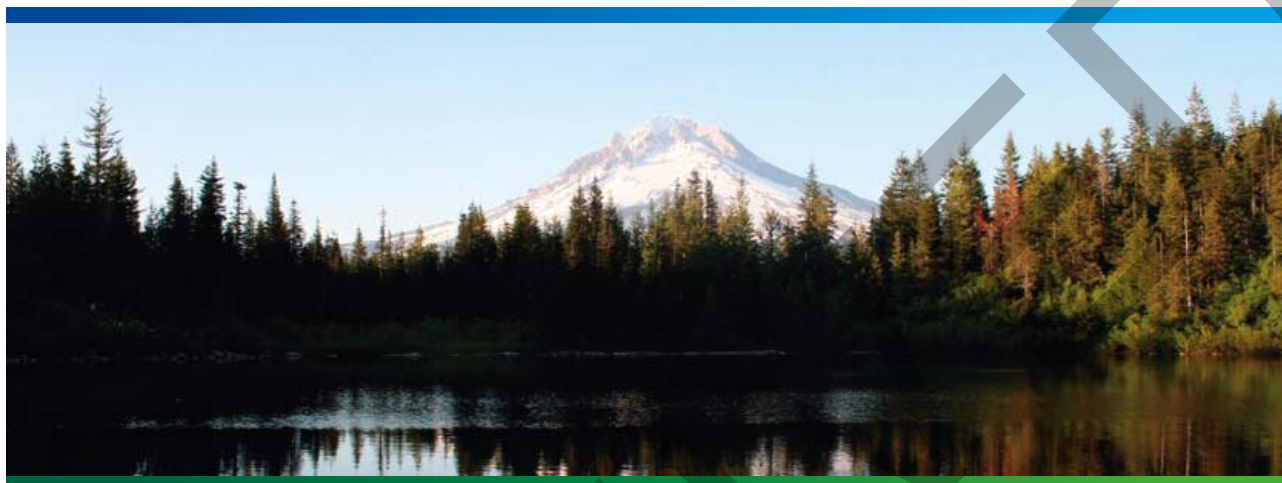




INTOSAI
Working Group
on Environmental
Auditing



Environmental Accounting:

Current Status and Options for SAIs

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This publication was prepared by the INTOSAI Working Group on Environmental Auditing (WGEA). The WGEA aims to encourage the use of audit mandates and audit methods in the field of environmental protection and sustainable development by Supreme Audit Institutions (SAIs). The WGEA has the mandate to

- help SAIs gain a better understanding of environmental auditing issues,
- facilitate exchange of information and experiences among SAIs, and
- publish guidelines and other informative materials.

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Acronyms and Abbreviations

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CSERA - Canada's System of Environmental and Resource Accounts

DEFRA - Department for Environment, Food, and Rural Affairs (United Kingdom)

DMI - Direct Material Input

ENRAP - Environment and Natural Resource Accounting Project (Philippines)

EU - European Union

GDP - Gross Domestic Product

NAMEA - National Accounting Matrix including Environmental Accounts

NDP - Net Domestic Product

OECD - Organization for Economic Cooperation and Development

SAI - Supreme Audit Institution

SEEA - System of Environmental and Economic Accounts

SEEA-E - System of Environmental-Economic Accounting for Energy

SEEA-F - System of Environmental and Economic Accounting for Fisheries

SEEA-W - System of Environmental and Economic Accounting for Water

SERIEE - European System for the Collection of Economic Information on the Environment

SNA - System of National Accounts

SNI - Sustainable National Income

UK - United Kingdom

UN - United Nations

UNCEEA - United Nations Committee of Experts on Environmental Accounting

UNSD - United Nations Statistics Division

USAID - United States Agency for International Development

WGEA - Working Group on Environmental Auditing

Foreword and Acknowledgements

This report was developed by the United States Government Accountability Office with the assistance of Uganda's Office of the Auditor General. Environmental accounting provides a framework for organizing environmental data so that it can be linked to economic data. Among other uses, it can help policy makers better manage resources; assess different types of environmental pressures; identify the implications of different regulations, taxes, and consumption patterns on environmental sustainability; and identify paths to sustainable development. The report discusses international progress made in developing environmental accounts; how environmental accounting is being used to inform decision-making on the foremost environmental issues of our times, including climate change; and how it may be of use to SAIs in fulfilling their responsibilities as they address these important issues.

The report updates information in the Working Group's 1998 report on the subject entitled, *Natural Resource Accounting: An Inventory of Possibilities for Supreme Audit Institutions (SAIs)*. Since the time of this earlier report, international organizations have continued to work on developing internationally accepted standards for environmental accounting, and many countries have developed and are refining their environmental accounts.

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Readers are invited and encouraged to consult this paper as well as information on other WGEA products and services at the INTOSAI-WGEA website, www.environmental-auditing.org

We hope you will find this document useful.



Mihkel Oviir

Auditor General of Estonia
Chair of INTOSAI WGEA

Executive Summary

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This report updates the 1998 Working Group on Environmental Auditing (WGEA) report on the subject of environmental accounting. Environmental accounting provides a framework for organizing environmental data so that it can be linked to economic data. Among other uses, it can help policy makers better manage resources, assess different types of environmental pressures, identify the implications of different regulations, taxes, and consumption patterns on environmental sustainability, and identify paths to sustainable development. Significantly, environmental accounting has been recognized by the global community as an important tool for monitoring, measuring, and analyzing climate change. Given its multifaceted usefulness in policy analysis, environmental accounting can play an important role in Supreme Audit Institutions' (SAIs) work on climate change as well as other issues.

Since the 1998 report, international organizations have continued to work on developing internationally accepted standards for environmental accounting, and many countries have developed and are refining their environmental accounts. Many in the international statistical community now say that some of the methodologies are sufficiently advanced to be elevated to the level of an international statistical standard on par with the System of National Accounts (SNA)¹. At the same time, environmental accounting is still a developing discipline with varying approaches and certain key challenges. For example, valuing some natural assets, such as clean air and water, is complicated by the fact that these goods are generally not priced in markets. In addition, environmental accounting's applicability to the work of SAIs has only recently been investigated by some countries.

This report is intended to provide information about the current status of environmental accounting and highlight how these techniques can further the work of SAIs on their most pressing environmental issues. Specifically, it examines:

- The status of efforts since the 1998 report by international organizations to develop environmental accounting standards,
- The efforts of a number of individual countries from around the world to develop and expand their use of environmental accounts, and
- Options on how SAIs can use environmental accounts in their audit work or be otherwise involved in their country's environmental accounting efforts.

To document international efforts in the field of environmental accounting, we compiled information from the latest guidance on environmental accounting practices published by the United Nations Statistics Division and relevant policy papers from international environmental accounting working groups, academics, national government statistical and accounting bodies, and non-governmental organizations. To highlight individual countries' efforts in environmental accounting, we obtained information from published reports, conference proceedings, and national government statistical body websites. We then contacted knowledgeable officials from each country to verify this information and incorporated any comments we received as appropriate. Using the 1998 report as a basis for identifying options for how SAIs can use environmental accounts in their audit work, we supplemented these options with information we compiled from select SAIs regarding their efforts in environmental accounting at the national and international level.

Among the report's key findings:

- Since 1998, the United Nations (UN) and other international institutions have taken additional steps to support the development of environmental accounts. In 2003, the UN, European Commission, International Monetary Fund, Organization for Economic Cooperation and Development, and World Bank issued a revised handbook for the System of Environmental and Economic Accounts (SEEA). This handbook is intended to help national and international agencies compile environmental accounts that reflect their information needs and priorities. Subsequently, in 2007, the UN published its recommended system of environmental and economic accounting for water, and is currently working with other organizations to revise the 2003 handbook with the goal of adopting the new version as an international standard in 2012. *Appendix 1 includes a timeline of key events in environmental accounting since 1972.*
- Many industrialized countries and an increasing number of developing countries have developed some components of environmental accounting and continue to refine their accounts. As of 2007, at least 72 countries had developed components of environmental accounts or planned to do so in the near future; 36 countries had standardized their water accounting practices using the SEEA framework; and 36 additional countries were in the process of standardizing theirs. Countries have developed their accounts to varying degrees. Very few countries have developed a broad range of accounts,

¹ The SNA consists of an integrated set of macroeconomic accounts, balance sheets, and tables based on internationally agreed-upon concepts, definitions, classifications, and accounting rules. Together, these principles provide a comprehensive accounting framework within which economic data can be compiled and presented in a format that allows for economic analysis, decision-making, and policy-making. A joint publication by the United Nations, the Commission of the European Communities, the International Monetary Fund, the Organization for Economic Co-operation and Development, and the World Bank, the *System of National Accounts 1993* is a conceptual framework that sets the international statistical standard for the measurement of the market economy.

and no country has yet developed a full set of accounts as outlined in the SEEA. Additionally, several countries such as the Netherlands, the Philippines, China, and Germany have developed their own methods of environmental accounting outside of the SEEA framework. Countries are using their environmental accounts to track pollution; the use of natural resources, such as water, forests, and mineral deposits; and environmental protection expenditures. The accounts are also used in policy analysis and resource management decision making. For example, Australia has used its accounts to assess whether specific government programs are meeting their intended goals. In addition, to better manage its water resources, Australia has used its water accounts to assess how water is being used across Australia and how that has changed over time. Namibia has used its accounts to make changes to its quota fees on fish catch. *Appendix 2 includes examples of 12 countries' experiences with environmental accounting.*

- Depending on the level of experience with environmental accounting within their governments, SAs can become involved in a variety of ways. For example, in the United States—which is not currently developing accounts—the Government Accountability Office hosted a forum of experts to discuss environmental accounts and challenges associated with environmental accounting. In the United Kingdom—which has developed some environmental accounts—the National Audit Office reviewed the process that the Department for Environment, Food and Rural Affairs used to measure and maintain a greenhouse gas emissions inventory and found ways the Department could improve its procedures. In Canada—which also has developed some environmental accounts—the Office of the Auditor General is studying environmental accounting and other management practices to see how they can be used to determine whether federal managers are adequately considering the environmental effects of expenditures within the context of sustainable development.

Chapter 1:

Introduction

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Currently, many policymakers lack information needed to understand the potential environmental impacts of their decisions, and the economic implications of changes to their environment and natural resources. In contrast, a wealth of economic information is usually available about production and income, which policymakers use to understand the state of the economy, monitor trends, and make projections that inform policy debates. Similarly, environmental accounts have the potential to provide key information that policymakers can use to understand the state of the environment, how it is changing over time, and the consequences of various policy options.

This report updates a 1998 Working Group on Environmental Auditing report on this subject. At the time of that report, environmental accounting was a relatively new discipline. Since then, international organizations have been working to develop internationally accepted standards for environmental accounting, and many countries have developed and are refining their environmental accounts. The international statistical community believes that some of the methodologies are now well advanced and should be elevated to the level of an international statistical standard on par with the System of National Accounts. It must be noted, however, that environmental accounting is still a developing discipline with varying approaches and some debate. See appendix 1 for a timeline of key events in environmental accounting since 1972.

This section discusses environmental accounting, describing in particular what the practice entails; how the information derived from it can help countries get a better handle on how to value their resources; and the benefits of environmental accounting to SAIs. Subsequent sections discuss the status of international efforts since the 1998 report to develop environmental accounting standards, the efforts of a number of countries from around the world to develop and expand their use of environmental accounts, and options for how SAIs can use environmental accounts in their audit work or be otherwise involved in their country's environmental accounting efforts.

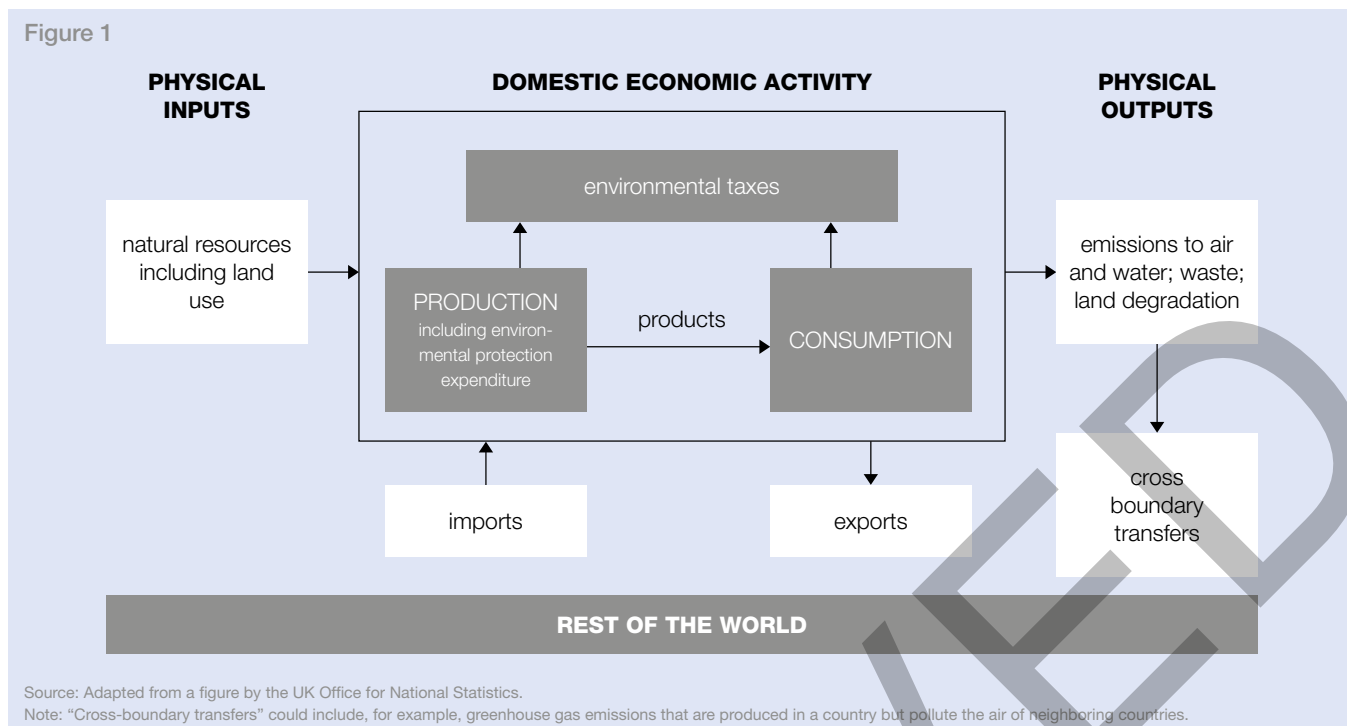
WHAT IS ENVIRONMENTAL ACCOUNTING?

Environmental accounting provides a framework for organizing information on the status, use, and value of natural resources and environmental assets—including fisheries and forest accounts, among others—as well as expenditures on environmental protection and resource management.² The latest categorization of environmental accounts by the international community include four types of accounts—natural resource asset accounts, pollution and material physical flow accounts, monetary and hybrid accounts, and environmentally-adjusted macroeconomic aggregates—which are described in more detail in section 1.2. Importantly, environmental accounting provides a way to link environmental data with the economic data contained in a country's SNA.³ For example, **Figure 1** illustrates how information contained in a country's environmental accounts regarding natural resource use, environmental expenditures, and emissions flows are components of the economic activity of production and consumption within a country and the world-at-large.

In 1992, the United Nations (UN) held the Conference on Environment and Development, or Earth Summit, in Rio de Janeiro to discuss sustainable development. As stated in the preamble of Agenda 21—a plan of action agreed upon by more than 178 governments in attendance—the integration of environmental and development concerns and greater attention to them will lead to the fulfillment of basic needs, improved standards for all, better protected and better managed ecosystems and a safer and more prosperous future. Toward that end, Agenda 21 recommended, among other steps, that countries implement environmental accounting. The recommendation was based on the Conference's finding that

² Environmental accounts are not synonymous with environmental statistics. While concepts, methods, definitions and classifications can be consistent within sets of environmental statistics collected for a specific purpose, there is often no consistency from one set of statistics to another. For example, environmental statistics are often collected with a particular regulatory or administrative purpose in mind and the way in which they are structured is specific to this need. Environmental accounts, on the other hand, are consistent with each other to the extent possible in concepts, methods, definitions, and classifications. Section 1.3 elaborates further on this distinction.

³ In this respect, environmental accounts differ from environmental indicators, which may provide information about conditions or trends in attributes of the natural world, but may not necessarily be compiled in such a manner to link directly with a country's economic data. According to the UN Environment Programme, both environmental indicators and environmental accounts can be useful for countries' state-of-the-environment reporting.



better measurement of the environment's crucial role as both a source of natural capital and as a sink—or repository—for by-products generated during human activities is an important first step towards the integration of sustainability into economic management.

Environmental accounts can provide policymakers with ecological indicators and descriptive statistics to monitor the environment's contribution to the economy and the economy's impact on the environment. In addition, environmental accounting can potentially serve as a tool for strategic planning and policy analysis to identify the implications of different regulations, taxes, and consumption patterns on environmental sustainability and paths to sustainable development of specific economic activities.⁴ For example, comprehensive information on fish stocks and the extent to which certain fish stocks are being depleted could help fishery managers better identify appropriate harvest limits and provide policymakers with better information for use in negotiating international fishing treaties.

THE FOUR TYPES OF ENVIRONMENTAL ACCOUNTS

The four types of environmental accounts described below represent the latest categorization of environmental accounts by the international community.

1. Natural resource asset accounts primarily focus on stocks of natural resources. Accounts contain data on opening

stocks, closing stocks, and changes to stocks. Two types of changes to stocks are differentiated: changes due to economic activity (e.g., mining minerals) and changes due to natural processes (e.g., births and deaths of trees in a forest account).

a) Physical asset accounts track the physical amount of a resource. These accounts provide indicators of ecological sustainability and can be used to show the effects of policy on resource stocks. Thus, they can help managers monitor resources more effectively. An example of a physical asset account is a land account that tracks the conversion of agricultural land to urban settlements.

b) Monetary asset accounts establish a monetary value for the total national wealth of a resource. These accounts can be used in conjunction with national economic accounts to determine a country's total wealth, the diversity of a country's assets, how the ownership of assets is distributed, and how vulnerable assets are to price fluctuations—which is particularly important in economies that depend heavily upon unprocessed goods. An example of a monetary asset account is a forest account that tracks the value of native forests.

Figure 2 is an excerpt from the UK's monetary asset account for oil and gas. This account shows the monetary value of the asset at the beginning of the year, the value of the changes in the stock of the asset, and the final monetary value. The value of the UK's recoverable oil and gas reserves mainly depends upon the estimated physical amounts remaining, the rate of extraction, and the assumed future price per unit of oil or

⁴ On an individual level, consumers have also expressed interest in the environmental costs of goods and services, as evidenced by websites dedicated to calculating "food miles" and "carbon footprints."

gas, net of the cost of extraction. Since actual market values for transactions are not widely available, these values are estimated using the net present value method. This method relies on information about the size of the resource rent, the number of years for which the rent is to be received and the

social discount rate to be applied.⁵ The account places a monetary value on the depletion of oil and gas stocks, and thus the value of depletion can be set against national income for a more accurate picture of wealth.

Figure 2

OIL	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
Opening stocks¹	146,207	19,475	26,215	46,964	53,611	51,812	50,833	53,045	78,536	100,192	120,921
Extraction ²	-9,717	-1,112	-3,780	-6,878	-6,578	-6,326	-6,166	-8,260	-10,034	-10,982	-16,674
Revaluation due to time passing	3,847	580	1,698	2,735	2,557	2,333	2,524	3,657	4,924	5,610	8,784
Other volume changes	1,174	332	-1,577	-295	1,467	5,051	3,238	6,103	2,134	8,922	2,190
Change in extraction	176	0	276	-1,142	-961	0	-1,291	-2,253	-3,459	-3,685	0
Change in rent	-58,596	-6,458	15,267	11,660	611	-3,584	2,283	24,918	26,329	18,282	59,183
Normal holding gains	8,389	1,486	690	567	1,105	1,597	1,574	1,326	1,762	2,581	3,487
Closing stocks	91,480	14,304	38,789	53,611	51,812	50,883	53,045	78,536	100,192	120,921	177,891

GAS	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
Opening stocks¹	927	-8,207	15,374	30,495	43,011	50,451	46,566	44,250	50,754	65,402	69,439
Extraction ²	-30	340	-1,477	-4,222	-5,048	-5,091	-4,980	-5,632	-7,622	-7,304	-7,019
Revaluation due to time passing	22	-236	977	2,143	2,513	2,466	2,164	2,510	3,499	3,153	3,341
Other volume changes	6	-284	3	256	359	-2,501	1,423	1,025	-4,022	5,744	687
Change in extraction	29	-62	942	1,335	-552	-355	-37	-1,072	-1,941	-1,256	-1,972
Change in rent	-450	2,985	7,701	12,636	9,282	42	-2,326	8,567	23,596	2,015	1,860
Normal holding gains	53	-626	405	368	886	1,555	1,440	1,106	1,139	1,685	2,002
Closing stocks	558	-6,090	23,924	43,011	50,451	46,566	44,250	50,754	65,402	69,439	68,340

Source: K Office for National Statistics

¹ The estimated opening and closing stock values are based on the present value method. The estimates are extremely sensitive to the estimated return to capital and to assumptions about future unit resource rents. Please refer to the UK Office of National Statistics webpage for more information about these accounts: www.statistics.gov.uk/default.asp

² Negative extraction is shown here for the purposes of the calculation only. Of itself, extraction should be considered a positive value.

2. Pollution and material physical flow accounts provide information at the industry level about the quantity of resources—energy, water, and materials—that are used in economic activities, and quantity of residuals⁶—solid waste, air emissions, and wastewater—generated by these activities. In addition, these accounts often include data on pollution and material flows in relation to other countries, such as cross-boundary pollution and exports of goods. These accounts can take several forms, but they are generally organized to show the origin (supply) and destination (use) of materials and pollution. More detailed accounts also show how inputs are transformed into other products, pollution, and waste, and they provide information on the net material accumulation to either the economy or environment (i.e., the difference between the total inputs and the total outputs of each activity).

Examples of pollution and material physical flow accounts include time series accounts for carbon dioxide emissions and energy use. These are accounts specifically for tracking trends in carbon dioxide emissions and energy use over time.

Physical flow accounts are widely used for policy analysis. For example, they have been used to evaluate the impacts of environmental taxes and to design economic policies aimed at reducing pollution emissions. The European Union (EU) has used flow accounts extensively for two policy priorities: greenhouse gas emissions and acid rain. Data from the flow accounts are used to identify the sources of environmental degradation and to assess alternatives for alleviating them. These accounts can also be used to produce environmental

⁵ The UN defines resource rent as “the difference between total revenue generated from the extraction of natural resources and all costs incurred during the extraction process, including the cost of produced capital, but excluding taxes, royalties and other costs that are not directly due to the extraction process.” More details about the UK’s methodology for these accounts are available in the UK’s Office of National Statistics Environmental Accounts publication at www.statistics.gov.uk/downloads/theme_environment/EA_Jun08.pdf

⁶ A residual is the amount of a pollutant that remains in the environment after a natural or technological process has taken place.

indicators that show whether national goals—such as a specified level of greenhouse gas emissions—are being achieved.

Figure 3 is an excerpt from Sweden's physical flow account for carbon dioxide. This account provides the number of tons of

carbon dioxide emitted every year, from 1993 through 2004, by many sectors of the Swedish economy (although only five are shown here). This figure shows, for example, that while carbon dioxide emissions from agricultural activities fluctuated between 1993 and 2004, carbon dioxide emissions from forestry activities tended to increase fairly steadily over the same time period.

Figure 3
Excerpt from Sweden's Physical Flow Account for Carbon Dioxide Emissions, 1993 through 2004, in thousands of tons

ECONOMIC ACTIVITY	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Agriculture	1,686	1,806	1,753	1,736	1,762	1,814	1,736	1,664	1,677	1,705	1,779	1,823
Forestry	446	474	454	452	469	493	513	538	599	655	694	722
Fishing	333	344	329	315	317	316	298	301	287	287	285	293
Mining energy resources	8	9	14	15	11	8	8	10	8	11	5	6
Mining non-energy resources	565	564	604	596	637	546	497	534	594	516	467	475
Total emissions for these activities	3,038	3,197	3,154	3,114	3,196	3,177	3,052	3,047	3,165	3,174	3,230	3,319
Total emissions across all economic activities	59,942	63,376	61,893	65,840	61,887	63,113	60,353	59,803	59,708	59,497	62,092	62,941

Source: Statistics Sweden. The table shown here is a truncated version of the original, which can be found at: www.scb.se/Pages/TableAndChart_39287.aspx

3. Monetary and hybrid accounts separate data from countries' conventional accounts to focus on expenditures and taxes related to protecting and managing the environment, as well as the economic contribution of environmental services industries.⁷ Examples of monetary and hybrid accounts include fees collected by government for resource use, such as levies on minerals, forestry, or fisheries, and funds spent on water treatment and solid waste management. There are five types of monetary and hybrid accounts:

a) *Environmental protection and resource management expenditure accounts* identify expenditures made by industry, government, and households to protect the environment or manage resources.

b) *Environmental goods and services industry accounts* outline environmental goods and services and their contributions to GDP, employment, and exports.

c) *Environmental and resource tax accounts* contain taxes and other fees collected by the government for pollution emissions and resource use.

d) *Monetary flow accounts* assign a monetary value to the environmental costs and benefits tied to resource use and the generation of pollutants.

e) *Hybrid flow accounts* combine physical flow accounts and monetary flow accounts in one matrix.

These accounts help address questions about regulation, e.g., the cost of environmental regulation over time; the effectiveness of environmental protection expenditures and eco-taxes; and the impact of such expenditures on prices, productivity, and international competitiveness. They can also be used to derive decoupling indicators and resource intensity and resource productivity indicators.⁸

Figure 4 is an excerpt from New Zealand's account on Environmental Protection Activity Expenditures. This table shows the amount spent by the local and central (national) government on specific types of environmental protection activities. New Zealand's account is not complete as it does not yet include information on industry or household expenditures.

4. Environmentally-adjusted macroeconomic aggregates

use the previous types of environmental accounts to adjust product and income accounts to assess overall environmental health and economic progress. Examples of environmentally-adjusted macroeconomic aggregates include environmentally-adjusted GDP and Net Domestic Product (NDP). As Figure 5 illustrates, environmentally-adjusted macroeconomic aggregates can help assess overall environmental health and economic progress by correcting the GDP to include the monetary value

⁷ As noted, monetary and hybrid accounts are derived from data already included in countries' conventional accounts. Monetary asset accounts are not included here because they are not solely derived from data already included in countries' conventional accounts. Rather, monetary asset accounts are also based upon physical asset accounts.

⁸ Decoupling occurs when the growth rate of an environmental pressure is less than that of its economic driving force (e.g., GDP) over a given period. Decoupling indicators have an environmental pressure variable for numerator and an economic variable as denominator. Resource intensity is the ratio of resources used to economic value added, and resource productivity is the inverse.

of declines in resource stocks from environmental extraction and depletion.⁹ Similarly, these adjusted aggregates can also correct the GDP or NDP to include the cost of environmental degradation from economic activities that create pollution.

BENEFITS OF ENVIRONMENTAL ACCOUNTING TO SAIS

Environmental accounts are an important source of data that SAls can use in a variety of program audits. For example, flow accounts for air emissions could help SAls determine if acid rain control policies instituted by their governments are succeeding in reducing harmful pollutants. Likewise, for those SAls that

conduct prospective analyses, information from flow accounts on the status and usage of a nation's water supply could help SAls evaluate the potential effect of various policy options. Environmental accounting data are also useful when there is a crisis that demands an immediate response. For example, when Australia was experiencing a multi-year drought, policy makers used data from the water asset accounts to determine the economic and environmental impact of changes in water resources allocation and use.¹⁰ In a crisis, policy-makers want quick answers; but if the country has not been investing in data-collection, the necessary information may not be available. Similarly, SAls will also be able to respond more quickly and effectively to policy-makers' needs if they have access to the appropriate data.

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Figure 4
Excerpt from New Zealand's Environmental Protection Activity Expenditures Account, 2001 through 2003, in thousands of New Zealand dollars

EXPENDITURE CATEGORY	Local Government		Central Government		Total expenditures by category		TOTAL
	Current expenditure	Capital expenditure	Current expenditure	Capital expenditure	Current expenditure	Capital expenditure	
Year Ending June 2001							
Waste management	188,452	25,572	7,526	0	195,978	25,572	221,550
Waste water management	312,029	276,292	0	0	312,029	276,292	588,321
Pollution abatement	13,123	17	3,894	0	17,017	17	17,034
Biodiversity and landscape	38,804	4,819	184,486	5,942	223,290	10,761	234,051
Research and development	1,129	13	74,670	0	75,799	13	75,812
Not elsewhere classified	12,863	451	15,194	9	28,057	460	28,517
Total yearly expenditures	566,400	307,164	285,770	5,951	852,170	313,115	1,165,285
Year Ending June 2002							
Waste management	182,515	26,398	8,776	0	191,291	26,398	217,689
Waste water management	275,526	359,028	0	0	275,526	359,028	634,554
Pollution abatement	7,347	38	7,148	0	14,495	38	14,533
Biodiversity and landscape	59,669	510	202,917	3,660	262,586	4,170	266,756
Research and development	1,515	0	75,559	0	77,074	0	77,074
Not elsewhere classified	20,553	581	17,797	89	38,350	670	39,020
Total yearly expenditures	547,125	386,555	312,197	3,749	859,322	390,304	1,249,626
Year Ending June 2003							
Waste management	185,965	23,509	8,857	0	194,822	23,509	218,331
Waste water management	276,034	326,889	0	0	276,034	326,889	602,923
Pollution abatement	9,843	0	6,904	0	16,747	0	16,747
Biodiversity and landscape	67,214	2,475	209,345	6,386	276,559	8,861	285,420
Research and development	3,274	0	76,300	0	79,574	0	79,574
Not elsewhere classified	43,635	1,989	18,745	149	62,380	2,138	64,518
Total yearly expenditures	585,965	354,862	320,151	6,535	906,116	361,397	1,267,513

Source: Statistics New Zealand

⁹ The issue of GDP's adequacy as an indicator of national success has received attention recently. For example, the EU Commission is currently undertaking an effort to develop aggregate measures similar to GDP that incorporate environmental and social aspects into an assessment of a nation's well-being.

¹⁰ In 2004, INTOSAI's WGEA published a document entitled, *Auditing Water Issues: Experiences of Supreme Audit Institution* that summarizes the collective experience of SAls around the world, drawing on the lessons learned from more than 350 audits, and provides practical tips for SAls.

Although many SAIs already have access to environmental statistics, data from environmental accounts can enhance their program audit work. Audit findings from various countries have shown that environmental statistics can oftentimes be problematic for a variety of reasons.¹¹ For example, statistics may have been collected for a specific administrative need and often suffer from methodological and conceptual changes over time. Inconsistencies in the data limit the usefulness of environmental statistics in analysis, as statistics on different environmental issues—such as greenhouse gas emissions and sulfur dioxide emissions—cannot always be compared easily with one another. Thus, environmental audits sometimes conclude that the audit objectives cannot be answered due to inadequate data.

In contrast, environmental accounts are consistent—in terms of concepts, methods, definitions and classifications—from one account to another and over time, to the extent possible. Thus, data from environmental accounts can help SAIs better evaluate the

trade-offs between different policies with similar goals. Furthermore, turning environmental statistics into structured accounts can help strengthen and standardize existing environmental data. For example, statisticians must resolve any discrepancies in the underlying statistical data in order to build the accounts. As a result, SAIs' work can be strengthened through access to more reliable data.¹²

Additionally, unlike environmental statistics, environmental accounts share the structure, set of definitions and classifications of the economic accounts. For example, physical flow accounts link emissions of greenhouse gases to their source industries just as economic accounts link monetary data to industries. In addition, both the environmental and economic accounts use the same industry classifications so information from these accounts can be analyzed within a common framework. This can serve as a powerful analytical tool for SAIs conducting environmental audits. For example, an SAI could link greenhouse gas emissions to source industries to evaluate policies based on the polluter pays principle.¹³

Figure 5
Examples of Environmentally-Adjusted Domestic Product Aggregates
from the System of Environmental and Economic Accounts, 2003

EXTRACTION-ADJUSTED DOMESTIC PRODUCT	Currency units (billions)	Index (GDP=100)	DEPLETION-ADJUSTED DOMESTIC PRODUCT	Currency units (billions)	Index (GDP=100)
Gross domestic product	692.4	100.0	Gross domestic product	692.4	100.0
Consumption of fixed capital	-104.4		Consumption of fixed capital	-104.4	
Net domestic product	588	84.9	Net domestic product	588	84.9
Decline in the value of resource stocks due to extraction	-58.6		Decline in the value of resource stocks due to extractions net of discoveries and natural growth	-12.8	
Extraction adjusted domestic product	529.4	76.5	Depletion-adjusted domestic product	575.2	83.1

Source: System of Environmental and Economic Accounts (SEEA) 2003

¹¹ For example, New Zealand's Office of the Auditor-General has reported on limitations in the quality of data and information used by the Ministry of Fisheries to assess fish stocks.

¹² Developing environmental accounts does not supplant the need for maintaining high-quality environmental statistics; rather environmental accounts provide an additional important tool for SAIs and policy-makers because they link environmental data to the economic data contained in a country's system of national accounts. Data quality remains a key issue for environmental accounts and any underlying environmental statistics data.

¹³ The polluter pays principle states that an entity that causes pollution should pay for the cost of removing it, or provide compensation to those who have been affected by it.

Chapter 2: Status of International Efforts to Develop Standards

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Since the 1998 report on the status of environmental accounting practices by INTOSAI's Working Group on Environmental Auditing, international organizations have made much progress in developing environmental accounting methodologies. In conjunction with other international organizations, the UN issued a handbook on general environmental accounting methods in 2003, and has since issued additional handbooks regarding the application of these methods to particular resources such as fisheries and water. The UN and other international bodies are currently in the process of updating the 2003 handbook with the goal of adopting certain methodologies as an international standard in 2012.

SEEA-2003 – TOWARDS AN INTERNATIONAL STANDARD

The UN, the Organization for Economic Co-operation and Development (OECD), and other international institutions have recommended that countries develop environmental accounts to respond to the need for consistent environmental information that provides policy makers with indicators and descriptive statistics to monitor the interaction between the economy and the environment. This information also serves as a tool for strategic planning and policy analysis to identify more sustainable development paths. To support the development



of environmental accounts, the UN, European Commission, International Monetary Fund, OECD, and the World Bank issued a handbook in 2003 on accounting approaches for use by both national and international agencies who wish to compile environmental accounts that reflect their information needs and priorities.¹⁴

An accounting approach is designed to bring a more systematic discipline to the organization of environmental statistics. Just as the development of the original guidelines for national accounting in the 1950s was the first step toward today's robust, internationally comparable economic statistics, the handbook referred to as System of Environmental and Economic Accounts 2003 (SEEA-2003) provides a framework for bringing order and comparability to environmental statistics.

It does this by:

- encouraging the adoption of standard classifications in environmental statistics;
- encouraging the development of comprehensive and consistent data sets over time; and
- facilitating international comparisons.¹⁵

The handbook covers complex and diverse topics, some of which are still subject to debate. It also reports on best practices, and where a variety of accounting approaches exist, the handbook presents the advantages and disadvantages of each approach. Wherever possible, the handbook presents harmonized approaches, concepts and definitions which should provide the basis for the development of standards, and advice on how to compile environmental accounts and carry out analyses based on them.

A SERIES OF PUBLICATIONS TO SUPPORT THE SEEA

As described below, the UN has released two publications to support the SEEA, and is in the process of drafting two more. Three of these publications apply environmental accounting methods to a particular natural resource (i.e., fisheries, water, and energy). The fourth publication further develops the material flow accounts discussed in the SEEA, and raises the concepts, definitions, and tables from best practices to the level of an international standard.

1. In 2004, the United Nations Statistics Division (UNSD) and Food and Agricultural Organization jointly released the *Handbook of National Accounting: Integrated Environmental and Economic Accounting for Fisheries* (SEEA-F).

¹⁴ United Nations, European Commission, International Monetary Fund, Organization for Economic Cooperation and Development, and World Bank, *Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003* (New York, N.Y.: 2003).

¹⁵ International comparisons using data from environmental accounts can be an important tool for policymakers. For example, the standardized methodology for compiling data into accounts may allow one nation to compare and contrast its inputs and outputs to other nations or to collectively look at the inputs and outputs of a region.

The SEEAF is intended to:

- clarify the SNA and SEEA concepts and expand them for fisheries and related resources (such as ocean areas, inland lakes and rivers, and coastal areas);
- harmonize accounting practices for fisheries so that accounts are comparable across countries;
- promote accounting for the fisheries sector (through case studies and explanations of how the accounts are useful for policymakers); and
- provide a guide and a training tool.

2. In 2007, the UN released the *System of Environmental and Economic Accounting for Water* (SEEAW). Building upon the methodologies for water accounts described in SEEA-2003, the SEEAW is divided into two parts. Part I includes internationally accepted concepts, definitions, and classifications for water accounts and a set of standard tables outlining statistics that countries are encouraged to compile. Part II covers more experimental concepts and methodologies including quality accounts, the economic valuation of water beyond the 1993 SNA¹⁶ and examples describing applications of the SEEAW. Although still considered experimental, the concepts explored in Part II can be an important resource for policymakers. For example, water quality accounts can help policy makers identify the cause of water pollution and design appropriate responses, such as charging fees for sanitation services. The SEEAW has been adopted as an interim international statistical standard by the United Nations Statistical Division upon recommendations by the United Nations Committee of Experts on Environmental Accounting (UNCEEA).

3. Also at UNCEEA's recommendation, the UN is developing the *System of Environmental-Economic Accounting for Energy* (SEEA-E), with technical assistance from the London Group on Environmental Accounting and the Oslo Group on Energy Statistics.¹⁷ The SEEA-E will present the agreed-upon concepts, definitions, and classifications and standard tables and accounts for energy and energy-related air emission accounting. In addition, the SEEA-E will discuss the links between the emission inventories—which are reported under the United Nations Framework Convention for Climate Change—and the air emissions accounts. The SEEA-E is expected to be adopted by the United Nations Statistical Commission upon recommendation of UNCEEA in early 2010.

4. A process similar to the drafting of the SEEA-E has been established to draft the System of Environmental-Economic Accounting for Material Flow Accounts (SEEA-MFA).¹⁸ The SEEA-MFA will present agreed upon concepts, definitions, classifications, and accounting rules for measuring items such as domestic extraction, imports and exports, supply and use of products, and the generation of residuals. The SEEA-MFA accounting framework will allow physical data on material flows to be presented with economic data in a format designed for economic analysis and policy-making. The SEEA-MFA is also expected to be adopted by the United Nations Statistical Commission upon recommendation by the UNCEEA in 2010.

Online Access to the Environmental Accounting Handbooks

SEEA 2003

<http://unstats.un.org/unsd/envaccounting/seea.asp>

SEEAF

<http://unstats.un.org/unsd/envaccounting/seeaf.asp>

SEEAW

<http://unstats.un.org/unsd/envaccounting/seeaw.asp>

SEEA-2012

UNCEEA is currently working with the London Group on Environmental Accounting and other international and national statistical organizations to revise the SEEA-2003 with the goal of adopting the new version as an international standard in 2012.¹⁹ The fundamental principles of the current system will remain intact, however the presentation will be streamlined, methodologies will be updated to reflect recent advances in environmental accounting, and policy discussions will include emerging issues such as climate change. The revised SEEA-2003 will be organized in three parts. Part I will discuss the accounts and approaches that have been internationally standardized and accepted. Part II will discuss accounts and approaches that may be useful, but where experts have not reached a consensus for a standardized methodology. Part III will discuss the uses and potential policy applications of environmental accounts.

¹⁶ The 1993 System of National Accounts was published jointly by the United Nations, the Commission of the European Communities, the International Monetary Fund, the Organization for Economic Co-operation and Development, and the World Bank to set the international statistical standard for the measurement of the market economy. It consists of an integrated set of macroeconomic accounts, balance sheets and tables based on internationally agreed concepts, definitions, classifications, and accounting rules. It is currently undergoing a worldwide comprehensive update.

¹⁷ See also http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA_3_8.pdf

¹⁸ See also http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA_3_17.pdf

¹⁹ See also http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA_3_11.pdf

Chapter 3:

Ongoing Environmental Accounting Efforts by Individual Countries

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Many industrialized countries, including Australia, Canada, and France, and an increasing number of developing countries, including Namibia and the Philippines, have developed some components of environmental accounting and continue to refine their accounts. As of 2007, 72 countries had established an environmental accounting program or were planning to do so in the near future. Additionally, 36 countries had standardized their water accounting practices using the SEEA-2003, and 36 additional countries were in the process of standardizing theirs. For example, to better understand how to make the most of Australia's limited water resources, the Australian Bureau of Statistics and the National Water Commission have produced water accounts that track the supply and use of water in the Australian economy. Canada has also annually produced environmental accounts since the early 1990s and has used them in many ways, including developing environment-economy indicators such as urban-rural land use change and annual stock estimates for timber, energy, and mineral resources.

Several countries have adopted their own methods of environmental accounting outside of the original SEEA-1993 and others have adapted environmental accounting techniques or otherwise used environmental accounts for policy purposes.

For example:

In 1993, the Netherlands developed a National Accounting Matrix including Environmental Accounts, or NAMEA, which is a matrix that adds environmental physical flow accounts to the flow accounts of the SNA. Since that time, Statistics Netherlands has developed consistent time series for oil, natural gas, and six types of environmental degradation (such as the greenhouse effect and acidification) based on emission flows. In addition, the EU officially adopted the NAMEA framework and is helping finance other EU countries that want to develop their own NAMEA systems. Furthermore, the NAMEA account is now included in the SEEA (in its 2003 update).

Through Eurostat, member countries and partners of the European Union developed their own system of satellite accounts—which are accounts that are linked to but not a part of national economic accounts—in 1994 called the European System for the Collection

of Economic Information on the Environment (SERIEE). SERIEE is a system of satellite accounts that contain data on environmental protection expenditure and economic data on the use and management of natural resources. SERIEE is composed of two satellite accounts: an Environmental Protection Expenditure Account and a Resource Use and Management Account. The main objectives of the SERIEE are to (1) trace the monetary flows linked to environmental protection, (2) characterize the impact of environmental protection on the European economic system, and (3) compute environmental indicators. Since the SERIEE is the most extensive system for recording environmental protection expenditures, the SEEA-2003 recommends that “those interested in entering into greater detail in the area of environmental protection activities” consult SERIEE.

The Philippines conducted an Environment and Natural Resource Accounting Project (ENRAP) over the course of nine years, beginning in 1991. ENRAP experimented with several accounts, such as adjusting the Gross National Product for the depreciation of forests and accounting for the production of fuelwood and food by rural households.

China has made efforts to calculate an environmentally adjusted macroeconomic aggregate, or “Green GDP.” In 2004, President Jintao requested that the government study how to calculate a “Green GDP.” To do so, the government commissioned research studies that estimated the cost of environmental damage from China's economic growth, and subtracted the cost of damage from its GDP. China also calculated a GDP that was adjusted for estimated pollution abatement costs. One of the authors of the SEEA-2003 regards the Chinese effort as a major contribution to the international community because it integrates Marxist economics, Chinese philosophy, and market economic principles to establish a value theory and pricing method for natural resources.

Germany is a leader in the development of material and energy flow accounts, which are the most developed of all its accounts. Germany compiled economy-wide material flow accounts in the mid-1990s and updates them annually; they are now available for the years 1991-2007. Data from these accounts are aggregated across sectors and materials to provide an indicator of the economy's “direct material input”—or all materials (i.e., domestic

extraction plus imports) which are of economic value and are used in production and consumption activities.

A 2007 global assessment of environmental accounting by the UN identified several trends in countries' environmental accounting programs.²⁰ For example, industrialized countries appear to most commonly produce environmental expenditure accounts and pollution and material flow accounts. In developing countries, water accounts of various types seem to be the most common, followed by energy and emissions flow accounts, mineral asset accounts, and forest accounts. In addition, some techniques—especially those used to attribute values to environmental goods and services—have not been widely used or accepted.

While some environmental goods, such as forestry products or mined minerals, are sold in markets and are therefore relatively easy to value, others, such as clean air and water, are not priced in markets. Estimating the value of these non-market environmental goods presents significant methodological challenges. As a result, many environmental accounting efforts have taken a staged approach, concentrating first on those sectors in which environmental goods are sold in markets, and then, as financial resources permit, addressing the more difficult challenges associated with non-market environmental resources.



USE OF ENVIRONMENTAL ACCOUNTS TO ADDRESS CLIMATE CHANGE

Given the complex nature of climate change, the cost to prevent and adapt to its effects, and the controversy surrounding the issue, policy decisions in this area will need to be based on sound data. Environmental accounts can play a key role in helping governments make well-founded decisions regarding climate change. In fact, asset and flow accounts have been recognized by the global statistical community as

a useful framework for monitoring, measuring and analyzing climate change. Since climate change is linked to economic growth, governments must be able to connect economic data to environmental data to develop policies that allow for economic growth while supporting sustainability. Official statistics do not always support necessary analyses. As governments better understand the driving forces, pressures, and impacts of climate change, appropriate policy responses can be developed. Environmental accounts can play a key role in the development and evaluation of these policy instruments and regulations.

More specifically, accounts of greenhouse gas stocks and flows can help illuminate the impacts of policy initiatives that are intended to mitigate climate change, such as cap and trade programs. For example, the UK has used flow accounts to develop a model for carbon emissions trading and to determine which industries would be most positively and negatively affected by carbon taxes.

In addition, forest asset accounts can be used to help estimate the change in carbon stocks since forests act as carbon sinks.²¹ A few countries, including Australia, Canada and Finland, have constructed such accounts. According to environmental accounting experts, if international carbon trading becomes more widely practiced, developing countries with large amounts of forest stock could benefit economically from constructing asset accounts.²²

Country Example:

Canada's Forest Carbon Accounting System

Canada developed a monitoring, accounting, and reporting system that integrates several data sources including forest inventories; forest growth and yield information; statistics on change agents such as wildfire, insect disturbances, and forest management activities; and land-use changes (afforestation and deforestation). This effort does not rely upon SEEA methods, nor does it use data from Statistics Canada. Rather, the model relies upon several provincial and federal government data sources, as well as Natural Resources Canada's own data compilations for the annual reporting of greenhouse gas emissions and removals submitted for Canada's national greenhouse gas inventory report. Nonetheless, the data are used in the carbon budget model of the Canadian forest sector to create a national carbon account that estimates carbon stocks, stock changes and non-CO₂ emissions and removals to meet international reporting requirements. The data are also used in support of government policy to predict future changes in carbon stocks under differing scenarios, which enables forest managers to consider the effect of proposed alternatives on carbon emissions when making management decisions. See appendix 2 for more information on Canada's environmental accounts.

²¹ Carbon depletion is estimated as a percentage of forest biomass.

²² Although the monetary value of a forest's carbon sequestration is currently difficult to determine, it will be important to add this value to the forest's monetary value as timber. Some studies have attempted to value carbon storage. For example, one study estimated that the forests in one American state provide somewhere between \$3.5 to \$10.4 billion worth of sequestration.

More broadly, land use and land cover asset accounts can also be useful for assessing the impacts of climate change and meeting the Kyoto Protocol's reporting requirements, since land cover affects the global climate system through various biological processes.²³ For example, changes in land cover alter the land's reflectivity, which in turn determines how much of the sun's energy is absorbed. Additionally, changes in land cover due to deforestation and forest fires alter ecosystems and release greenhouse gases to the atmosphere. Since countries that adopted the Kyoto Protocol are required to report on the carbon emission impacts of land-use changes, some countries, such as Australia and the UK, among others, have developed accounts to monitor changes in land-use and forest resources, and assess the impact of any changes on their national carbon emissions.

Water accounts are also relevant, as climate change is expected to decrease the availability of freshwater while demand rises, resulting in water scarcity. In addition, as sea level rises, some countries will incur infrastructure costs as they attempt to keep rising water from flooding their lands. The costs of storing water to prepare for scarcity and for building levies to prevent flooding are included in water accounts.

Fish accounts could also be useful. Some countries' economies, especially in the developing world, rely heavily on the fishing industry. Climate change is expected to change the temperature, salinity, and acidity of the water, thus affecting fish stocks. Stock accounts could be used to track the resource level and warn managers when fish levels begin to drop, before they become dangerously low.

Environmental accounts can also be used to derive climate change-related indicators. For example, countries can set a target level of carbon dioxide emissions and measure their progress against that standard using aggregate indicators of emissions. Countries can also use these data on carbon dioxide emissions and projections of emissions to estimate whether the government will meet its emission targets.²⁴ The International Panel on Climate Change (IPCC) published guidance on methods for measuring national greenhouse gas emissions, and greater harmonization with the IPCC guidelines has been discussed as part of the revision of the SEEA planned for release in 2012.²⁵

Country Example: Australia's Water Accounts

Droughts are common in Australia, and any change in the abundance, distribution, or availability of water will be extremely challenging for the country to mitigate. Given that climate change is expected to cause such changes in water supply, Australia has used its water accounts to understand the impact of and responses to water shortages due to climate change.²⁶ For example, the Australian Bureau of Statistics used the country's water accounts to analyze changing water-use patterns over time and across industries, sectors, and regions. The agency discovered, among other things, that the agricultural industry gained the least amount of value added from additional water use while manufacturing gained the most, as compared to other industries. In addition, although the agricultural sector remained the least efficient water use over time, it did increase its efficiency by about one-third between the 2000-2001 and 2004-2005 time frames, while the mining industry's efficiency decreased by about one-fifth. Water accounts can be used to devise water pricing and trading strategies that encourage more efficient water use and ensure that water is allocated where it adds the most value. For example, the Australian government recommended that water distributed to urban users should be priced to recover all costs associated with its capture, storage, treatment, and distribution, while water distributed to rural and regional users should be priced to cover only the current costs associated with supplying water. The water accounts can then be used to chart changing patterns of water use associated with such evolving water pricing and trading policies. See appendix 2 for more information on Australia's environmental accounts.

²³ Some countries, such as Norway, have successfully used geographic information systems data in environmental audits concerning land use change and sustainable development. Additionally, geographical information systems data can be an important source for developing land use environmental accounts.

²⁴ INTOSAI's WGEA developed a draft guidance document entitled, *Auditing Government Response to Climate Change*, that describes key issues to consider when planning climate change audits.

²⁵ See www.ipcc-nggip.iges.or.jp/public/index.html for a copy of the 2006 IPCC guidelines for national greenhouse gas inventories.

²⁶ Climate change is not the only factor that affects the variability of Australia's water supply. Since Australia's water accounts are relatively new, it is difficult to distinguish precisely between the effects of climate change and the effects from other factors.

Chapter 4: Inventory of Options Available to SAIs



OPTIONS AVAILABLE TO SAIS IN COUNTRIES THAT ARE NOT CURRENTLY DEVELOPING ENVIRONMENTAL ACCOUNTS

In countries that are not currently developing environmental accounts, SAIs could take the following actions:

- determine the value of environmental accounts for their government by identifying the costs and benefits of developing environmental accounting within their country, and/or
- assist their governments in the development of environmental accounts by:
 - 1) identifying challenges to applying environmental accounting in their country,
 - 2) recommending strategies for overcoming challenges,
 - 3) identifying goals for developing environmental accounts,
 - 4) identifying agencies and organizations that compile information useful for national environmental accounts, and/or
 - 5) identifying best practices in environmental accounting.

The following are suggestions of various ways that SAIs can become involved in environmental accounting within their countries. It also includes examples of how SAIs are using environmental accounting, depending on the level of experience with the discipline within their governments.

For example, SAIs have taken or plan to take the following actions:

- **United States:** The Government Accountability Office, in conjunction with the National Academy of Sciences, held a forum to discuss environmental accounts. Participants included U.S. federal agency officials and national and international statistical, energy, environment, and natural resource experts. During the forum, participants discussed strategies for overcoming challenges associated with environmental accounting, agencies that could be involved in such an effort, and lessons learned from the international community, among other topics.
- **The African Organization of English-speaking Supreme Audit Institutions:** Participating African countries plan to learn more about environmental accounting and its uses by conducting research on environmental accounting and related audits and meeting with South Africa's statistics bureau, which uses environmental accounts.
- **WGEA:** In 1998, WGEA released a report on environmental accounting—written by the Netherlands Court of Audit—to facilitate the spread of information on environmental accounting among its member SAIs. Among other things, the report described the efforts of international institutions to advance the field of environmental accounting, described some countries' efforts in developing the accounts, and described ways that SAIs could conduct related work.

OPTIONS AVAILABLE TO SAIs IN COUNTRIES THAT HAVE DEVELOPED SOME ENVIRONMENTAL ACCOUNTS

In countries that have developed some environmental accounts, SAIs could take the following actions:

- audit the reliability of environmental accounts or methodologies used to develop them,
- use environmental accounts in program audits to assess the effectiveness of environmental policies and programs and/or whether or not government programs are complying with national laws,

- use environmental accounts to determine the government's compliance with reporting requirements from international conventions,²⁷ and/or
- assess the extent to which program managers are using environmental accounts in decision-making and identify opportunities for managers to enhance their use of the accounts.

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For example, SAIs have taken or plan to take such actions:

- **Canada:** The Commissioner of the Environment and Sustainable Development, located within the Office of the Auditor General, is tasked with examining whether or not federal managers are adequately accounting for the environmental effects of expenditures in the context of sustainable development. To this end, auditors are studying environmental accounting and other management practices to determine how they can be used in this oversight activity and how they can be used by federal managers to execute their responsibilities.²⁸
- **Estonia:** While conducting an audit on how the State Forest Management Center's logging plans affect the value of the state forest, the National Audit Office discovered that the methodology used to estimate monetary values for forests differed from the state's and the international community's accounting standards in several ways. This example illustrates an opportunity for SAIs to be involved as their country develops environmental accounts to ensure that the methodologies follow international standards.
- **United Kingdom:** The National Audit Office reviewed the process that the Department for Environment, Food and Rural Affairs (DEFRA) used to measure and maintain a greenhouse gas emissions inventory. The audit found that DEFRA's methodology follows international best practices. However, the audit also found that DEFRA could improve its procedures by, for example, maintaining a record of errors found in the data.

²⁷ Depending on a SAI's level of expertise regarding international reporting requirements, such a review may require external technical assistance.

²⁸ INTOSAI's WGEA developed a guidance document entitled, *The World Summit on Sustainable Development: An Audit Guide for Supreme Audit Institutions* that provides information for SAIs on how to conduct audits of sustainable development activities.

Chapter 5:

Observations

The value of environmental accounting has long been recognized by leading international environmental organizations and many countries as an important policy design and resource management tool for creating a sustainable future. In recent years, it has become increasingly viewed as particularly relevant for many of the world's paramount environmental challenges—most notably climate change—and as an important aide in helping governments better devise defensible, measurable, and practical solutions to respond to them.

Environmental accounting as a discipline, however, is still evolving. Environmental accounting covers complex and diverse topics, some of which are still subject to debate. In particular,

valuing some natural assets, such as clean air and water, is complicated by the fact that these goods are generally not traded in markets and alternative techniques for establishing their prices face conceptual and empirical challenges.

Given the evolving nature of environmental accounting, SAIs are uniquely positioned to assist their governments in helping to advance and improve on the development of accounts. In doing so, SAIs will help advance the development of a tool that can add great value to their own audits and analyses through more consistent and reliable information on the environment and the relationship between the environment and the economy.

Appendix 1: Key Developments in Environmental Accounting

The following timeline outlines key events in the development and refinement of environmental accounting as a discipline.

Figure 6
Timeline of Key Developments in Environmental Accounting

DATE	KEY DEVELOPMENT
1972	For the first time, the relationship between economic development and environmental degradation was discussed by the international community at the United Nations (UN) Conference on the Human Environment.
1970s	The first environmental accounts were constructed by Norway.
1983-1987	The UN set up the World Commission on Environment and Development, also known as the Brundtland Commission, in 1983. The Commission examined whether nations were misusing their natural and environmental resources and issued a report entitled <i>Our Common Future</i> in 1987. The report popularized the concept of sustainable development as an alternative to unfettered economic growth and defined "sustainable development" as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
Early 1990s	The World Bank conducted a review of environmental accounting. The resulting report listed countries that had developed accounts, the methods used, and the extent of coverage.
1992	The UN Earth Summit was held in Rio de Janeiro to discuss sustainable development and recommended the implementation of integrated environmental and economic accounting. One of the resulting agreements stated that "A first step towards the integration of sustainability into economic management is the establishment of better measurement of the crucial role of the environment as a source of natural capital and as a sink for by-products generated during the production of man-made capital and other human activities."
1993	The first handbook for developing a system of integrated environmental and economic accounting (SEEA) was issued. SEEA-1993 was developed by the UN, but as a final conclusion on concepts and methods was not reached, it was issued as an interim handbook.
1994	A group of countries active in environmental accounting formed the London Group on Environmental Accounting in order to share their experiences in developing and implementing the accounts. The collaboration helped develop recommended methodologies for selected parts of the revised SEEA.
1998	The International Organization of Supreme Audit Institutions' Working Group on Environmental Auditing (WGEA) released a report entitled <i>Natural Resource Accounting: An Inventory of Possibilities for Supreme Audit Institutions</i> (SAls) to inform SAls about the current state of affairs in the field of environmental accounting, as well as to inform and promote debate regarding the opportunities available to SAls in this field.
2000	The United Nations Statistics Division (UNSD) and the UN Environment Programme published <i>Integrated Environmental and Economic Accounting - An Operational Manual</i> that was written by the Nairobi Group (a group of government, international, and non-governmental organization experts). The manual contains guidance on implementing parts of the SEEA and provides additional examples on how the accounts are used in policymaking.
2003	The UN, Eurostat, International Monetary Fund, OECD, World Bank, and the London Group released a revised version of SEEA-1993, which was drafted with technical assistance from the London Group on Environmental Accounting. The revised SEEA made progress towards the standardization of concepts, definitions, and methodologies.
2004	The UNSD and Food and Agricultural Organization jointly released a draft of the <i>Handbook of National Accounting: Integrated Environmental and Economic Accounting for Fisheries</i> (SEEA-F). The SEEA-F was the first in a series of handbooks in support of the SEEA.
2005	The UN Statistical Commission established the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) during its 36th session, whose objectives are to: (a) mainstream environmental-economic accounting and related statistics; (b) elevate the SEEA to an international statistical standard; and (c) advance countries' implementation of the SEEA.
2005	Also during its 36th session, the UN Statistical Commission established the Oslo Group on Energy Statistics to contribute to the development of improved methods and international standards for national official energy statistics, and, in particular, to review and contribute to the updating of the UN's handbooks and manuals on energy statistics. The Oslo Group is contributing to the development of the <i>System of Environmental-Economic Accounting for Energy</i> (SEEA-E).
2006	UNCEEA began a Global Assessment project to: (a) to assess the current status of national implementation of environment statistics, environmental-economic accounting and related statistics; (b) to identify priorities and future plans in these areas; and (c) to assess impeding factors in the collection, compilation and dissemination of environment statistics, environmental-economic accounting and related statistics.
2007	The UN Statistical Commission adopted Part I of the System of Environmental-Economic Accounting for Water (SEEA-W), as an interim statistical standard and encouraged its implementation in countries.
2007	The UN began working on SEEA-E, scheduled to be adopted by the United Nations Statistical Commission upon recommendation by UNCEEA in 2010.
2008	The UN, jointly with Eurostat and OECD, is drafting the <i>System of Environmental-Economic Accounting for Material Flow Accounts</i> (SEEA-MFA), which is scheduled to be adopted by the United Nations Statistical Commission upon recommendations by the UNCEEA in 2010.
2009	The UNSD released reports on the Global Assessment of Water Statistics and Accounts and Energy Accounts.

Appendix 2: Examples of National Environmental Accounting Efforts

This appendix provides examples of 12 countries' experiences with environmental accounting. We selected these countries to: (1) highlight different stages of account development, (2) provide representation from both the developing and developed world, and (3) demonstrate a variety of applications for environmental accounts at the national level. These country profiles include

AUSTRALIA



Australia has developed SEEA-based stock and flow accounts for energy and emissions, fisheries, minerals, and water. Australia has also determined a monetary value for land, mineral, and forest stock accounts and has included them in its balance sheets to create a measure of total wealth. Mineral accounts have only been issued once, but cover a range of years. Water accounts have been issued three times thus far, for 1993-1994 to 1996-1997, 2000-2001, and 2004-2005. The water accounts can be linked to Australia's national accounts as well as other natural resource data sets. In 2009, Australia released preliminary water accounting standards and guidelines for developing general purpose water account reports. The country has also developed local government environmental expenditure accounts.

The accounts have been used to assess how well federal programs, such as programs whose purpose is to make irrigation more efficient, are meeting their intended goals. Since droughts are common in Australia, water policy is a high priority and water accounts are used to effectively manage this scarce resource. Furthermore, a variety of groups—including government decision-makers, industry, and academics—have used the water accounts to perform economic analyses of the interaction between water supply and use and the economy. In addition, academics have used water accounts to perform input-

basic information obtained from published reports, conference proceedings, and national government statistical body websites for each selected country. We supplemented basic information with additional details when available. We then contacted knowledgeable officials from each country to verify the information and incorporated any comments we received as appropriate.

Examples of Analyses Using Environmental Accounts in Australia

- One analysis determined that reducing water use in the Murray-Darling Basin of Australia by 10% could result in the loss of 400–900 jobs and \$88 million from Australia's GDP.
- Another analysis examined what would happen to the Australian economy and price of water if water demand increased and supply decreased; one conclusion was that water trading would cause water to be diverted away from agricultural use towards urban water use.

output analyses of water use and make comparisons between industry sectors as well as projections about water use.

Further developments in environmental accounting are anticipated. The Australian Bureau of Statistics is currently working on producing energy accounts for 2004-05, and is also working towards the next water account for 2008-09. Australia's Bureau of Meteorology intends to release a new water account in 2010, using the country's preliminary water accounting standards. There is also increasing interest in environmental accounting among Australian policy agencies to facilitate evidence-based decision making. Additionally, two Australian states have shown interest in using the environmental accounting framework to organize their environmental information.

BOTSWANA



Botswana has developed both water and mineral accounts, using SEEA whenever possible. Botswana is a semi-arid country with very scarce water resources. As the country began rapidly developing and demand for water grew, creating water accounts became crucial to help the government allocate its scarce water resources. Botswana developed both stock and flow accounts for water and has done some preliminary work on monetary valuation of mineral stocks. The water accounts cover the years 1990-2002.

Botswana's accounts were specifically developed to support policy analysis. Accordingly, the water accounts have been used to support water pricing and allocation policy development, as well as strategies for rural development. Although the stock accounts were developed more recently and are currently incomplete, Botswana has used its flow accounts to 1) establish trends in overall water consumption, 2) observe changes in institutional suppliers, 3) identify the leading water consumers and the 'growth' sectors of water consumption and 4) compare the water efficiency of different economic sectors and trends in overall water efficiency. Botswana has also assessed the economic benefits from water use in each sector of the economy.

Some developing countries are hesitant to develop environmental accounts because they are not a part of the major international initiatives driving development policy, such as the Millennium Development Goals. For example, Botswana expressed concern in 1993 that accounting for depletion of minerals would negatively affect indicators of macroeconomic performance and thus damage their international credit rating. However, Botswana plans to continue development of environmental accounts through its Department of Environmental Affairs and the Department of Water Affairs. Additionally, Botswana has recently become interested in incorporating total wealth accounts as one of the macroeconomic indicators of performance under their next National Development Plan.

Examples of Analyses Using Environmental Accounts in Botswana

- One analysis determined that per capita water use as well as the water intensity of the economy (measured by the GDP per cubic meter of water used) declined in the 1990s; however, the total volume of water used still increased because population and GDP grew more than the gains in efficiency.
- Another analysis examined the amount of national income and employment created in each sector by water use, as well as the economically important diamond sector's trends in output per unit of water.

Additional information

Botswana's National Conservation Strategy Agency, now the Department of Environmental Affairs, provided the impetus for developing the accounts. In 1995, a group of academics created the Programme for Natural Resource Accounting in East and Southern Africa, which provided support for Botswana's environmental accounting effort.

CANADA



Canada's System of Environmental and Resource Accounts (CSERA) represents a comprehensive framework for linking the environment and the economy through physical and monetary statistics. Canada's environmental and resource accounts have been developed around the Canadian System of National Accounts to ensure coherent and systematic compilation of stock, flow or state statistics pertaining to the environment or natural resources. CSERA is broadly consistent with SEEA-2003 even though it was not directly based on it. The CSERA comprises three major accounts: natural resource stock accounts, material and energy flow accounts and environmental protection expenditures accounts.

The statistical products derived from CSERA are used by the Canadian government as a tool for policy development and analysis. For example, certain datasets are key inputs into scenario and general equilibrium modeling conducted by some federal policy departments in Canada. Additionally, these accounts allow the tracking of greenhouse gas emissions associated with economic activities by all sectors of the economy. The broader research community (academia, consultants, non-governmental and international organizations) also takes advantage of datasets from various environmental accounts.

Examples of Analyses Using Environmental Accounts in Canada

- The detailed time series on energy consumption and intensities as well as direct/indirect greenhouse gas emissions data are used to conduct environmental impact assessments for new government policies.
- The physical and monetary data on energy, mineral and timber assets are used to track the stocks of resource assets in Canada. The monetary values of these assets are used to calculate a broader measure of Canada's national wealth that includes natural resources.
- The environmental protection expenditures accounts are valuable data sources for analyzing the level of investments made by Canada's primary and manufacturing industries in response to environmental regulations. These are also useful in terms of monitoring business uptake of environmental technologies and in assessing Canada's capability and competitiveness in developing environmental technology.

Additional information

- The following CSERA accounts are updated annually: sub-soil asset accounts; energy use and energy intensity accounts; and greenhouse gas emissions accounts. The environmental protection expenditures accounts are updated periodically, depending on data availability. For example, only basic, non-consolidated data on environmental protection expenditures are updated regularly through the Survey of Environmental Protection Expenditures: annually from 1994 to 1998 and biennially thereafter.
- Also inherent in the CSERA is the adoption of the natural capital approach to guide its conceptual and methodological frameworks. This approach articulates the contribution of the environment to human well-being via flows of materials and services – as a source of raw materials and a sink for wastes. For example, the energy use and emissions accounts in the CSERA enable the measurement of energy consumption and intensity of use.

CHINA



The Chinese government began examining environmental accounting concepts in 1988, with the intention of integrating natural resource accounting with the national accounting system. Between 1998 and 2001, China worked with Norway to develop energy accounts and pollution flow accounts for eight air pollutants. With support from the World Bank, China began researching the economic valuation of pollution and estimated the values for 2003 using actual costs, hypothetical abatement costs and the costs of environmental degradation. In 2004, President Jintao requested the study of an environmentally adjusted macroeconomic aggregate, or “green” GDP. One of the authors of the SEEA-2003 regards the Chinese effort as a major contribution to the international community, because it integrates Marxist economics, Chinese philosophy, and market economic principles to establish a value theory and pricing method for natural resources.

As China is still developing its accounting techniques, the accounts have not yet been explicitly used in policy-making. However, the government is developing a policy framework to institute a “Circular Economy”—a closed-loop system that emphasizes sustainable development— which will include a revision of the Environmental Protection Law of China and other related laws. Environmental accounts could be included in this process.

COLOMBIA



Colombia began its environmental economic accounting efforts in 1992. Since then, the country has developed physical and monetary asset accounts for oil, gas, and coal covering the years 1994-2004; nickel, iron, and copper for 2000-2004; and forests for the years 1998-2001. Environmental expenditure accounts exist for the following sectors: government, manufacturing, recycling, agriculture, transportation, and mining. Material flow accounts were developed using a National Accounting Matrix including Environmental Accounts (NAMEA) for minerals, oil, and forests for the years 2000-2003, and for water for the year 2000. Finally, Colombia has developed indicators for air quality and water quality (1994-2004). Although Colombia used SEEA-1993 as a reference point, they were not always able to strictly apply the handbook’s techniques.

Colombia’s accounts could be used more often in policy making. However, Colombia is reviewing SEEA-2003 to see if it is feasible to create additional accounts. Additionally, the government intends to expand environmental protection accounts to include additional sectors, such as the health and construction sectors.

Examples of Analyses Using Environmental Accounts in China

- Based on government-sponsored research studies estimating the cost of environmental damage from China’s economic growth, China has calculated a “green” GDP that incorporates these costs. China has also calculated a GDP that was adjusted for estimated pollution abatement costs
- China has constructed environmental indicators that are used to prepare and implement the country’s five-year plans. For example, indicators are used to monitor pollution abatement standards that are outlined in the plans.

China has plans to expand its environmental accounting efforts. The government has drafted two accounting frameworks—“A Framework of Resources and Environmental and Economic Accounting for China” and “A Framework of Environment and Economic Accounting for China”—and is in the process of drafting technical guidelines and plans to pilot implementation. Eight working groups have been formed, which focus on developing accounts for land, minerals, water, forestry, grassland, ocean, biological resources and recycled resources using SEEA-2003 as a reference. China also plans to develop environmental expenditure accounts, and would like to work with other countries with experience in advanced environmental economic accounting techniques.

An Example of an Analysis Using Environmental Accounts in Colombia

Currently, Colombia uses the information to monitor environmental expenses as part of government planning.

NAMEA: A NAMEA, or “National Accounting Matrix including Environmental Accounts,” is a matrix that adds environmental physical flow accounts to the flow accounts of the SNA. Environmental indicators that are directly comparable with conventional economic aggregates can be derived from NAMEA. The first NAMEA was compiled in 1993 for the Netherlands and Statistics Netherlands has since developed consistent time series for oil, natural gas, and six types of environmental degradation (such as the greenhouse effect and acidification) based on emission flows. NAMEA is discussed in SEEA-2003. In addition, the EU officially adopted the NAMEA framework and is helping finance other EU countries that want to develop their own NAMEA systems.

FRANCE



France began developing environmental accounts in the 1980s and has since developed some natural resource asset accounts, physical flow accounts, and environmental protection & resource management expenditures accounts. In 1998, France was one of the pilot countries implementing the Integrated Environmental and Accounting for Forests—a set of 20 main tables created by the Eurostat Task Force on Forest Accounting that covered monetary and physical balance sheets for land and standing timber, economic accounts for forestry, monetary and physical supply-use tables, material balances and tables describing non-market environmental functions of forests—and the country now regularly publishes forest asset accounts as well as subsoil asset accounts. Flow accounts are established for water, recycling, air emissions (in the NAMEA format), and water emissions. The environmental protection expenditure accounts are the most developed of France's accounts, although they are missing some areas, including soil and groundwater. France has tried to build biodiversity considerations into its accounts, and thus disaggregates government expenditures that were made in support of conserving biodiversity. As of 2006, France was focusing on developing water asset accounts. France's accounts are compiled using the European System for the Collection of

Examples of Analyses Using Environmental Accounts in France

- France has used expenditure accounts to determine the contribution of environmental services industry to the economy, and found that the industry accounted for 2.3 percent of GDP and 1.4 percent of employment in 1997.
- France has developed ten key environmental indicators including: (1) greenhouse gases, (2) environmental expenditures (government, business and household), (3) energy, (4) public opinion, (5) air, (6) biodiversity, (7) resources (e.g. fossil fuel consumption, minerals, and agriculture), (8) water, (9) land cover, and (10) waste (including recycling).

Economic Information on the Environment (SERIEE) framework and they are published every year.

In the future, France would like to use water valuation to help resource managers make allocation decisions based on both the market and non-market uses for water.

Additional information

Initially France embarked on an ambitious agenda to produce accounts for every asset that was received from previous generations and should be passed onto future generations—including both natural and cultural resources. In the 1990s, it became clear that this plan was too ambitious, and the government decided to develop a smaller number of accounts.

SERIEE: The European System for the Collection of Economic Information on the Environment (SERIEE) is a system of satellite accounts that contain data on environmental protection expenditure and economic data on the use and management of natural resources. Eurostat published the SERIEE manual in 1994, in response to the EU's Fifth Action Program on the environment. The Program called for the improvement of environmental data to help move the EU onto a path of sustainable development. SERIEE is composed of two satellite accounts: an Environmental Protection Expenditure Account and a Resource Use and Management Account. The main objectives of the SERIEE are to (1) trace the monetary flows linked to environmental protection, (2) characterize the impact of environmental protection on the European economic system, and (3) compute indicators. Since the SERIEE is the most extensive system for recording environmental protection expenditures, the SEEA-2003 recommends that "those interested in entering into greater detail in the area of environmental protection activities" consult SERIEE.

GERMANY



Germany began work on environmental accounting in the 1980s. Germany's environmental economic accounts are fully compatible with its system of national accounts and are SEEA-based. The country is a leader in the development of material and energy flow accounts, which are the most developed of all its accounts. Economy-wide material flow accounts were first compiled in the mid-1990s and are now available for the years 1991-2007. They are updated annually. Data are aggregated across sectors and materials to determine a physical macroeconomic indicator—the economy's "direct material input" (DMI), or all materials which are of economic value and are used in production and consumption activities (domestic extraction plus imports). Germany has also developed accounts for emissions, land use, water, environmental expenditure and environment-related taxes.

Examples of Analyses Using Environmental Accounts in Germany

- The German Federal Cabinet adopted "A National Strategy for Sustainable Development in 2002" which outlined 21 policy objectives that are linked to the key national indicators for monitoring sustainable development.
- In 2007, Germany conducted an analysis regarding the effects of foreign trade on the environment, and found that the energy intensity in the production of export goods declined between 1995 and 2004, but that carbon dioxide emissions remained significantly higher in the production of exported goods than in the production of imported goods over that same time period.

Germany uses the accounts to examine, for example, the use of the environment as a sink for pollutants (i.e., measuring the output of pollutants) and how different industries contribute to these pressures. The accounts have been used to produce national key indicators, which measure sustainable development

and direct policy. As Germany is the world's top exporting country, it used its environmental accounts to investigate the effects of increased foreign trade on the environment in 2007. See the sidebar for more information on this analysis.

Additional information

Independent research institutes have also used Germany's accounts. For example, the accounts have been used to measure "dematerialization," or the extent to which the country's resource use is decoupled from economic growth over time. The World Resources Institute released a study of 5 industrialized countries in 2000 that found that Germany was the only country whose material requirement per capita declined over a 20 year period. Research institutes have also used Germany's environmental accounts in various modeling projects assessing how certain policy measures would influence economic and environmental indicators. Furthermore, the framework of material flow accounts is being used to identify how individual firms can reduce both their environmental impacts and costs.

MEXICO



The UN, World Bank, and Mexican government collaborated in a pilot study to implement aspects of the draft SEEA in 1990 and 1991 and test their feasibility. The team used 1985 data from Mexico's existing system of national accounts and integrated them with newly created environmental accounts for oil depletion, deforestation and land use, and environmental degradation (consisting of land erosion, air and water pollution, groundwater use, and household-generated solid wastes). Economic values were applied to the resources using different valuation techniques. The accounts were used to produce two environmentally-adjusted macroeconomic aggregates: one that deducted the cost of resource depletion from NDP, and one that deducted environmental degradation. The former is directly linked to measures such as the market value of the resource, shadow prices, and net rent, and is therefore a less controversial indicator than the latter. The pilot study also examined resource

An Example of an Analysis Using Environmental Accounts in Mexico

- Mexico uses the environmentally-adjusted aggregates derived from its environmental accounts as a measure of sustainable development in its National Development Plan and other environmental projects.

use and environmental protection expenditures made by various sectors, which facilitate policy analysis more readily than the adjusted aggregates. Since the pilot study, Mexico has published asset accounts for the years 1985-2004. Called the System of Economic and Ecological Accounts, Mexico, the accounts cover minerals, energy, soil, water, and land.

Mexico plans to expand its accounts for forest and water (using SEEA) as well as its material flow accounts.

NAMIBIA



In the mid-1990s, Namibia began work on environmental accounting with financial support from the United States Agency for International Development (USAID) and the Swedish International Development Agency. Namibia's economy is largely dependent on natural resources, and the country has very little industry. As such, they developed environmental accounts for their natural assets—such as water, fisheries, minerals, and livestock—rather than creating accounts for outputs such as pollution. For example, Namibia produced data on stocks, use, productivity and value estimates for fisheries and water sectors. This work continued through the late 1990s, using SEEA as guidance.

The accounts were designed to aid policy analysis from the beginning and thus have been used to study and report on various policy issues. For example, Namibia's fisheries accounts demonstrated that the country's quota fees on fish catch were not recovering a significant share of the resource rent²⁹ and thus the fees were increased. The accounts have also helped Namibia decide how to allocate scarce water supplies and how rangeland degradation affects the value of livestock.

Additionally, Namibia is currently in the process of developing a set of National Core Environmental Indicators³⁰ that will be

²⁹ The UN defines resource rent as "the difference between total revenue generated from the extraction of natural resources and all costs incurred during the extraction process, including the cost of produced capital, but excluding taxes, royalties and other costs that are not directly due to the extraction process."

³⁰ Core indicators are those for which the data collection and evaluation methodologies are well-defined and existing data provide a historic record in support of future analyses.

used to monitor the environment and make decisions regarding environmental management. For example, indicators will be used in Namibia's Information and Communication Service for Sustainable Development program, which is funded by Finland, to address important questions such as whether the environment has improved, worsened, or held steady, the underlying causes for this change, and what steps can be taken to address any negative change.

THE NETHERLANDS



The Netherlands has rigorously developed pollution and material flow accounts and created a new material flows accounting system—the NAMEA—that has proven instrumental in the field of environmental accounting. The pollution flow accounts include both imports of pollution as well as exports. The Netherlands publishes accounts for air emissions (in the NAMEA format), water emissions, energy flows, environmental taxes, waste, nutrients and subsoil on an annual basis.

The accounts have been used in a variety of ways, such as determining various sectors' share of pollution emissions relative to their contributions to the economy. In addition, the pollution accounts have been aggregated into indicators for specific environmental issues such as the greenhouse effect. Some macroeconomic indicators have been calculated for The Netherlands as well. One study calculated a "Sustainable National Income," or SNI, which is the maximum income that can be sustained without technological development. The study combined an assessment of physical sustainability, abatement cost functions, and general equilibrium modeling. The authors found that the Netherlands would have to make enormous changes to become sustainable by their measure: the SNI was 56% lower than the actual national income. Households would have to decrease their consumption by 49% and governments by 69%.

THE PHILIPPINES



The Philippines' experience with environmental accounting began as two separate efforts. The first effort began in 1991 with support from USAID and is referred to as the Environment and Natural Resource Accounting Project (ENRAP). ENRAP was specifically designed to provide useful information for policy analysis and was conducted in four phases over nine years. Monetary asset accounts were created and used to adjust production accounts. For example, the first ENRAP account was an estimate of Gross National Product adjusted for the depreciation of forests. ENRAP also accounted for the production of fuelwood and food by rural households, which were considered important because of their potential links to deforestation. The second effort, with support from the UN, began in the mid-1990s and involved the implementation of SEEA. The Philippines developed resource stock accounts for forests, minerals, fisheries, and soil, and estimated the costs of preventing air and water pollution. Both efforts resulted in estimates of a Green GDP. In 1997, an executive order institutionalized environmental accounting and

An Example of an Analysis Using Environmental Accounts in Namibia

- Namibia has used its accounts to develop a Social Accounting Matrix tool to analyze several important issues including the impacts of climate change, tourism, water management, trade, and strategies for long-term development.

Examples of Analyses Using Environmental Accounts in the Netherlands

- One analysis indicated that the Netherlands' environmental costs and economic benefits were distributed very unequally across sectors. Notably, the agriculture, chemicals and public utilities industries together accounted for 51% of greenhouse gas emissions but only 6% of GDP.
- Another study calculated an environmentally-adjusted NDP that assumed that economic development must meet certain environmental standards. The Netherlands' NDP was adjusted to take into account the costs of reducing environmental degradation, but also allowed for technological and other changes. This estimate was intended to inform policy makers about the likely impacts of various options for development and the instruments for achieving them.

The Netherlands plans to publish forest, land use, economy wide material flows, and environmental subsidy accounts in the future.

Examples of Analyses Using Environmental Accounts in the Philippines

- One study determined that increasing environmental controls (e.g., enforcing laws more strictly) would not substantially reduce business competitiveness for the large majority of industries.
- Another study determined that liberalizing trade while using current technologies will create more pollution, however the pollution is more likely to come from increased resource extraction (e.g., mining) than from increased manufacturing.

created environmental accounting units within three agencies. The Philippines has since produced water accounts (through 2001 for groundwater and 2000 for surface water) and updated most of its other accounts.

The Philippines has used its environmental accounts to conduct policy studies on many topics, including economic growth and pollution, the impact of pollution control on economic competitiveness, declining fisheries resources, the reduction of lead in gasoline, improvements in energy use, and the importance of small and medium industries in pollution management, among others.

The Philippines' statistics agency plans to expand their efforts to produce flow accounts and expenditure accounts.

SWEDEN



Sweden began its environmental accounting efforts in the 1990s. The work was commissioned to three different government agencies: Statistics Sweden, the National Institute for Economic Research, and the Environmental Protection Agency. Since that time, Statistics Sweden has developed asset accounts for forests; flow accounts for water use, energy, chemicals, air and water emissions, and waste; as well as accounts for environmental expenditures, environmental taxes, and environmental subsidies. The accounts follow the SEEA to a large extent. The bureau also developed a database on environmental industries.

Sweden's environmental accounts have been used by the National Institute for Economic Research to develop an environmental economic general equilibrium model, which supports the country's mid-term economic forecasts by assessing the economic impacts of various environmental goals, including Kyoto protocol targets. Additionally, environmental accounts have played a large role in important public debates on climate change, sustainable growth, and green taxes (i.e., taxes intended to help the government regulate the environment, such as a tax on carbon). The government has commissioned studies

Additional information

Because the USAID and UN projects used different accounting approaches that competed with one another, implementing environmental accounting in the Philippines was more complex, according to a report by the International Resources Group.

Examples of Analyses Using Environmental Accounts in Sweden

- The government requested a study using data from the accounts to estimate monetary values for the depreciation of natural resources and estimated pollution abatement costs, although this particular study did not go so far as to deduct the estimates from GDP.
- Additionally, valuation studies have been conducted that examined the cost of acid rain from other countries' emissions to Sweden. The costs included forest loss, crop loss, health impacts, and declines in real estate values. Sweden used the results of such studies to support their positions in European negotiations on sulfur emissions.

in these areas, which used the accounts to help frame policy issues and analyze strategies to resolve them.

Sweden is interested in expanding its environmental accounting efforts by, for example, publishing energy accounts more frequently, and developing new asset accounts.

Additional information

- The energy, air emissions, taxes, subsidies and environmental expenditure accounts are published annually. The other accounts are published less frequently, due in some cases to a lack of regularly updated data and in other cases to a lack of users for the accounts.
- The National Institute for Economic Research's initial work involved valuation studies with the goal of developing environmentally-adjusted macroeconomic aggregates. However, the work has been redirected towards conducting economic impact studies on environmental policies in general. The EU has provided financial support for part of Sweden's work in implementing recommendations of Europe's statistical office, Eurostat.

Appendix 3:

Bibliography and Website List

BIBLIOGRAPHY

- Abraham, K.G., Mackie, C. (Eds), *Beyond the Market: Designing Nonmarket Accounts for the United States*, Panel to Study the Design of Nonmarket Accounts, Committee on National Statistics, Division of Behavioral and Social Sciences and Education, Washington, D.C.: The National Academies Press, 2005.
- Alfsen, K., et al, *International Experiences with "Green GDP"*, Statistics Norway, 2006 (www.ssb.no/english/subjects/01/06/30/rapp_200632_en)
- Apps, M.J., Kurz, W.A., *Developing Canada's National Forest Sector Carbon Accounting System*, Working Paper submitted to the XII World Forestry Congress, 2003 (www.fao.org/DOCREP/ARTICLE/WFC/XII/0618-B2.HTM)
- Caizhong, G., et al, Chinese Academy for Environmental Planning, *Integrated Environmental and Economic Accounting in China: Proposed Framework and Preliminary Findings*, 2006 (<http://unstats.un.org/unsd/envaccounting/londongroup/meeting10.asp?sid=1>)
- Country Updates (Canada, Germany, Sweden, The Netherlands) for the 10th Meeting of the London Group on Environmental Accounting, 2006 (<http://unstats.un.org/unsd/envaccounting/londongroup/meeting10.asp?sid=1>)
- Hamilton, K., et al, *Where is the Wealth of Nations?: Measuring Capital for the 21st Century*, Washington, DC : The World Bank, 2006
- Hecht, J.E., "Environmental Accounting: Where We Are Now, Where We Are Heading?", *Resources*, Issue 135, 1999 (<http://www.rff.org/rff/documents/rff-resources-135-enviroaccount.pdf>)
- Hecht, J.E., *Lessons Learned from Environmental Accounting: Findings from Nine Case Studies*, Washington, D.C.: World Conservation Union (IUCN), 2000 (www.joyhecht.net/professional/papers/lessons.envt.acct.pdf)
- Lange, G.M., *Policy Applications of Environmental Accounting*, 2003 (<http://siteresources.worldbank.org/INTEEI/214574-1115814938538/20486189/PolicyApplicationsofEnvironmentalAccounting2003.pdf>)
- Lange, G.M., Hassan, R., *The Economics of Water Management in Southern Africa: An Environmental Accounting Approach*, Cheltenham, UK: Edward Elgar Publishing, 2006 (www.columbia.edu/~gl2134/)
- Mates, W., et al, New Jersey Department of Environmental Protection, *Valuing New Jersey's Natural Capital: An Assessment of the Economic Value of the State's Natural Resources*, 2007 (www.state.nj.us/dep/dsr/naturalcap)
- Organization for Economic Co-operation and Development, *Material Flows and Related Indicators: Inventory of Country Activities*, 2005 (<http://unstats.un.org/unsd/envaccounting/ceea/archive/pubdetail.asp?pubid=48>)
- Palm, V., *Uses of Environmental Accounting in Sweden*, Eurostat Working Paper No. 2/2001/B/1, 2001 (<http://unstats.un.org/unsd/envaccounting/ceea/archive/pubdetail.asp?pubid=81>)
- Sève, J., *A Discussion Paper on Environmental and Natural Resources Accounting and Potential Applications in African Countries*, 2002 (www.unep.ch/etb/areas/VRC_category.php?category=4)
- Smith, R., Statistics Canada, *Measuring the Impacts of Climate Change: Are Central Statistical Offices Prepared?*, Presentation at the Conference on Climate Change and Official Statistics, 2008 (http://unstats.un.org/unsd/climate_change/CC_Conference_presentations.htm)
- United Nations, European Commission, International Monetary Fund, Organization for Economic Co-operation and Development, World Bank, *The Handbook of National Accounting: Integrated Environmental and Economic Accounting*, 2003 (<http://unstats.un.org/unsd/envaccounting/seea.asp>)
- United Nations Statistics Division, *Global Assessment of Environment Statistics and Environmental-Economic Accounting*, 2007 (<http://unstats.un.org/unsd/envaccounting/ceea/assessment.asp>)
- United Nations Statistics Division, *SEEA News and Notes*, Number 2, 2008 (<http://unstats.un.org/unsd/envaccounting/ceea/seeanews.asp>)
- United States Government Accountability Office, *Highlights of a Forum: Measuring Our Nation's Natural Resources and Environmental Sustainability*, GAO-08-127SP, 2007 (www.gao.gov/new.items/d08127sp.pdf)

WEBSITE LIST

- NEW ZEALAND'S STATISTICS BUREAU** www.stats.govt.nz/environment/default.htm
- SWEDEN'S STATISTICS BUREAU** www.scb.se/templates/Product___38175.asp
- U.K.'S STATISTICS BUREAU** www.statistics.gov.uk/CCI/Nscl.asp?ID=5872
- UN WEBSITES:**
 - EARTH SUMMIT** www.un.org/geninfo/bp/envirp2.html
 - ENVIRONMENTAL ACCOUNTING** <http://unstats.un.org/unsd/envaccounting/default.asp>
 - ENVIRONMENTAL ACCOUNTING HISTORY** <http://unstats.un.org/unsd/envaccounting/histbground.asp>
 - LONDON GROUP** <http://unstats.un.org/unsd/envaccounting/londongroup/>
 - SEEA** <http://unstats.un.org/unsd/envaccounting/seea.asp>
 - SEEA-E** <http://unstats.un.org/unsd/envaccounting/seeae/>
 - SEEAF** <http://unstats.un.org/unsd/envaccounting/seeaf.asp>
 - SEEAW** <http://unstats.un.org/unsd/envaccounting/seeaw.asp>
 - UNCEEA** <http://unstats.un.org/unsd/envaccounting/ceea/>
- U.S. GLOBAL CHANGE RESEARCH PROGRAM** www.usgcrp.gov/usgcrp/ProgramElements/land.htm