. In most countries, however, such expenditures may not be a good indicator of the changes in the market and non-market values of the environmental services provided by the forest.

There are clearly benefits flowing from the existence of the forests. The real costs associated with the provision of the environmental services are not captured by the pricing mechanism of the market, because they are not attached to the cost of exploiting these assets for their timber values (Joisce 1996). Two approaches that attempt to capture both the costs of direct and indirect impacts have been advanced in the SEEA. They are maintenance costing and contingent valuation and other demand side valuations. Maintenance costing focuses on the impacts of production in assessing the costs of keeping the forest intact. Contingent and related valuation of the demand/benefits/damage side of environmental services, on the other hand, attempt to measure the loss or generation of ecological and environmental benefits.
consumer services. Both approaches attempt to find, in principle, market values for measuring environmental costs and benefits (Bartelmus 1998).

Maintenance costing searches for market values of factor inputs, required for the potential restoration or avoidance of environmental impacts caused by economic agents. Contingent and related demand-side or use valuations attempt to measure preferences for maintaining, restoring or improving environmental, as if markets exist for these services.

Contingent valuation thus reflects the environmental cost borne by ecosystems and individuals. However, maintenance cost appears to exhibit characteristics of both the cost-caused and cost-borne concepts, if restoration costs are included. Restoration costs represent the expenditures that society would have incurred to restore environmental quality lost in the past to desirable levels, expressed by “sustainability standards”. These quality losses can of course not be tracked back to those who caused damages through emissions in past accounting periods or imported transboundary pollution from other economies. While reflecting maintenance cost concept of restoring environmental assets, restoration costs thus also represent the environmental costs accumulated and borne by society over time. The environmental cost accumulation represents an environmental debt. Environmental debt incurred by past generation indicates the responsibility of the current generations for environmental effects that would have to be borne by future generations. In its reference to an accumulated environmental burden, this concept is not strictly comparable with production and income aggregates.

Maintenance cost is the imputed cost that would have been incurred if the environment had been sustainably used (undiminished future use). That, under the maintenance cost approach, is the cost of “protecting” the forest. Such costs would cover both direct and indirect services of the forest. Differing level of maintenance provide different cost levels. The cost of avoiding the loss of certain services would also affect other services provided by the forest. Therefore, when valuing each service separately, one should take special care not to double count the costs. Also, given the shortcomings of the different valuation techniques presented, it is important that physical data be maintained in detail to ensure that non-economic issues are not overlooked, or obscured by disagreements on how to cost nonmarket phenomena.

A short description of the indirect impacts, as listed in Table 14 is provided below. Valuation techniques that have been used in case studies for the estimation of these impacts are described. Such methods are not necessarily consistent with the SEEA.

Soil erosion refers to changes in quality of the land, due to loss of topsoil. It affects the productivity of the land and can be due to natural causes as well as to economic activities, such as agriculture and forestry. Physical as well as monetary measures of soil erosion are complex. The universal soil erosion equation, includes rainfall erosivity, and soil erodibility factors and relies upon, length and steepness of the slope coupled with the degree of vegetative cover to measure average annual soil loss in physical terms (Narain and Nachtergaele 1998).

Several valuation techniques have been proposed. Several methods are based on maintenance costs, that is the costs of nutrient replacement, of terracing the slope, of rehabilitating the plot to its former productive conditions, etc. The latter cost is a restoration cost and, as mentioned earlier it pertains to cost-borne type of valuation and therefore not consistent with the SEEA. Also, in the SEEA the value of soil erosion caused by logging on
steep slope is considered to be an indirect impact of forest depletion and, therefore, its value is not deducted from the value added of forestry.  

**Carbon sequestration** relates to the capability of forest to bind carbon and contribute to the prevention of global warming and climate changes. The carbon sequestration is usually estimated through physical models of forest types and land-use change. It depends on the species mix, the organic matter content of the species, the age distribution of the forest stand and soil and climate factors (Adger et al. 1995). In practice, carbon balances can be calculated by multiplying the elements of the physical asset accounts for forest, in volume, by the coefficients of dry matter content and of carbon concentration in the dry matter of the different species (see above and Hoffrén 1996). The SEEA, as mentioned before, embraces the cost caused approach, and therefore captures the cost of loss of carbon sequestration through the valuation of timber depletion and/or the valuation of emissions above absorption levels. Absorption level depends also on the carbon sequestration capacity of the forest. The cost of abating or avoiding CO2, N2O and CH4 emissions is estimated using end of pipe technology, substitution costs, etc. and deducted from the value added of the causing industry. Damage-valuations, instead, attempt to value global-warming value. Temperature changes are related to physical impacts, which are then valued. This involves various emission scenarios and damage and abatement functions. Such types of valuations, as mentioned above, are not consistent with production and income accounting.  

**Watershed protection** relates to mitigation of flooding, groundwater recharge, and reduction in the volume of runoff. Loss of watershed has an indirect impact on productivity of agricultural land, for example. The cost of loss of watershed could be estimated, with a demand side valuation, as the cost of mitigation of flood damage, purification of water from suspended sediments, etc.  

**Quality of the forest ecosystems and health and vitality of forest ecosystems** are related to the functions of the forest as habitat for flora and fauna and as providers of ecological services. These characteristics of the forest are the most complex to measure. The SEEA does not even attempt to put a monetary value on “environmental” forests, that is those forest that fall outside the production boundaries of the SNA. It recommends instead simply measuring the area of forest land. Indicators on the quality of the forests’ ecosystems could be presented. Indicators on the health of ecosystems are obtained by linking landscape quality and biotope (plant community) quality with the stock of species in biotopes (Seibel et al.). **Biodiversity** therefore may constitute an important element of ecosystem health. In the SEEA, the number of endangered species as well as the number of individuals per species is reported in physical terms. While perhaps desirable it is not necessary to monetize the gains or losses in biodiversity.  

**Recreational activities** are indirectly included in the SNA as tourism expenditures. The question of which expenditures are considered as integral part of recreational expenditures is very relevant. Willingness to pay for the recreational experience has been estimated in several cases. Most of the time the results are site specific and are hardly extendable to the national level.  

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22 One approach adopted for agricultural soil erosion is to estimate rent losses due to decreased land productivity.
3.7 Impacts on Forests Caused by Non-forest Sector Activities

Economic activities, even though not directly linked to the forest, may have negative impacts on the quality of the forests and reduce or enhance the capacity of forests to produce products and environmental services. The forest capacity of carbon sequestration allows industries to release emissions safely into the air, until the absorption level is met. The absorption level depends on the concentrations of pollutants in the air and the vegetative characteristics of the forests. If the air quality were such that the absorption level has already been saturated, acid depositions would affect foliage and soil and water body chemistry and broader aggregates of ecosystem health and productivity.

In order to have a clear understanding of the impacts of pollution on forest; one should have information on the cause-effect relationship between emissions and environmental impacts. These relationships are hard to identify. Emission data describe the cause but not the effect of pollution. Environmental indicators/indices describe the state of the environment and yield clues about the effect but not specific links between the cumulative multiple sources and their respective damages. Rather, emissions are loosely linked to ambient concentration levels. In general, however, there is not adequate information on the influence mechanisms, the state, rate of damage changes, the means of prevention of extensive damage or the tolerance of various forest ecosystems to these disturbances.

The present state of the forest “health” depends, on present and past activities as well as on transboundary airflows and the import and export of pollutants. It is usually not possible to identify which activity, when and in which country, caused the present state of the forest. In order to try to evaluate the impacts of economic activity on forests, three differing and complementing techniques, none of which are completely satisfactory, could be applied. They are:

a) Conversion of emissions into theme equivalents – acidification, in the case of forests. Emissions contributing to acidification are weighted to form a single indicator, according to the acid forming potential of each pollutant. Also, domestic pollution is augmented with the imports and reduced with the exports, of pollutants. Despite the arbitrariness of the weights, such indicator of net air pollution in the country provides useful information on the amount of acid deposition in the country.

b) Description of the change in the state of the forest in one year through environmental indicators/indices. Several indicators describing the quality of the forest are regularly compiled. One of the most commonly used is defoliation, which is the number of needles that are missing as compared to a healthy tree in the same forest. This indicator is described as a percentage of the missing needles or leaves. The reasons for needle loss are age of the trees, weather, climatic factors and pollution. Other environmental indicators of the health of the forest include biodiversity indicators, area of forest land, forest stock, etc. In order to evaluate the state of the forest, interpreting a large number of physical indicators; measured in different units can be complicated. Indices have been compiled aggregating the different indicators with weights. Given that little information is available on the relationship between the indicators, usually describing different aspects of the quality of the forest, the selection of weight is arbitrary. The choice of the weight might have a big impact on the magnitude of the indices, therefore, one should be cautious when interpreting indices of the state of the forests. Quality indicators have been linked to the asset accounts. Although physical indicators of the state of the forests reflect the impacts of activities that may have taken place elsewhere in previous accounting periods, they reflect impacts borne by the forests.
c) Monetary valuation of the damages caused by economic activities on forests. The valuation of the changes in the quality of forests in one year, as measured by changes in environmental indicators/indices, provide information on the "environmental debt" of the country (see above). Techniques used to monetize the impacts of economic activities on forests are based either on direct or indirect valuation methods. Direct valuation methods consist of estimating the willingness to pay of individuals to guarantee the existence of the forest or their willingness to accept reduction in their consumption or income to retain a stock of forests not impaired by economic activities. Problems with this method include the following. Respondents to survey questions may not have sufficient information concerning the costs and benefits of forests so that their responses are poor indicators of more informed values. Survey respondents may also not be easily able to express their values in monetary terms. Indirect methods estimate damage costs in the form of loss of production or costs accrued in avoiding such loss. This method allows the use of market prices, in order to evaluate the costs to society (National Institute of Economic Research and Statistics Sweden 1994).

The SEEA provides an integrated database, which could serve as a starting point for the evaluation of the impacts of economic activities on forest, both in physical and monetary terms, as described in a), b) and c). Emissions are recorded by industry and impact the domestic and international environment. They are then valued at maintenance costs to assess the costs of the direct impacts of production on the environmental asset changes. Damage valuation methods, reported in c), while providing useful information, are not fully consistent with the SNA and, therefore do not enter in the calculation of environmentally-adjusted aggregates.

3.8 Environmentally-adjusted Economic Aggregates

A forest sector SEEA allows the calculation of a range of economic aggregates which reflect cost adjustments. For example, a supply-use identity is an indicator of the supply of goods and services produced and imported in the Forest sector. It is equal to the use in intermediate and final consumption, capital formation and export. If all forest uses are properly linked, it will yield an indicator of all forest benefits. Also, a forestry environmentally-adjusted value-added identity can be calculated. This describes value-added for the sector net of depletion and degradation costs. Finally, an environmentally adjusted domestic-product identity for the whole economy may also be calculated. This is the environmentally adjusted value added of all industries with a further reduction of household generated environmental costs. This later index will allow better inter-industry comparisons of economic performance.

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23 This discussion is based on UNSD (1997).
4 Country Experiences: Selected Case Studies, Trials, and Policy Recommendations

4.1 Introduction

There have been a variety of experiences in establishing satellite accounts for the forest sector and in using data typically found in such accounts in evaluating sustainable development issues. Some studies have been initiated with the fundamental purpose of establishing new accounts and accounting procedures so that robust information will be available on an annual basis for the kinds of policy analyses discussed in the first chapter of this report. Other studies have been essentially policy oriented in nature. Vincent and Hardwick (1997) provide an excellent review of the breadth of sustainable forest development studies. The primary thrust of many of the studies they reviewed was to utilize data similar to what has been proposed for forest sector satellite accounts in analyzing sustainable development. The range of experiences is rather broad. Eurostat, the statistical division of the European Union, has initiated a 5 country pilot study with the fundamental purpose of developing harmonized accounting procedures for all member countries. Experiences from the first year of these trials are reported in this chapter. The Statistical Division of the United Nations (UNSD), along with other international agencies, has helped several countries develop economic and environmental accounts. Much of this work was done before the development of standardized accounting procedures cited in chapter 3 of this report, although the accounts are consistent with this material. FAO commissioned four case studies, and the World Bank sponsored two studies through the Danish Trustfund of Environmentally and Sustainable Development. A key thrust of these studies focused on sustainable forestry issues with particular attention to prospects and potential problems associated with timber asset valuation procedures proposed by Vincent and Hartwick (1997). These commissioned studies contrast with those initiated by Eurostat and UNSD because they were not concerned with robust accounting principles per se, but rather on asset valuation and sustainability.

In addition to these commissioned case studies, trials and the assisted implementation of new satellite accounts, there has been a wide array of sustainable development studies of the forest sector. Some of these investigations have been done as national income accounting exercises and others have been essentially policy analyses which utilize the kind of data that would be found in forest sector satellite accounts if they existed.

Many important lessons can be learned from these broad and varied experiences. What problems are there in data sources? How have assets be valued? What approaches have been used in monetizing nonmarket goods and services? What kinds of sustainable development issues have been addressed? Is the thrust of these studies the depletion of timber assets or broader forest ecosystem level concerns? How has depletion been defined? What has been the relationship between forest assets in the SNA and forests in the SEEA? How have inter-industry impacts been treated?

In this chapter we examine and summarize these broad experiences with the purpose of providing insights to those that will develop and utilize forest sector satellite accounts. Following the discussion of country experiences, the chapter and report conclude with a set of priority actions, capacity building and training needs.
4.2 Eurostat’s Experience with Forest Sector Accounting Trials

The framework for forest accounting grew out of Eurostat’s broader program for the development of Natural Resources Accounting, (see Joisce, (1996) report of the London Group Stockholm session). This framework constituted the first step of the program on the forest sector and focused on the integration of physical and monetary balance sheets, physical and monetary supply-use tables and economic accounts for forestry. Subsequent steps for the incorporation of additional environmental concerns will be initiated during 1998, and will encompass non-SNA forest values.

In 1996-1997, five countries, under contracts with Eurostat, agreed to test ten main tables derived from the accounting framework. The purpose of the pilot exercises was to test the proposed forest accounting framework to determine what kinds of problems might be encountered if the system is more broadly implemented. The essence of the framework included the following objectives, which broadly shape the evaluation of the pilot studies.

- To link in a consistent way, physical and monetary data,
- To link flow and stocks accounts,
- To introduce some environmental concerns,
- To formulate an accounting framework that allows for the calculation of most of the indicators retained by the Ministerial Conference on the protection of forests in Europe (Helsinki 1993), as well as a comprehensive description of the interactions between human activities and forests as a component of natural environment.

Two essential aspects of the accounting framework are balance sheets and flow accounts.

4.2.1 Balance Sheets

*Balance sheets* represent the essential classification of forest assets. Starting from internationally agreed-upon forest definitions (FAO, UN-ECE), this classification is intended to be the basis for describing the main changes in the status of forests. The accounting objective of providing a more detailed trend of European forest changes was to be accomplished by coupling balance sheets through cross-classification with economic issues. For example, an attempt was made to integrate defoliation and mortality of forests to reflect changes in forest sector benefits. In addition, the benefits of carbon accumulation in forests as a global environmental benefit were integrated within the physical forest balance sheets.

On the monetary side of the forest balance sheets, no specific approach to value estimation was required of the participating countries. Rather, the choice was left to countries with the recommendation that the methods be simple, easily reproducible, and not particularly demanding of data.

4.2.2 Flow Accounts

*Flow accounts* describe levels or rates of activities within an accounting period. Descriptions of activities can be expressed in physical terms or monetary terms. Examples of physical flows are changes in land use, the growth of cultivated timber within a year, amount of timber felled, and the amount of logs consumed. The monetary counterpart to physical flows is rates of money flows. For example, the monetary counterpart to the physical volume of timber felled in a year is the annual value of the stumpage payments. The objective in establishing these accounts is to provide data necessary to link the forest sector flow activities with flows
in other economic sectors. For example, if the forest sector sold logs to the sawmill sector, the monetary flows represent the links between the two sectors. A "Forest Resource Use and Management Account" was proposed, as well a description of residuals flows.

4.2.3 Proposed Tables

*Fifteen tables* were drafted in order to test the proposed European forest accounting framework. These tables represent a starting point and were not intended to cover all the forests issues and aspects addressed by the accounting framework. The composition of the 15 tables included the following items.

- Balance sheets in physical and monetary terms (areas and volume of standing timber): 4 tables
- Output related to forests and economic accounts for forestry 3 tables
- Supply use tables in physical and monetary terms 4 tables + 2 complementary tables on residuals
- Mass balances: 2 tables + a complementary table

4.2.4 Experience and Insights

The pilot exercises were originally intended to test the feasibility of the framework concerning classification issues, and the separation of economic accounts between forestry and logging. Valuable and somewhat unanticipated lessons concerning forest valuation were also forthcoming. The experimental exercises also provided important insights into the changing character of European forests although these results should be considered as unofficial.

4.2.4.1 Classification and Physical Balances

In general the statistical offices took the position that all European forests are exploitable for wood production and are more or less "cultivated". However, in fact, some forests are non-exploitable either because they are protected or inaccessible. Within the class of exploitable forests, it is possible and at times useful to distinguish between forests that result from "afforestation" in recent time periods (e.g. 20 years) as opposed to regularly managed forests or more mature forests, or stands without any intervention for at least 25-30 years. This classification may be very important because the later class of timber is more likely to be harvested in the near term than the former and as a result is implicitly more valuable.

The pilot exercises point to the need to harmonize classifications before drawing any conclusion from the data. It is clear that the share of non-exploitable forests vary widely between countries due to different definitions of protection or accessibility. Using national forest inventory (NFI) data did not present any insurmountable problems in determining physical balances of forest land and standing timber over a five-year period. These balances do not show great variation in terms of total forest area. However, they do indicate a general movement from "non protected" to "protected" status while at the same time showing an increase of stocks of standing timber in exploitable forests.
4.2.4.2 Introducing Forest Quality Classifications

Quality classifications were introduced in the accounting framework. The objective was to provide a basis for examining trends in the physical degradation of forests thereby providing a basis for the corresponding valuation of forest losses. Germany was successful in cross-classifying economic and quality characteristics. Sweden and Finland only were able to provide information in annex tables. None of the countries reported forest degradation in their monetary balance sheets. It became apparent that in order to value forest degradation, it is necessary to have both physical data and different prices for the various quality classes of timber. Apparently this kind of information is not readily available. Furthermore, if a present value approach were applied to the balance sheets for forests, it would be necessary to use different natural growth rates for the various quality classes as an expression of degradation. This in turn would have to be coupled with discounted (and apparently unavailable) quality class prices. Based on the problems with valuing forest degradation, it may be necessary to reevaluate the continuation of this component of forest sector accounting. Whether or not a full cross-classification of economic and quality parameters shall continue to be included in the accounts must be discussed. The German report shows that the cross-classification is feasible.

Other countries had lesser success in these initial ventures.

4.2.5 Monetary Valuation

Forest valuation has traditionally involved development of separate values for land and standing timber. Because timber is sold more often as an asset to be removed from the land than is the case of the combined sale of land with standing timber, timber values are typically more readily available than are forest land values. Furthermore, when forestland is sold with standing timber, both assets are commonly included in a single transaction price.

Valuation of land was approached by using either actual or “recommended” (prices set by qualified land appraisers) prices for sales of transacted forest real estate. This method seems preferable to any other. However, further analysis may have to be done to determine how variation in the characteristics (for example difference in tree species, timber volumes, and development rights) of the real estate transactions contributes to explaining variation in real estate prices. In subsequent studies, a variety of approaches for estimating land values will be conducted. These approaches include market values, recommended values, alternative use values (marginal agricultural land values may be particularly meaningful), and capitalized rent values.

A variety of approaches were utilized in the valuation of standing timber. For example, Sweden and Finland use stumpage prices while Germany uses a hedonic pricing method. Although valid comparisons are not always possible, it appears that the asset value of the total forest, which is the sum of land and standing timber values, is very high relative to the actual transactions received. This point should be carefully examined and given considerable thought.

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24 Quite incidentally, Jackson (1997) just completed a consulting study for the Montana Department of Natural Resources which studied forested real estate transactions an was able to separate the value from standing timber from other land asset values.
4.2.6 Economic Accounts for Forestry and Logging

The intent of the original proposal was to define all trees in exploitable forests as cultivated. This essentially implies that all timber growth in exploitable forests is an output contributing to GDP. As a consequence, separate accounts for forestry and logging were advocated so that the benefits could be separated. This was only done in a consistent way by one country. Because the aim in the accounting framework is to link economic accounts with balance sheets, as well as to link monetary data with physical data, it would be useful to actually complete this part of the pilot exercises independent of the decision taken by national accountants. This would provide more meaningful information and help further evaluate the trial accounting framework.

An interesting result of the exercise is that, with the exception of Germany, the rate of return of Forestry is 2.5 - 3%, when the value of standing timber is calculated by stumpage prices. This rate of return is low in some respects. However, in developed countries, the long-term real rate of return on capital, before adjustments have been made for natural resource depletion, has been on the order of 2 to 4%. It appears that the preliminary forest sector rates of return are in keeping with the overall long-term performance of the developed economies. Perhaps one reason that the rate of return was higher in the German case study is their apparent reliance on hedonic stumpage prices. The term hedonic means “quality adjusted” prices. In comparing the average quality of timber being harvested with that of less mature growing “work-in-progress” timber, one would expect quality differences. Timber quality normally improves with growth so that the value per unit of volume of mature timber should exceed the value per unit of volume of maturing timber. This means that the average value per unit of volume of growing stock is typically less than the average value per unit of volume of timber being cut. If the value of growing stock is not adjusted downward to reflect it’s lower average quality, timber receipts as a percentage value of stock will appear unrealistically low.

Other products related to forest and other wooded land (berries, mushrooms, game, recreational fees, etc., either market or for own final use) were partially identified by the different national exercises. Forest management expenditures were not desegregated and separately allocated for these products.

4.2.7 Supply and Use Tables: Mass Balances

The purpose of developing supply and use tables is first to provide a consistent linkage between economic uses. Particularly important are the linkages between final wood product consumption and exports and the resulting derived demand for timber. This most fundamental linkage demonstrates the importance of forest resources in a national economy.

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25 This does not seem to be the position of Eurostat EAF (revised edition). However, if natural growth is not recorded as output in balance sheets, the relationship between excess growth in relation to fellings will have to be treated as “other changes in the volume of assets”.

26 Jackson and McQuillan(1979) developed a hedonic pricing method which uses the diameter distribution of timber sold to predict timber prices. Small trees are worth less per unit of volume than large trees. Stand growth models typically project the diameter distribution of timber stands so that diameter based prices may be an excellent way of allowing prices to change for maturing forests. This would place lower asset values on young timber than old timber in mass appraisals such as are being deployed in these studies. Forest management that converts from large timber to smaller timber is also a form of forest degradation and wealth depletion.
Due to the differences between national classifications of activities and products and the European classification of industries and products (NACE Rev.1 and CPA) it was not always possible to fill in the proposed tables according to common classifications. Moreover, in some cases, owing to unavailable data, uses and supply could not be matched. Some additional work is necessary because data concerning the supply and use of wood are apparently inconsistent and can’t be matched with corresponding elements in economic accounts.

*Residuals* are the left over waste products associated with production. Another important objective of the pilot studies was to describe flows of wood and paper wastes as well as residuals linked with forest related activities. This objective was more or less accomplished in the in the area of wood and paper waste products. However the lack of detailed data for the waste treatment and recycling industry hampers the elaboration of accounting for residuals balances.

### 4.2.8 General Assessment of the Eurostat Pilot Exercises

The main conclusion from the limited initial exercises is that consistent integration of physical and monetary data, along with flows and asset stocks is not straightforward. This is true even for countries which have comparatively well developed forest data bases and where the initial experience focuses simply on reformatting and delineating SNA transactions and balance sheets. Assessment of actual maintenance costs or forests protection expenditures will necessitate further analytic efforts as will the choice of a harmonized valuation method. Besides consolidating the experiences of the first pilot exercises, there may be adjustments in the accounting framework as well.

The objective of the next phase of developing natural resource accounting, scheduled for the current year, will be an attempt to integrate "non SNA" values. However, there will be no attempt to modify the aggregates of system of integrated accounts. Even when previously mentioned market valuation issues are solved, the remaining key problems appear to be the development of approaches to handle these "non SNA" values. The following represents a more detailed list of aspects of these non-SNA values and associated issues.

- Are non-SNA values already (partially or totally) included in some SNA valuations?
- Are non-SNA values actual values?
- Are non-SNA values comparable with SNA values?
- Are non-SNA values additives?
- When extending the production boundary of SNAs in order to include natural services, how should the services be treated?

At the next stage of model construction, the objective of satellite monetary accounting should be to propose a consistent treatment (consistent both in terms of contemporary economic analysis and SNA conventions and concepts) of the important nontimber economic values. Finally, further consideration should be given to some of the recent studies on valuation such as Hulkrantz's (1992) Swedish study. This study included many important nonmarket values and found that when these values were included, value added was substantially larger.
4.3 Implementation Experiences in Countries assisted by UNSD

The United Nations Statistics Division (UNSD), with the financial support of UNEP, UNDP and The World Bank, has provided technical assistance to several countries for the implementation of the SEEA. One component of the SEEA compilation consists of forest accounts, although other important environmental accounts have also been instituted. The first set of countries that tested the feasibility of the SEEA before the publication of Integrated Environmental and Economic Accounting (1993) were Mexico and Papua New Guinea in 1992. Satellite accounts were next implemented in the Republic of Korea, Philippines, Ghana and Colombia between 1993 and 1998. The account compilation methodology used in these six countries is consistent with methodology presented in this report. All case studies used data already available from government sources and from special studies. The valuation method for depletion allowance used for all the following case studies is the net price method.

4.3.1 Philippines

The National Statistical Coordination Board (NSCB), with the technical assistance of UNSD completed the SEEA implementation project. The project was carried out jointly with the Department of Environment and Natural Resources (DENR), the National Economic Development Authority (NEDA) and the United Nations Development Programme (UNDP). Asset accounts for forests, fish, mineral resources, land/soil and water were compiled for the period 1988-1994 in physical and in monetary terms. In addition, emissions costs for selected industries were estimated and environmentally modified indicators were calculated. The forest accounts included accounts for dipterocarps, pines, mangroves, mossy and submarginal forests. Rattan accounts were the only non-timber product account included for dipterocarp forests because rattan has a significant economic value. Forest depletion was the most significant part of the environmental cost generated during the period 1988-1991. After the introduction of the logging ban in 1992, the depletion as well as the contribution of the forestry industry to NDP (0.39% in 1994) decreased substantially. Figures on the forest and land accounts are currently being revised.

4.3.2 Colombia

The Administration Department of National Statistics (DANE), with the technical assistance of UNSD, implemented the Colombian System of Integrated Environmental and Economic Accounting (COLSEEA). The project was carried out jointly by the Interagency Committee on Environmental Accounts (CICA), involving DANE, the National Department of Planning (DNP), the Ministry of Environment, the Institute of Hydrology, Meteorology and Environment Studies and UNEP. Environmental protection expenditures of industries, households and government along with accounts for mineral resources, forest, land and water were compiled. Accounts were compiled for produced and non-produced economic forests as well as for noneconomic environmental forests. Changes in the opening and closing forest stocks were reported in both volume and biomass and were estimated using data generated by special studies. Deforestation caused by illegal logging and fuelwood production was included in the asset accounts and estimated income generated from nontimber forest uses was limited to eco-tourism and the production of pharmaceutical product values.

27 Attempts were made in special studies to estimate and monetize important environmental forest functions for water volume regulation and soil protection.
4.3.3 Republic of Korea

Korea Environment Institute, with the technical assistance of UNSD, has just completed a pilot compilation of the SEEA. Asset accounts for land, forests, fish and mineral resources as well as environmental protection expenditures and emissions into land, air and water were estimated. Deforestation and forest depletion do not constitute an environmental concern in Korea. Forest stocks have been increasing steadily, as a result of extensive reforestation and protection policies. The contribution of forestry to GDP was only 0.2%.

4.3.4 Ghana

Ghana Statistical Service, with the technical assistance of UNSD and the Overseas Development Administration (ODA) coupled with financial support from UNEP undertook a pilot SEEA compilation. Asset accounts for timber, marine fish, subsoil assets, water, and forestland were compiled for the period 1991-1993. Even though the importance of non-timber forest products is recognized in the Ghanaian economy, it was not possible to obtain data estimates necessary to compile broad forest sector accounts. The value of forest land was estimated using adjusted compensation rates paid by the mining companies for forest destruction. No estimate of the allowable cut was available, it was therefore not possible to estimate depletion relative to a ceiling rate of harvest (UNSD’s approach to hard sustainability).

4.3.5 Mexico

The project was carried out in 1990 and 1991 jointly by UNSD, the World Bank and the National Institute of Statistics, Geography and Informatics (INEGI) in Mexico. Attention focused on the following environmental concerns for the year 1985: oil depletion, land, water, and soil degradation, deforestation and changes in land use. Timber accounts as well as land use accounts (including land use changes) were calculated. Environmental protection expenditures by the forestry industry were estimated to be very low. A depletion allowance was calculated and deducted from the value added of the forestry industry. The environmentally adjusted value added turned out to be 27.2% of the value added for forestry.28 The contribution of the forestry industry dropped from 0.54% of NDP to 0.15% of environmentally adjusted NDP when depletion was incorporated in the production accounts and nonforest products were excluded. The capital output ratio, an indicator of the capital productivity of the sector dropped from 45.38% to 12.34% when natural capital was added to produced capital with depletion accounting.

4.3.6 Papua New Guinea

UNSD and The World Bank carried out environmental account implementation in 1992. SEEA was compiled for 1986-1990 and included forests, mineral resources and energy accounts. Forest asset accounts were compiled for “economic” (i.e. that have a potential economic use for logging activities) and “environmental” (i.e. forest land non-accessible for logging operation, mountain areas, etc.) forests. The forestry industry is comparatively small and represents about 4.1% of GDP. Lack of reliable data on timber production did not allow the estimation of depletion. An attempt was made to estimate the value of losses of ecological functions due to exploitation. The estimates were on the estimated compensation

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28 This is calculated on the narrowly defined forest industry ISIC 02.
costs by logging companies to landowners and amounted to a range of 0.4-2.3 % of NDP and 6.4 – 39.3% of NVA of the forestry industry.29

4.3.7 Experience of UNSD Assisted Countries

Several points are noteworthy in these studies. First, existing data sources had to be augmented by special studies. Second, forest resources varied from country to country. For example, some countries limited the forest sector to timber. Others added eco-tourism, fuelwood, rattan, or pharmaceutical values. No country examined carbon sequestering services or their value. It appears that broad multiple-use values were not consistently appraised and included in forest sector accounts. Virtually no country had good timber prices so the net-price values had to be estimated as residual values. Of course, one would expect that the inclusion of depletion would reduce estimates of value added. The change in the amount of value added in Mexico seems to be “surprisingly large”.

4.4 A Summary of the FAO/World Bank Commissioned Studies

Case studies in Brazil, Chile, Philippines and Zimbabwe were supported and directed by FAO and the World Bank with the primary purpose of examining the feasibility of utilizing the valuation approaches proposed by Vincent and Hartwick (1997) to evaluate sustainable development.

Each included country faces unique sustainable development dilemmas. At the same time, many problems are shared somewhat in common in developing the necessary information to evaluate the contribution of the forestry sector to a society’s long term economic well-being. As a result, we start this part of the chapter with a summary and overview of the particular focus of each case study. In doing this, we examine the physical accounts utilized in the case study, the approach to valuation and then we briefly restate the conclusions. Following the presentation of each case, we look at patterns in analytical problems and make broader suggestions about the usefulness of forest sector information in these approaches to policy analysis concerning sustainable forestry.

4.4.1 Brazil

Seroa da Motta and Ferraz do Amaral (1997) examine rates of depletion of both Mahogany and all other timber in the Brazilian Amazon. The area excludes the state of Mato Grosso but includes the area referred to as the Legal Amazon. The Amazon is the world’s largest tropical rainforest and its socio-political-bioeconomic importance is reflected by the authors’ exclusive focus on the region’s timber sustainability. No estimates of other forest benefits are included.

The physical accounts are suggested, rather than directly enumerated and are represented by stock estimates in 1990 and 1995 for “all timber”. In addition, there is a 1990 estimate of the stock of “mahogany”. There are no land accounts, nor are there neither other indicators of timber quality nor ways of adjusting outputs in other economic sectors. There is also no direct adjustment of GDP for timber assets in the Amazon.

This study relied upon estimates of stumpage price and production costs. They use the Vincent and Hardwick approach. Stumpage values are net of average extraction costs. In the absence of any estimate of the elasticity of marginal extraction costs, the authors do a

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29 The SEEA does not recommend deduction from GDP.
sensitivity analysis using two extreme (0 and infinity) and more informed rates of 1 and 3. In addition, they also do a sensitivity analysis of the discount rate with values of .02, .04 and .10. The authors were able to obtain average prices of sawn logs but only average rather than marginal costs of logging and extraction were available. This made the development of the valuation approach proposed by Vincent & Hardwick (1997) very difficult.

Of course the sensitivity analysis creates a variety of estimates concerning the longevity of both mahogany and all timber assets. In all cases the mahogany asset liquidation is expected to be completed many orders of magnitudes earlier than for all timber. This suggests that there is a qualitative degradation of the timber resource. Because, the report doesn't examine changes in the forest sector's wealth, it was not possible to look at the broader view of sustainable development.

The authors experienced many data availability problems. It would have been useful to more broadly examine changes in land use, timber wealth, and related forest benefits in a broader context of sustainability. Furthermore, the issue of dual issues of both inoperable stocks and unused harvests looms large in areas like the Amazon. For example, if unused harvests represent 50% of the volume removed, and substantial areas are inoperable, the longevity or sustainability of the harvests could be very different from the conclusions of this study.

4.4.2 Chile

Vergas and Sandoval (1997) examine the sustainability of timber produced from short rotation timber plantations (cultivated economic assets). There is no attempt to examine changes in land use, nor other forest benefits. The study is limited to areas planted in plantations for the periods of 1985-1996. For growing stock, the inventory includes land areas and ages of both species for annual ages from 1 to 20 years, the typical harvest age in the plantations. There were no adjustments for catastrophic losses or for other market or non-market forest benefits. Plantations account for the industrial basis of forest products in Chile, although the plantations account for only 2.8% of the total surface of the country while the native forests account for 17.8% of the total land area.

Separate asset values for plantations of each of two tree species were calculated using the modified El Serafy approach. Since the plantations are intensively managed around 20 year rotations, an asset value for each age was multiplied by the appropriate number of hectares for that age in accumulating the plantation asset value. Costs of timber extraction were constant, as were stumpage prices during the period of analysis. Timber prices were estimated using the residual value method of timber appraisal rather than using observable stumpage prices.

From the standpoint of forest plantations, Chile has been accumulating wealth. Based on current plantations and rates of growth and harvesting, asset accumulation is expected to continue through the end of a 20 year forecast period. In other words, the plantations represent a sustainable form of wealth accumulation in the nation's economy. Also evident was the effect of a policy modification toward the end of the period of analysis that reduced the incentives to develop plantations. Corresponding with the policy change was a lower, but still positive rate of increase in the plantation land base and resulting lower rate of asset accumulation.

From the standpoint of a broader calculation of forest benefits, it would be interesting to know what land uses were being replaced with the addition of forest plantations. Also, it would appear that carbon sequestering would be a net benefit of plantation accumulation and a reasonably simple extension of the analysis. No attempts were made to estimate value
added from forest plantations. Also, even in plantations, there may be unused harvests, so that the asset values may be overstated.

4.4.3 Zimbabwe

Mabugu, Milne, and Campbell (1997,1998) evaluate the sustainability and economic importance of fuelwood in Zimbabwe. About 70% of the nation's energy consumption is derived from wood. Fuelwood use is a contributing factor to deforestation, and recently was rated as the most serious environmental problem facing the country. Fuelwood use is a case of an unreported forest value and as a result, the role of forests in providing fuelwood is easily overlooked. Furthermore, using the usual indicators of welfare such as per capita GDP, the economy has been in steady decline throughout the early to mid 1990s. Thus, developing better estimates of the sustainability of natural resources and wealth are very important to Zimbabwe.

Essentially, two accounts are utilized, a land account and a timber account. The forest land account has been experiencing about a 2% annual rate of loss to agricultural uses during the period of 1986-1995. In assessing the timber stock and growth available for fuelwood collection, further reductions were made in the accounts due to the protected nature of some lands such as national parks. Growth estimates were made in terms of mean annual increment (MAI). Estimates of fuelwood consumption had to be made by utilizing studies of the number of households using fuelwood and fuelwood consumption rates. The consumption estimates were adjusted downward to fuelwood removals by deducting estimates of supplies from drywood and land clearances.

One thorny problem is to estimate the costs of fuelwood collection. The report relies on an opportunity cost approach since most fuelwood is informally collected rather than compensated work. This kind of work is almost universally left out of national income estimates. Costs depend on the time involved and because deforestation takes place near residences first, costs increase with distance traveled to collect wood. This suggests that costs will rise with time and with total fuelwood harvested. The value of fuelwood was estimated using market prices of fuelwood. Hotelling rent is determined by converting the total rent by Vincent and Hardwick’s conversion factor formula using an annual interest rate of .18 and an elasticity of marginal cost of 0.6. There was literally no estimate of the elasticity of marginal costs so the authors essentially had to assume a number in order to complete the valuation work. Finally the estimated value of fuelwood was added to create an adjusted GDP and NDP.

Fuelwood adjustments represent about a 1-% adjustment to GDP. This is substantial and suggests that estimating other forest benefits is likely to produce a much better indication of the importance of forests to national well being. With forests disappearing at an annual rate of 2%, this may indicate some need for new policy analysis. The authors found a variety of problems in collecting and utilizing data. For example, they had hoped to readjust GDP in the energy sector to reflect the reliance on wood energy but were unable to do so. They recommend a different and more useable form of data collection in the future.

Adding the value of wood fuel consumption to the national income measures of well being in Zimbabwe helps develop a better understanding of sustainability. There is currently adequate forest growth to sustain levels of fuelwood consumption. However, because fuelwood use has such local spatial collection economies, there may still be major problems that aren't reflected in this scope of analysis. Because national accounts examine changes in economic aggregates, these kinds of sustainability issues may still be overlooked in forest sector satellite accounts. There should be a way of cross walking between the national and local levels of analysis.
4.4.4 The FAO/World Bank Commissioned Studies in Retrospect

Perhaps most interesting from the standpoint of broad patterns is the lack of good timber inventory data. Even in the case of the Chilean plantations, managed stand yield projections were used and coupled with records of land areas planted as a means of estimating the inventory of wood in each annual age class. The most difficult timber and forest inventory problems, which really preclude good estimates of the value of this kind of natural wealth, were found in Brazil and Zimbabwe.

Each study was also confronted with problems in resource valuation where timber pricing was not a particularly easy accounting venture. In spite of the normal economic classification of timber as a market good, imperfect market arrangements make it very difficult to estimate the true worth of the timber. Some countries had reasonably good estimates of the costs of growing and tending timber. Where the examination focused on native forests as opposed to plantations, it was difficult to separate operable from inoperable forest lands and also to adequately examine how qualitative differences in timber affected asset and flow values.

Recalling that an important element of the Vincent and Hartwick (1997) approach to valuation relies on knowledge of the elasticity of the marginal cost of logging, it is fair to say that data of this type is in extremely short supply. Seroa da Motta and Ferraz de Amaral (1997) provide interesting insights into and critiques of the limitations of the Vincent and Hardwick approach.

Finally, in all of the countries there is little evidence of knowledge of unused harvests and their impact on sustainability. In Zimbabwe, fuelwood harvests are estimated from household surveys. In Brazil, harvests were estimated from mill production data and in the plantations of Chile, it was simply assumed that utilization of a mature plantation was complete.

4.5 Broad Patterns in National Income Based Forest Sector Studies

Having identified the broad view of total forest benefits and total forest values that are germane to sustainable forestry and sustainable development in an earlier chapter, we now turn our attention to a different form of experiences. Here we ask the question, where have people focused their studies to date? Has the main focus been on the sustainability of timber and forest lands or has the attention instead been placed on the broader array of forest benefits? Have analysts been more interested in the asset accounts (balance sheets) or the flow accounts? Have countries in one region of the world been more likely to examine sustainable development from a national income accounting perspective than another region? And how many studies actually looked at the contribution of the forest sector, either broadly or narrowly conceived, to national income?

Dube, Jackson and Narain (1998) utilized the summary of studies presented in Vincent and Hardwick to examine patterns in these studies. Since the late 1980s, the greatest number of studies that have aimed at incorporating forest resources into the national accounts pertains to countries in Asia, and the least to countries in Africa. The number of studies increased more or less steadily during the 1990s, with the greatest number, nearly a dozen, being published or otherwise made available in 1996. Several more are in preparation under the auspices of the UN Statistical Division. Only twelve of the studies appear to have involved government agencies responsible for the preparation of national accounts.

The benchmark study is the well-known examination of Indonesia by the World Resources Institute (Repetto, 1988). This is the most frequently cited study on natural resources (including forest resources) and the national accounts. A study for the World Bank by Peskier (1989), which commented on the WRI study and contained additional estimates for
Tanzania, came next. Most of the studies covered one or more resources in addition to forests. That is, they did not focus exclusively on forests. More than half covered subsoil assets in addition to forests. Other non-forest resources included agricultural soils, rangeland, fisheries, and, in a few instances, air and water pollution. The forestry-specific studies tended to be the more recent ones and covered the longest time periods. In particular, the Canada studies analyzed the longest period, from the early 1960s to the early 1990s. Most studies, whether forestry-specific or more comprehensive, covered at least one decade.

Virtually all the studies included timber, and nearly half covered one or more nontimber aspects of forest resources. The list includes nonmarket production of fuelwood, berries, mushrooms, game, rattan, and peat; amenity values associated with protected areas and biodiversity; environmental services like watershed protection and soil protection; carbon sequestration; and acid deposition.

Some studies made adjustments to both flow (current) and asset accounts, while others made adjustments to just one or the other. Of those that made adjustments to current accounts, about two-thirds made adjustments for net accumulation. In most cases, the net accumulation estimates were for timber, although a few studies included nontimber values in calculations of net accumulation of forest land. Five studies estimated the value of nonmarket production of forest goods, which is an adjustment to GDP. One study (Finland) investigated a specific SNA recommendation, that timber growth in “cultivated” forests be valued and added to GDP. New Zealand has already implemented this recommendation for some time. About a third of the studies made adjustments related to asset accounts. In most cases, they simply calculated the value of the standing forest, without formally linking the estimates to stock and flow accounts. A few did, however, and compared the asset value of forest resources to the value of other assets in the economy. Malaysia studies, in addition to focusing on adjustments at the national level, also adjusted income accounts at the subnational level. They found that the impacts of net accumulation adjustments varied greatly within the country, with important implications for regional sustainability.

4.6 Knowledge Gained from Country Experiences

The promise of full benefit accounting for the forestry sector in the evolving national income accounting procedures is great. But, the potential also exists to do the forests and people of the world a lot of harm if the new accounting systems are illframed, poorly implemented or if inadequate, erroneous, or incomplete data is utilized in the accounting systems. We now examine the four kinds of experiences in aggregate. The fundamental question is what can be gained from looking at the EUROSTAT trials, the UNSD assisted examples of implemented forest sector accounts, the FAO/World Bank commissioned studies, and the broad pattern of other investigations. We hope to be able to use the experiences to uncover any potential conceptual problems, persistent patterns of inadequate data, or other problems that may help in developing and using forest sector satellite accounts.

4.6.1 Experiences and Potential Problems with the Physical Measures of Forests

Chapter 1 discussed the importance of physical measures of forests, timber, and related resources. The inventory of forest lands and standing timber is never a simple problem.

Collecting inventory data is expensive and countries define lands and timber volumes in ways that are not always completely comparable. In the Brazilian Amazon, there really was no timber inventory. Rather, some sample plots were used to extrapolate an estimate of the mass of timber over an area which itself is hard to estimate in total size. The Chilean study
had estimates of the plantation land base and estimated timber inventory by coupling the planting date with yield projections. In Zimbabwe, forest inventory has traditionally focused on plantation forests so that the authors of that case study were faced with making some informed, but somewhat ad hoc estimates of growth in the natural forests. Coupling the problems of estimating a traditional timber inventory with emerging needs to examine quantitative aspects of forests in nontraditional ways was driven home from the EUROSTAT trials. The volume of standing timber maybe a reasonable indicator of carbon storage. However, considerable effort must go into examining total carbon storage and uptake throughout the life of both economic and noneconomic forests in order to gain better knowledge about the relationship between the commercial measures of stem biomass and total forest carbon uptake and storage.

There are no standard commonly accepted ways of measuring biodiversity. In fact there are several conflicting measures. In the absence of a readily accepted physical biodiversity index, less robust criteria and indicators might be included in forest sector satellite accounts.

Timber inventory data was apparently not a major problem in the EUROSTAT trials, but lack of a harmonized inter-union measure of operable lands apparently was a problem. This measure should not be based exclusively on physical parameters of forest sites. Costs and values must also define inoperable lands. Likewise, isolated sites that are otherwise productive may never the less be inoperable. The cost structure of logging can easily differ between countries. Operable sites in one economy may be inoperable elsewhere. There was no attempt to define the operable land base in the Brazilian Amazon. The Zimbabwe case study did make an operability adjustment concerning the production of fuelwood. It also recognized that the costs of fuelwood gathering were a function of the distance traveled to collect fuelwood, although it is not clear whether this form of location economies was part of the operability definition.

Finally, some country experiences indicate that measures of log removals are a poor indicator of logging depletion. Without good estimates of logging related mortality, log removals will understate depletion. In some developing countries this form of data problem could convert what appears to be net accumulation to net depletion. Thus log flows to wood using industries must typically be converted by a physical coefficient in order to convert log removal flows to reductions in standing timber stocks. The coefficient essentially represents “unused” harvests.

4.6.2 Experiences in Quantifying and Valuing Forest Benefits

The country experiences reveal a variety of problems in valuation. Not only are there problems in valuing nonmarket resources, there are also problems in valuing timber and forest land as well. In the Brazilian case study the most reliable market prices were for sawn logs and these values had to be adjusted to estimate the value of the standing timber resource. Furthermore, timber in the Amazon is treated as an open-access resource and the prices under these circumstances can’t reflect its competitive value. In the Chilean case study, the residual value method was used to estimate timber prices. It is an approach that subtracts average costs for an average operator from average product values. In an auction system, bid prices are determined by the interaction of marginal costs and marginal values, not averages. The “average cost operator” doesn’t win a timber auction. Thus, the residual value appraisal system can create bias that persistently understates actual timber values. Virtually all of the countries that implemented accounts with UNSD assistance used similar estimating procedures. When timber value is underestimated, all estimates of value added are understated as well.
Timber valuation methods in the EUROSTAT trials were left to each country. In countries that used stumpage prices to value the entire forest inventory (balance sheet asset value), the apparent estimated rates of return were 2.5 to 3%. Germany used a hedonic method and the apparent rate of return was higher. Apparently by using quality-adjusted prices, Germany’s standing timber value was estimated in a manner to reflect the actual value of the timber. Normally, immature trees are of lower value than mature ones. On the average, immature trees are smaller than mature timber, and smaller timber is typically converted into products of lower value and costs more per unit of volume to log and deliver to milling facilities. Unless the standing asset value is adjusted for these kinds of differences the net price method will overstate asset values relative to stumpage receipts. Virtually every case study has made this kind of error with the apparent exception of Germany and Chile. Stumpage prices reflect the qualitative characteristics of the timber sold. Because the entire forest has timber which is growing and changing in its characteristics as it grows, it is typically not worth as much per unit of volume as timber which actually enters the market place. This point is sufficiently important to warrant a brief diversion into some basic timber economics.

Timber has long been defined as a case of maturing assets. Timber appreciates for three basic and fundamental reasons. Timber grows so that standing physical capital accumulates with time. As timber grows, individual trees become larger. Large trees are worth more than small ones for two important reasons. There are fewer pieces of wood to handle per unit of timber volume so that logging, hauling, loading, unloading, sorting and sawing costs are less for larger logs than smaller ones. Furthermore, larger trees are typically converted into products of higher values. Lumber with larger dimensions, veneer products, and increasing amounts of wood with fewer (and sound) knots are all factors that help increase the value of wood per unit of volume as timber stands grow and appreciate. Furthermore, real wood product prices have increased around the world rather steadily since the end of World War II. This is the result of basic changes in scarcity. Thus if the average annual rate of timber growth is 2 to 3% over the life of a timber stand, its real rate of value growth typically far outstrips its physical growth rate. If forest sector accounts don’t reflect these basic timber economic facts, the purposes of developing full benefit accounting for sustainable forestry and sustainable development are essentially defeated because of the false appearance that forests are a “bum” investment opportunity.

Another key valuation issue surrounds the treatment of forest maintenance and protection costs. If a forest is managed to produce multiple benefits there are really but two accounting alternatives. Preferably, the total value of all forest benefits must be compared with total management costs. If total benefits are not measured, it is perhaps prudent to develop some administrative rules to separate costs and allocate them various benefits produced. In this later way, the share of watershed protection would be allocated to a water resource account; a share would be allocated to an eco-tourism account and so forth. For example, the countries assisted by UNSD, developed satellite accounts for timber but with the exception of the Philippines and Columbia, net timber flows were the only environmental forest benefit.

30 The experienced annual rate of return on forests lands and timber should be thought of as the sum of the forest income and the change in asset value divided by the sum of the land value plus the standing timber value. Clearly, if the numerator is erroneously high, the calculated rate of return will be erroneously low.

31 A bum lamb is a problem lamb to the herdsmen. It is either an abandoned or orphaned lamb and typically must receive extra care if it is to survive.

32 It is true that those who raise sheep and sell wool and mutton don’t have to worry about separating feed costs to each product. From the point of view of national income accounting the case is interesting since one product is used in the textile industry and the other in the food industry so that the question of cost allocation is germane when it comes to value added calculations. Any approach to separability is arbitrary. Of course making social investment decisions in sheep may be arbitrary too if the price of wool or mutton does not reflect its’ social value.
The Ghana case is an interesting one since it is acknowledged that many other forest benefits were excluded. Rather clearly, either the total forest benefits must be compared with the total forest costs, or some form of cost apportionment is in order.

Another important valuation issue involves approaches to valuing forest land. Vincent and Hardwick (1997) approach this issue by essentially combining the capitalized value of the land in growing timber into the present value calculations of the timber itself. Any other forest land values would have to be based on other non-timber commodity land uses. Since the case studies in Australia, Brazil, Chile, and Zimbabwe apply the Vincent and Hardwick methodology, there is no attempt to add an extra value of forest land. The pilot studies under the direction of EUROSTAT hoped to develop a credible land value in the capital account balance sheets. They found that this form of value was lacking and recommend further studies to develop better estimates of these values. It would appear that if nations follow the Vincent and Hardwick approach to timber valuation, there is no need to add a capitalized value of the timber production growing rights to a separate land account. However, if people following this present value approach, have a separate land account, they should deduct the capitalized value of the infinite series of harvest (the land value in the Faustmann solution) from the rest of the forest land value.

All of the above discussion of valuation essentially focused on what is typically assumed to be market resources. Of course, economists typically assume that if a resource is classified as a market resource, there are no valuation problems. Having dispelled that myth, we now turn to a discussion of non-market resources and forest benefits recorded in other SNA sectors. Table 5 and Table 6 in Chapter 3 make it clear how value added for forests must be conceived. If economies leave out important values, net value added calculations can be easily criticized. Several of the countries in the group that instituted forest sector accounts under the assistance of UNSD must get full benefit accounting to make value added estimates more meaningful. Thus far, the most thorough development of value estimates of non-timber forest products have been done in countries included in the EUROSTAT trials. These countries have the most advanced and progressive forest research organizations in the world. Finland, Sweden, and Germany also have very advanced forest products industries and have developed the best forest management information systems as well. These three countries, which are included in the EUROSTAT trials, are in the best positions to evaluate the total benefit contribution of non-timber forest values.

Valuation issues for nonmarket environmental values remain troublesome. A reason is the macroeconomic or general equilibrium nature of the national income based policy analysis models. Since changes in outputs for entire industries are considered, it makes no sense to exclude consumers surplus for market goods and services and simultaneously includes it for market goods and services. Other approaches to valuation such as the environmental maintenance cost approach is also somewhat unconvincing because costs are being observed at output levels that would not rest in equilibrium if in fact markets were operating.

4.6.3 Experiences with Establishing Forest Sector Linkages

The most thorough development of linkage estimates is found in the EUROSTAT experiences. Recalling that there were really three kind of linkages to be established in the first phase of their trials, they found some unexpected difficulties. First, they wanted to develop better linkages between woodland timber sources and wood conversion sectors. Here they found that differences in industry definitions and lack of harmonization hampered the accomplishment of these tasks. Second, they sought to develop better residuals flow linkages between wood and paper products wastes and broader pollution phenomenon. They appeared to be more successful at the product side of production than at the woodland
side in these ventures. Finally, they hoped to link air pollution with forest degradation via defoliation losses. Here the initial success was very unconvincing. Only one country (Germany) could actually create the necessary cross-classifications in order to link these activities. Furthermore, none of the countries could trace the impact of air pollution activities on timber production itself. In fact, the disappointing results of these attempted linkages may mean that these efforts won’t be continued in the future.

Of course, if and when forest sector linkages are successfully implemented, several important analyses will be possible. Fundamental among these kinds of studies will be the estimation of total value added of all forest sector activities to total economy-wide activities. This will allow policy makers to make more informed judgments about budgets and other key policy decisions. A few studies hint at the importance of these ventures. For example, the Zimbabwe study suggests that the value of fuelwood in the economy is about 1% of GNP. Another important example is Hulkrantz’s (1992) Swedish study which estimated the value of carbon sequestering services along with fuelwood, berries, game and estimates of asset appreciation made a substantial difference in the calculated forest sector contribution to national well-being. These values by themselves increased total benefits by about one-third over more traditional estimates of value added.

4.6.4 Other Ecosystem Management Concerns

Our discussion has thus far focused on the experiences surrounding physical flows, which may in principle be expressed as monetized accounts in forest sector natural resource accounting. But, of course, it was recognized at the outset that other forest sector benefits might not be monetized in national income accounting or in satellite accounting. Perhaps the clearest example of that lies with existence values since there is apparently no physical flow associated with the knowledge that something of value exists nor are there actual users or rights to use specific products or services. The classical case of this are the existence values associated with biodiversity. It was held that these values differ from indirect use values of biodiversity. These later values might be thought of as the values associated with maintaining a stable life support system.

Many manifestations of these ecosystems management concerns are reflected in a variety of ways in SNAs and related satellite accounts. For example, some endangered species are not consumption goods. Their populations may be at risk as a result of habitat takings rather than population takings. They have no direct use values and there is no associated direct measure of annual economic activity. In some situations, forests could be removed from the base available for commodity exploitation as a means of protecting the species in question. This in turn could mean a reduction in the asset value of the forests without depletion. This falls under the discussion of the economic appearance and disappearance of an asset. The unfortunate aspect of national income accounting is that it makes these kinds of resource allocation decisions appear costless. Creation of protected habitat represents a reallocation of land in the nation’s land account, and a redefinition of the nation’s timber inventory in the sense that the timber inventory is an exploitable asset. Of course, the economic costs of these decisions lie in foregone exploitation since nothing is exchanged. All of these decisions can and often are made without explicit estimates of the value of the at-risk species. The implicit judgement, or perhaps better yet, the revealed minimum value of the protected species lies in its foregone values. At the same time, however, the forests presumably continue to take up carbon, provide water products and recreational services and may also continue to yield other nonwood products. To sum it all up, it may be necessary to have some capital accounts that are not directly associated with flow accounts.
The Criteria and Indicators are another interesting case in point. Here, would seem to be a case of essentially physical accounts (both stock and flow) which are not monetized. The purpose of these accounts is to give a far broader view of sustainability, but without a numeraire or unit of value which would allow broader welfare interpretation of environmental, social and economic trends. While the existence of Criteria and Indicators will allow policy makers to see positive and negative trends in key indicators of sustainable development, it remains to be seen how the absence of an unambiguous index of biodiversity will influence their social utility.

4.6.5 Sustainable-Yield, Sustainable Forestry, Sustainable Development and Environmental Accounting

Perhaps one of the most interesting aspects of all of the trials, case studies and country experiences are found in contrasting approaches to sustainable development. This point is brought forward most provocatively in comparing some of the results of the FAO/World Bank commissioned studies with the UNSD country experiences. Recall that the UNSD approach to sustainability is one where depletion only occurs when the level of harvest exceeds a calculated allowable cut. The approach followed under the FAO/World Bank studies was more traditional in the historical sense of balancing growth with harvests. For example, the Brazilian study concluded that current harvest levels couldn’t be sustained and that the problem was most readily apparent in Mahogany. In contrast, using the UNSD approach to sustainability, no conclusions were reached about the sustainability of harvests in Ghana precisely because no level of harvest was calculated. Under the UNSD system of “hard sustainability” there is no depletion until calculated sustainable harvests have been exceeded.

Forest economists familiar with mathematical routines used in calculating allowable cuts will readily recognize many weaknesses in the UNSD approach. The UNSD approach may indicate depletion when there is actual capital accumulation. Likewise, substantial depletion may occur and go unnoticed using the UNSD definition of sustainability.

In developing national income accounting methods and practices which are broadly useful, it must be remembered that the audience of potential users will come from a variety of sustainability contexts. The origins of sustained yield, while essentially concerned with long term capital management viewed the problem from the perspective of managing the inventory of physical capital. In contrast, economists who view sustainable development as being a problem of the long-term accumulation of broadly defined wealth are convinced of the necessity of monetizing all environmental assets. The recent sustainable forestry perspective sees the problem as one of striking a balance in the mix of forest uses without the necessity of valuing all environmental assets because the problem is really one of trying to balance conflicting political interests. In a sense, the physical inventory and flow accounts are of greatest interest to sustained yield forestry advocates. The capital assets and monetized flow accounts are of greatest interest to the sustainable capital accumulation

33 Three simple examples come to mind. Forest management may result in the gradual accumulation of a higher proportion of more valuable species. Forest management may result in the accumulation of higher quality wood. Real timber prices will likely to continue to increase for the foreseeable future. All of these values may more than counterbalance a harvest that exceeds a calculated ceiling harvest.

34 Three reasons readily come to mind again. Obviously, over-cutting may occur with or without a calculated sustainable harvest. Second, sustainable harvest calculations are based in part on assumptions about how much will be spent augmenting timber growth both in current and future periods of time. Often even the best-intended assumptions are laid to rest. The result would be unrealizable annual allowable cuts. Finally, forest depletion could go unnoticed if all of the most valuable timber was being removed and replaced by fast-growing “junk wood”.

Economic and Environmental Accounting for Forestry: Status and Current Efforts
school while the Criteria and Indicators are based from the perspective of sustainable forestry and are likely to be of greatest interest to advocates of this school of thought.

It may be impossible to both monetize all aspects of the Criteria and Indicators and link them to other activities in the forest sector. This should not preclude their being included in satellite accounts. Economists have long worked under the simplifying macroeconomic assumption of a homogenous physical stock of capital. This assumption has absolutely no empirical content yet remains a useful concept in macroeconomic modeling. Criteria and Indicators are an attempt to capture many of the non-additive components of the collective concept of sustainable forestry. They should not be dismissed because they don’t behave like standard accounting transactions.

4.7 Policy Recommendations

Having focused the report on a description of forest sector environmental and economic accounts coupled with attention to their prospects, experience and use to date, it is now important to turn a proposed set of priority actions.

• Support resource inventory efforts including the introduction of new technologies such as GIS.
• Support development of household surveys of nonwood forest products consumption. In some countries these surveys might be included in the periodic census of population.
• Develop key approaches for resource valuation of non-exchanged direct use values consistent with general equilibrium models.
• Support ventures into proper estimation of timber asset values where institutional arrangements create inaccurate value estimates.
• Support the development of methodology to estimate forest land prices.
• Work with agencies to develop criteria and indicators.
• Help develop and make available computer based analytical models that will utilize the environmental account information in policy analysis.
• Support the development of production flows, monetized values and sector linkages for countries where nontimber forest products are important yet unappreciated.
• Improve the transfer of know-how between EUROSTAT and countries with comparative rich experiences in environmental accounting in the forest sector to other less experienced countries.
• Create effective transfers of knowledge concerning sustainable wealth and sustainable forestry at high levels of policy and public information by hosting major workshops for the press.
• Avoid hardwired dogmatic approaches to sustainability. There is a variety of alternative sustainability “schools of thought” and there is considerable flux in what is the right approach. Develop accounting systems that can be applied to a variety of approaches to sustainability.

4.8 Training Needs/Capacity Building

Creating good forest sector accounts requires teams of people with a variety of backgrounds and experiences. Satellite accounts should be developed so that they are integrated into, and an extension of the SNA. Rather clearly, people with national income accounting training should be intimately involved as team members. There is a lot of specialized technical knowledge surrounding the management and use of forests. Language is specialized and the production relationships are also complex. Forest economists should be extraordinarily valuable team members as we. Beyond this, there is an increasing set of complex biological
issues concerning the existence and use of forests. Finally, it is clear that existing data and information sources are typically inadequate. Teams should have ready access to expertise in such subjects as timber inventory measurements, and household surveys. A good systems ecologist could also be a very important member of a forest account development team. Some countries may have these to enhance these capacities.
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