PART 4

INTERNATIONAL EXPERIENCE

Chapter 9. Developing and Using Environmental Accounts

Chapter 9

DEVELOPING AND USING ENVIRONMENTAL ACCOUNTS

Having committed themselves to achieving sustainable development, governments face a number of challenges beyond the traditional concerns of their natural resources and environmental agencies. One of the most important of these is integrating economic policies with policies for the management of natural resources and the environment. Policy makers setting environmental standards need to be aware of the likely consequences for the economy, while economic policy makers must consider the sustainability of current and projected patterns of production and consumption.

Such integration and adoption of the notion of sustainable development by governments have been the motivation for developing environmental accounting. Environmental accounts can provide policy makers with the following:

- Indicators and descriptive statistics to monitor the interaction between the environment and the economy, and progress toward meeting environment goals
- A quantitative basis for strategic planning and policy analysis to identify more sustainable development paths and the appropriate policy instruments for achieving these paths

After providing a context to explore the usefulness of the system of integrated environmental and economic accounting (SEEA) as an operational framework for monitoring sustainability and its policy use, this chapter summarizes the four general components of the environmental accounts.[1] The second part of the chapter reviews a few policy applications of economic accounting (EA) in industrialized and developing countries and indicates potential applications, which may not be fully exploited at this time.

Developing the Environmental Account: A Bird's Eye View

Environmental and resource accounting has evolved since the 1970s through the efforts of individual countries or practitioners, developing their own frameworks and methodologies to represent their environmental priorities. Since the early 1990s, the United Nations Statistics Division, the European Union (EU), the Organisation for Economic Co-operation and Development (OECD), the World Bank, in-country statistical offices, and other organizations have made a concerted effort to standardize the framework and methodologies. The United Nations (UN) published an interim handbook on environmental accounting in 1993 (UN 1993), as well as an operational handbook (UN 2000). The former was revised as *Integrated Environmental and Economic Accounting 2003* (SEEA). The discussion below describes the different methodologies and how they are related to the revised SEEA.

Environmental accounts have four main components:

- Natural resource asset accounts, which deal mainly with stocks of natural resources and focus on revising the balance sheets of the system of national accounts (SNA).
- Pollutant and material (energy and resources) flow accounts, which provide information at the industry level about the use of energy and materials as inputs to production and final demand, and the generation of pollutants and solid waste. These accounts are linked to the supply and use tables of the SNA, which are used to construct input-output (IO) tables.
- Environmental protection and resource management expenditures, which identify expenditures in the conventional SNA incurred by industry, government, and households to protect the environment or manage resources.
- Environmentally adjusted macroeconomic aggregates, which include indicators of sustainability such as the environmentally adjusted net domestic product (eaNDP).

Environmental Accounts and Concepts of Sustainability

As discussed in earlier chapters, many of the concerns about resource depletion and environmental degradation are reflected in the concept of sustainable development, defined as "… development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). Consistent with Hicks's notion of income (Hicks 1946), sustainability requires nondecreasing levels of capital stock over time or, at the level of the individual, nondecreasing per capita capital stock. Indicators of sustainability could be based on either the value of total assets every period, or by the change in wealth and the consumption of capital (depreciation) in the conventional national accounts.

Economic sustainability can be defined as *strong* or *weak,* reflecting controversy over the degree to which one form of capital can substitute for another. Weak sustainability requires only that the combined *value* of all assets remain constant. Strong sustainability is based on the concept that natural capital is a complement to manufactured capital, rather than a substitute. An indicator of strong sustainability, therefore, requires that all natural capital is measured in physical units. A less extreme version of strong sustainability accepts some degree of substitutability among assets, but recognizes that there are some *critical* assets which are irreplaceable. The corresponding measure of sustainability would be partly monetary (for those assets, manufactured and natural, which are not critical and for which substitution is allowed) and partly physical, for natural assets which are critical.

Asset Accounts

Natural resource asset accounts follow the structure of the asset accounts of the SNA, with data for opening stocks, closing stocks, and changes during the year. The changes that occur during the period are divided into those that are the result of economic activity (for example, extraction of minerals or harvesting of forests) and those that are the result of natural processes (for example, growth, births, and deaths). There is some controversy over how to treat new discoveries of minerals: as an economic change (the result of exploration activities) or as part of other volume changes. The monetary accounts for resources have an additional component, like manufactured capital, for revaluation.

Measurement of the physical stocks can present problems both as to what to measure as well as how to measure. In some earlier versions of subsoil (mineral) asset accounts, only economically proven stocks were included in the asset accounts. Some countries have modified this to include a portion of probable and possible stocks, based on the probability of these stocks becoming economically feasible to mine. Certain resources, like marine-capture fisheries, are not observed directly and require biological models to estimate stocks and changes in stocks.

Two methods have been used to value assets: net present value (NPV) and net price (this is just equal to the total resource rent per unit of resource). The NPV method of valuation requires assumptions about future prices and costs of extraction, the rate of extraction, and the discount rate. It is often assumed that net price and level of extraction remain constant, although when information is known about planned extraction paths or expected future prices, this information can be incorporated. A wide range of discount rates have been used by different countries.

In much of the early work on environmental accounting (Repetto and others 1989; Bartelmus and others 1992; van Tongeren and others 1991; UN 1993), the net-price method rather than NPV was used to value assets. The net-price method simply applies the net price in a given year to the entire remaining stock. The revised SEEA recommends NPV, and this method has become more widely used than the net-price method in more recent work.

Pollution and Material Flow Accounts

Pollution and material (including energy and resource) flow accounts track the use of materials and energy and the generation of pollution by each industry and final demand sector. The flows are linked through the use of a common industrial and commodity classification to IO tables and social accounting matrices (SAMs), as exemplified by the Dutch national accounting matrix, including the environmental accounts (NAMEA) framework, which has been adopted by Eurostat (the European Commission's official statistical agency) and the revised SEEA manual. Much of the work on environmental accounts has been pioneered by industrialized countries and reflects their major policy concerns.

Physical Accounts

The most widely available accounts are for energy and air emissions, especially emissions linked to the use of fossil fuels. Energy accounts have been constructed by many countries since the dramatic oil-price increases of the 1970s, and because many air pollutants are linked to energy use, it is relatively simple to extend the accounts to include these pollutants. Transboundary flows of atmospheric pollutants that cause acid rain have been a major policy concern throughout Europe for more than two decades. More recently, the concern with climate change has made tracking greenhouse gas emissions a priority. Accounts are also constructed for other air pollutants, water pollutants, solid waste, and other forms of environmental degradation such as soil erosion. In a growing number of countries, especially water-scarce countries (Australia, Botswana, Chile, France, Moldova, Namibia, and Spain), water accounts are a high priority.

Monetary Accounts for Environmental Degradation

In many countries, assigning an economic value to environmental benefits and damage may be considered the most effective way to influence policy, if not the most efficient way to design policy. However, controversy remains over whether these monetary estimates are properly part of the environmental accounts or a separate analysis of the (physical) accounts. Nevertheless, most countries attempt some valuation using one of two different approaches to valuation (or sometimes both, for comparison):

- Maintenance, or avoidance cost approach, which measures the cost of measures to reduce pollution to a given standard
- Damage cost approach, which measures the actual damage caused by pollution in, for example, reduced agricultural productivity resulting from soil erosion, increased corrosion of structures from acid rain, or damage to human health from water pollution

Willingness to pay can be used to value damage costs, although it is not widely used in environmental accounting efforts by countries at this time. Measuring damages caused by pollution is difficult—although it is theoretically the best method to deal with pollution in the accounts, it has not been used as often as the maintenance cost approach.

Monetary Accounts for Nonmarketed Resources

Valuation issues discussed in the SEEA have largely focused on environmental degradation, but other nonmarket goods and services also need to be valued. The use of near-market goods like nonmarket firewood or wild-food products are, in principle, included in the SNA, and many countries have included some estimate of these resources in the conventional national accounts. Water, on the other hand, is an example of an economically important resource that is often either not priced or priced in a way that is not related to its true economic value.

Environmental Protection and Resource Management Accounts

This third component of the SEEA differs from the others in that it does not add any new information to the national accounts, but reorganizes expenditures in the conventional SNA that are closely related to environmental protection and resource management. The purpose is to make these expenditures more explicit, and thus more useful for policy analysis. In this sense, they are similar to other satellite accounts, such as transportation or tourism accounts, which do not necessarily add new information, but reorganize existing information. This set of accounts has three quite distinct components:

- Expenditures for environmental protection and resource management, by public and private sectors
- The activities of industries that provide environmental protection services
- Environmental and resource taxes or subsidies

The environmental protection expenditure (EPE) represents part of society's effort to prevent or to reduce pressures on the environment, but the interpretation of indicators from the EPE accounts can be ambiguous. The EPE concept works best for end-of-pipe, pollution-abatement technologies in which an additional production cost is incurred to reduce pollution. The growing trend in pollution management stresses pollution prevention through redesign of industrial processes rather than end-of-pipe technology. New technology may be introduced, perhaps during the normal course of replacement and expansion of capacity that reduces pollution. However, no consensus exists about what share to attribute to the EPE. In some instances, process-integrated measures that reduce pollution may reduce costs and pollution simultaneously. The EU is responding to this problem by collecting data about the use of integrated-process technologies. Surveys of recycling are also included.

Macroeconomic Indicators

Each of the three sets of accounts considered so far provides a range of indicators, but, with the exception of the asset accounts, these indicators do not directly affect the conventional macroeconomic indicators such as gross domestic product (GDP) and net domestic product (NDP). Many practitioners have searched for a way to measure sustainability by revising conventional macroeconomic indicators or by producing alternative macroindicators in physical units.

Physical Indicators

Macroeconomic indicators measured in physical units have been proposed either as an alternative to monetary indicators or to be used in conjunction with monetary aggregates in assessing economic performance. Physical indicators reflect a strong sustainability approach. The two major sources of physical macroeconomic indicators are the NAMEA component of the SEEA flow accounts and material flow accounts (MFA), which are closely related to environmental accounts.

The NAMEA provides physical macroeconomic indicators for major environmental policy themes: climate change, acidification of the atmosphere, eutrophication of water bodies, and solid waste. These indicators are compiled by aggregating related emissions using some common measurement unit, such as carbon dioxide equivalents for greenhouse gases. The indicators are then compared with a national standard—such as the target level of greenhouse-gas emissions—to assess sustainability. The NAMEA does not, however, provide a single-valued indicator which aggregates across all themes.

The MFA provide several macroindicators; the most widely known is total material requirements (TMR) (Bartelmus and Vesper 2000; World Resources Institute 2000). TMR sums all the material use in an economy by weight, including *hidden flows,* which consist of materials excavated or disturbed along with the desired material, but which do not themselves enter the economy. In contrast to NAMEA theme indicators, TMR provides a single-valued indicator for all material use.

Monetary Indicators

The purpose of most monetary environmental macroeconomic aggregates has been to provide a more accurate measure of sustainable income. The first approach revised conventional macroeconomic indicators by adding and subtracting the relevant environmental components from the SEEA, the depletion of natural capital, and environmental degradation (O'Connor 2000). Most economists and statisticians accept the adjustment of NDP for asset depletion, in principle, even though there is not yet a consensus over the correct way to measure it. However, some economists and statisticians have criticized environmentally adjusted NDP (eaNDP) for combining actual transactions (conventional NDP) with hypothetical values (monetary value of environmental degradation). If the costs of environmental mitigation had actually been paid, relative prices throughout the economy would have changed, thereby affecting economic behavior and, ultimately, the level and structure of GDP and NDP.

A macroindicator related to eaNDP is adjusted net saving (genuine saving), which is reported in the World Bank's annual *World Development Indicators* (Kunte and others 1998; Hamilton 2000; World Bank 2005), and discussed earlier in detail in chapter 3. The criticism of eaNDP led to the construction of a second approach to constructing indicators, which asks the question, what would the GDP or NDP have been if the economy were required to meet sustainability standards? These indicators of a hypothetical economy are derived through economic modeling. Two modeling approaches were developed:

- Hueting's sustainable national income (SNI), which estimates what the level of national income would be if the economy met all environmental standards using currently available technology (Verbruggen and others 2000)
- Greened economy NDP (geNDP), which estimates how the economy would respond if the estimated maintenance costs were internalized in the economy

International Experience

Several countries construct environmental accounts on a regular basis with various levels of coverage, employing one or more of the above approaches. Table 9.1 identifies the major countries that are constructing

Table 9.1 Countries with Environmental Accounting Programs

		Flow accounts for pollutants & materials		Environmental protection & resource management expenditures	
	Assets	Physical	Monetary		Macro-aggregates
Industrialized countries					
Australia	X	X		X	
Canada	X	X		X	
Denmark	X	X		X	
Finland	X	X		X	
France	X	X		X	
Germany	X	X	X	X	X
Italy	X	X		X	
Japan	X	X	X	X	X
Norway	X	X			
Sweden	X	X	X	X	X
United Kingdom	X	X		X	
United States	X			X	
Developing countries					
Botswana	X	X	X[a]		
Chile	X		X[a]	X	
Korea, Rep. of	X	X	X	X	X
Mexico	X	X	X	X	X
Moldova		X[a]			
Namibia	X	X	X[a]		
Philippines	X	X	X	X	X
Occasional studies					
Colombia		X	X	X	
Costa Rica				X	
EU-15			X		
Indonesia	X				
South Africa	X	X	X[a]		

Source: Authors.
Note: Other European countries have also constructed environmental accounts but are not included here because of the limited policy analysis of the accounts. EU-15: European Union.
a. Accounts for water only.

EA on an ongoing basis in their statistical offices or other government ministries. Most of the work is being done in Australia, Canada, Europe, and a few developing countries. Of the developing countries, Botswana, Namibia, and the Philippines are particularly important because policy analysis was built into the EA project design. There are countless other one-time or academic studies, a few of which are referred to in the second part of this chapter.

Applications and Policy Uses of the SEEA

Broadly speaking, there are two sorts of applications of environmental accounting. The first is closest to statistical tradition and concerns the development of indicators and descriptive statistics of the various subject areas. The second shows how specific policy analyses can be based on the techniques provided by SEEA. Policy analysis usually requires more specialized expertise in the techniques of economic analysis and modeling, which may be lacking in some statistical offices.

Use of Asset Accounts for Monitoring and Policy Making

One of the fundamental indicators of a country's well-being is the value of its wealth over time. The discussion of sustainability indicated that there are different views about how wealth should be measured, that is, whether all forms of wealth can be measured in monetary terms (weak sustainability) or in some combination of monetary and physical units (strong sustainability). Asset accounts can contribute to more effective monitoring of national wealth. They can also be used to improve management of natural capital.

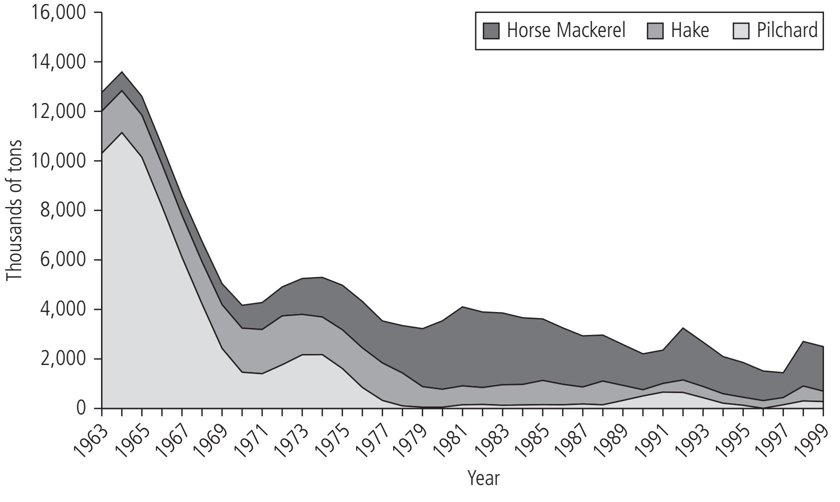
Monitoring Total Wealth and Changes in Natural Capital

The asset accounts provide fundamental indicators to monitor sustainability—the value of wealth and how it changes from one period to the next through depreciation or accumulation. Although total wealth and per capita wealth, expanded to include both manufactured and natural assets, are useful indicators, not many countries compile such figures yet. Instead, many countries have focused on compiling accounts for individual resources, sometimes estimating depletion of natural capital, which is used to compile a more comprehensive measure of depreciation than is found in the conventional national accounts

Physical asset accounts. The physical asset accounts provide indicators of ecological sustainability and detailed information for the management of resources. The volume of mineral reserves, for example, is needed to plan extraction paths and indicates how long a country can rely on its minerals. The volume of fish or forestry biomass, especially when disaggregated by age class, helps to determine sustainable yields and the harvesting policies appropriate to that yield.

The asset accounts track the changes in stock over time and indicate whether depletion is occurring. Thus, they can show the effects of resource policy on the stock and can be used to motivate a change in policy. For example, the biological depletion of Namibia's fish stocks since the 1960s has provided a very clear picture to policy makers of the devastating impact of uncontrolled, open-access fishing (figure 9.1). Similar accounts of depletion (or accumulation) have been constructed for forests in Australia, Brazil, Canada, Chile, Indonesia, Malaysia, the Philippines, and much of the EU.

Figure 9.1 Biomass of Hake, Pilchard, Horse Mackerel in Namibia, 1963–1999



Source: Lange 2003a.

Monetary asset accounts. The physical accounts for individual assets can be used to monitor ecological sustainability. However, the economic value of a resource must also be known for a more complete assessment. The monetary value of different assets, produced and nonproduced, can be combined to provide a figure for total national wealth. This figure can be analyzed to assess the diversity of wealth, its ownership distribution, and its volatility resulting from price fluctuations, an important feature for economies dependent on primary commodities.

Most countries with asset accounts for natural capital have typically published the accounts separately for each resource and have not attempted to measure total natural capital (the sum of all resources) total national wealth (the sum of manufactured and natural capital). Among developing countries, Botswana (Lange 2000a) and Namibia (Lange 2003a) are doing so. Among the industrialized countries, Australia (Australian Bureau of Statistics 1999) and Canada (Statistics Canada 2000) have integrated nonproduced natural assets with produced assets in their balance sheets.

Managing Resources: Economic Efficiency and Sustainability

In the early days of environmental accounting, resource rent was calculated in order to calculate the value of assets, but its usefulness as a resource management tool was not always recognized. The work by Norway (Sorenson and Hass 1998), Eurostat (2000) for subsoil assets, in the Philippines Environment and Natural Resource Accounting Project [ENRAP] 1999; Lange 2000b, Botswana (Lange 2000a), Namibia (Lange and Motinga 1997; Lange 2003a), and in South Africa (Blignaut and others 2000) has included detailed analysis of resource rent. Rent has been used to assess resource management in terms of economic efficiency, sustainability, and other socioeconomic objectives, such as intergenerational equity.

Physical Flow Accounts for Pollution and Material Use

Data from the physical flow accounts are used to assess pressure on the environment and to evaluate alternative options for reducing pressure on the environment.

Physical Flow Accounts

At their simplest, the flow accounts monitor the time trend of resource use, pollution emissions, and environmental degradation, both by industry and in aggregate. A rising level of emissions, for example, would be a clear warning sign of environmental problems.

The overview of environmental trends helps assess whether national goals, typically set in terms of total figures for emissions or material use, are being achieved. A great deal of work has been done throughout the industrialized world to construct time series of pollution emissions and energy use. Similar work has been done for water accounts by a number of countries, including Botswana, Chile, France, Moldova, Namibia, the Philippines, South Africa, and Spain. The example for Botswana shows declining per capita water use and declining water intensity of the economy (measured by the GDP per cubic meter of water used), but the volume of water has still increased because population and GDP growth outweigh the gains in efficiency (table 9.2).

Table 9.2 Index of Water Use, GDP Growth, and Population Growth in Botswana, 1993 to 1999 (1993 = 1.00)

	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
Volume of water used	1.00	1.01	1.03	0.99	1.04	1.05
Per capita water use	1.00	0.99	0.98	0.92	0.94	0.93
GDP per m^3 water used	1.00	1.02	1.06	1.18	1.22	1.26

Source: Lange and others 2000.
Note: m^3 = cubic meter

Policy Analysis

The flow accounts are widely used for policy analysis, for example, to assess the impact of environmental tax reform, to design economic instruments to reduce pollution emissions, and to assess competitiveness under new, more restrictive environmental policies. The EU has been the largest user of the accounts and has used them mainly to address two priorities: greenhouse gas emissions and acid rain.

Norway has used the flow accounts for energy and greenhouse gas emissions to assess a policy that many countries are considering: changing the structure of taxes to increase taxes on emissions and resource use, while simultaneously reducing other taxes by an equal amount in order to remain fiscally neutral, the so-called "*double dividend.*" Norway used its multisector, general-equilibrium model to look specifically at increasing the carbon tax to NKr 700 per ton of carbon dioxide with a compensating decrease in its payroll tax. Policy makers in Norway wanted to know what effects this tax reform would have on economic welfare. Using the general-equilibrium model, Norway initially found that employment and economic welfare would increase while carbon emissions declined. However, closer analysis of the results indicated that the tax reform would result in significant structural change in the economy—certain energy-intensive industries in the metal, chemical, and oil-refining sectors were particularly hard hit by the tax, and would reduce output and employment considerably.

Environmental Protection and Resource Management Accounts

This set of accounts has several quite distinct components, including:

- Expenditures for environmental protection and resource management, by public and private sectors
- Activities of industries that provide environmental protection services
- Environmental and resource taxes or subsidies

Environmental Protection Expenditure Accounts

Of the three components of this part of the accounts, EPE accounts have been the most widely constructed, mainly in the United States, Canada, the EU, Japan, and Australia. Some developing countries have also constructed EPE accounts, notably Chile, Colombia, the Republic of Korea, and the Philippines. Eurostat has published a handbook with a detailed list of indicators that can be obtained from the EPE accounts, from the most general (for example, time trend of EPE by sector and domain) to detailed (for example, spending within industries by domain). EPE accounts for the United States, for example, show that, as a percentage of GDP, expenditures have remained constant between 1.7 and 1.8 percent. Of the four developing countries that have compiled EPE, coverage differs from country to country. Only Colombia and the Republic of Korea cover EPE by all sectors. Costa Rica and the Philippines have compiled only EPE by government.

Environmental Services Industry

While EPE accounts have imposed substantial costs, they have also created opportunities: entirely new industries have arisen to fill the need for environmental services. The second part of the EPE accounts provides a clear definition of environmental services as well as the environmental services industry's contribution to GDP, employment, and exports. For some countries, the environmental services industry has become an important exporter, while other countries are large importers of these services. For example, in France, the environmental services industry accounted for 2.3 percent of GDP and 1.4 percent of employment in 1997. More than half the employment was in solid waste and wastewater management (Desaulty and Templé 1999).

Environmental and Resource Taxes

The third part of the EPE accounts includes taxes and other fees collected by government for pollution emissions and for resource use, such as levies on minerals, forestry, or fisheries. Environmental taxes and subsidies are important policy instruments for achieving sustainability. Many European countries are exploring the possibility of substituting green taxes for other forms of taxes to achieve a *double dividend*. The tax component of the EPE account can be very useful in assessing whether the tax regime provides incentives or disincentives for sustainable development, and whether taxes truly reflect the *polluter pays* principle that many countries have adopted. Taxes on specific natural resources and their use in resource management were discussed in the section on asset accounts.

Economywide Indicators of Sustainable Development

Many practitioners have searched for a way to measure sustainability either by revising conventional macroindicators or by producing new ones in physical units. Aggregate environmental theme indicators measured in physical units are derived from the NAMEA component of the SEEA. The physical indicators are meant to be used in conjunction with conventional economic indicators to assess environmental health and economic progress. A number of different revised environmental monetary aggregates have been calculated by different countries; all are discussed in the revised SEEA. At this time, there is no consensus over which indicators to use. Because each indicator serves a somewhat different policy purpose, the choice of indicator depends on the policy question.

Physical Indicators of Macrolevel Performance

The NAMEA provides physical macroeconomic indicators for major environmental policy themes: climate change, acidification of the atmosphere, eutrophication of water bodies, and solid waste. The indicators can be compared with a national standard—such as the target level of greenhouse-gas emissions—to assess sustainability. A national standard for greenhouse-gas emissions set, for example, in terms of a country's target under the Kyoto Protocol, can be useful. It may not be easy to assess some themes, such as eutrophication, which may have a more local impact, against a national standard. The NAMEA does not provide a single-valued indicator which aggregates across all themes.

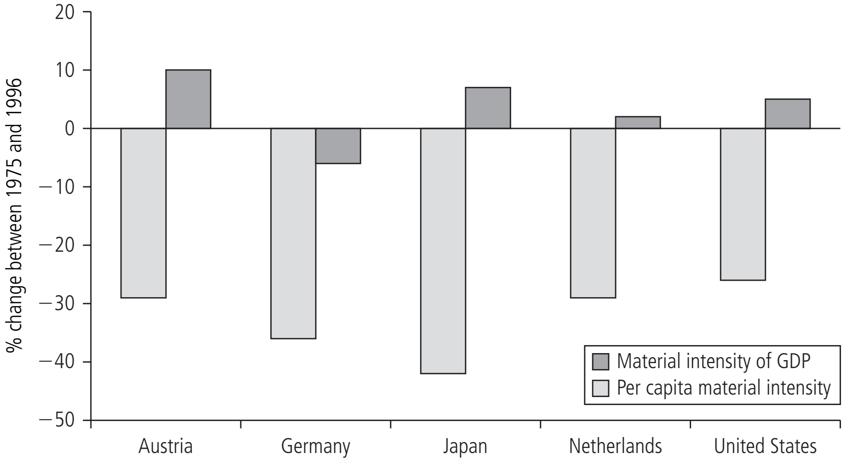
The material-flow accounts provide another set of physical macroeconomic indicators, of which the most widely known is TMR. The TMR sums all the material use in an economy by weight. Its purpose, like the monetary aggregates, is to provide a single-valued indicator to measure dematerialization—the decoupling of economic growth from material use.

The World Resources Institute study of MFA for five industrialized countries finds significant decoupling: since 1975, the material intensity of GDP in all five countries has declined by 20 to 40 percent (figure 9.2). This has been the result of efforts to reduce the volume of solid waste and the shift away from energy- and material-intensive industries toward knowledge-based and service industries. Per capita material intensity has not declined in most countries over this time period. Only Germany showed a decline of 6 percent.

Environmentally Adjusted NDP and Related Indicators

The most well-known indicator in this category is the eaNDP. Repetto and his colleagues calculated this indicator in their early work on environmental accounting as a way of focusing the attention of policy makers on the importance of environmental degradation and depletion of natural capital. Repetto's work in Indonesia (on petroleum, forests, and land degradation) and Costa Rica (on forests, fisheries, and land degradation) was followed by similar pilot studies in Papua New Guinea and Mexico sponsored by the UN and the World Bank.

Figure 9.2. Percentage Change in Material Use in Five Industrialized Countries, 1975–1996



Source: Based on World Resources Institute 2000, table 2, page 20.

Notes: Material intensity calculated as domestic processed output per GDP. Per capita material intensity calculated as domestic processed output per population.
Domestic processed output = domestic extraction + imports − net additions to stock − exports.

More recently, a number of countries have calculated partially adjusted eaNDPs, including Germany, Japan, the Republic of Korea, the Philippines, and Sweden. The great differences among countries in terms of the types of coverage and how the maintenance cost approach was implemented make it impossible to directly compare results across countries. The Republic of Korea, for example, assumed the same abatement costs in all industries, whereas the other countries estimated industry-specific abatement costs.

Sweden's eaNDP, called Genuine Income, shows the least change from conventional NDP, differing only by 0.6 percent. One reason for this very low figure, despite subtracting some environmental protection expenditures, which other countries did not do, is that it measures only environmental degradation from sulfur and nitrogen. Sweden also excluded degradation not already included in conventional measures of NDP, whereas other studies, notably those of the Republic of Korea and the Philippines, did not explicitly address the issue of potential double counting. The adjustment for Japan and Germany are rather large, mainly because they include the estimated cost of reducing carbon emissions (and for Japan, chlorofluorocarbons). The other studies did not address these global pollutants.

Modeling Approaches to Macroeconomic Indicators

Some researchers have criticized eaNDP for combining actual transactions (conventional GDP and NDP) with hypothetical values (monetary value of environmental degradation). The response to this criticism led to the construction of a new set of indicators that seek to estimate what sustainable national income would be if the economy had to change to meet the environmental constraints. Two major approaches were developed—Hueting's SNI and the geNDP.

Hueting's SNI is the maximum income that can be sustained without technological development (excluding the use of nonrenewable resources). Using a static, applied general equilibrium model, SNI has been calculated for the Netherlands in 1990 (Verbruggen and others 2000). The authors found that enormous changes would have to occur in order to fulfill the sustainability standards in the short term: SNI is 56 percent lower than national income in the base year; household consumption declines by 49 percent, government consumption by 69 percent, and net investment by 79 percent.

An alternative approach, the geNDP, estimates national income looking into a hypothetical future in which economic development must meet certain environmental standards. The impact on the economy is estimated by internalizing the costs of reducing environmental degradation. The purpose of this approach is to provide policy makers with guidance about the likely impacts of alternative development paths and the instruments for achieving them. In these models, technology and other model parameters are not always restricted to what is currently available. Estimates for the Netherlands were carried out by De Boer and others (1994). The Swedish National Institute of Economic Research (NIER) (2000) carried out a similar study focusing specifically on carbon dioxide emissions.

General Observations

Much of the use of environmental accounts has been in industrialized countries, especially Australia, Canada, and Europe. The asset accounts are compiled by most countries, but are not generally used to assess sustainability. The flow accounts are widely used, both for the construction of indicators and as inputs to policy modeling. The construction of monetary, environmental macroindicators is quite limited, and it is not clear that these indicators have been much used.

There are, in addition, four main observations regarding how useful environmental accounts are for policy:

- Although some countries are using the environmental accounts quite actively, the accounts are still underutilized, especially in developing countries.
- Very few countries have truly comprehensive environmental accounts.
- International comparisons are important, but not yet possible, because of differences in methodology, coverage, environmental standards, and other factors.
- For a country to fully assess its environmental impact, it must have accounts for the transboundary movement of pollutants via air and water, as well as accounts for its major trading partners to calculate the pollution and material content of products that it imports.

The asset accounts have been used to monitor sustainability in various ways, but many countries have not exploited their full potential to monitor characteristics of wealth and changes in wealth over time. This may be the result of the lack of emphasis on conventional asset accounts and measures of wealth. The lack of a consensus in the revised SEEA about a method for measuring the cost of depletion is also a deterrent. The asset accounts could also be more widely used to assist in resource management. Even simple analysis, such as comparison of rent to the taxes on rent and the costs of resource management, is not routinely carried out in countries that compile asset accounts for natural capital.

The flow accounts are more widely used for the construction of indicators, environmental profiles, and analysis. Considerable overlap occurs between the SEEA and the sustainability indicators proposed by the United Nations, OECD, and other organizations. Tighter links among these different approaches could be useful.

International Comparability

International comparisons are extremely useful for countries in assessing their resource management. The comparisons of water accounts in southern Africa or the environmental damage costs in Europe, for example, are extremely helpful for policy. So far, the comparison of accounts and of the resulting indicators across countries is not generally possible because of the wide range of definitions, coverage, and methodologies used by different countries. Monetary accounts may diverge even more than physical accounts because of the different valuation methodologies, environmental standards, and other assumptions necessary for valuation. With the exception of the genuine saving indicator, it has not been possible to compare monetary environmental macroindicators across countries.

Several studies in Europe have shown that the quantities of pollution exported and imported via air and water are very large. Without accurate information about these quantities, the use of environmental accounts for policy will be limited. Similarly, substantial pollution and resources are embodied in international trade. The Swedish study showed that environmental coefficients (whether of pollution emissions or resource use) can diverge substantially among countries, and that a proper assessment of the environmental impact of a country's imports can only be made with information about the environmental coefficients of one's trading partner, from the partner's environmental accounts. In addition, management of global or regional environmental problems, whether climate change or acidification, require comparable environmental accounts for each country.

Endnote

1. This chapter is mainly drawn from Lange (2003b) and the SEEA, chapter 11.