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TOWARD IMPROVED ACCOUNTING FOR NATURAL RESOURCES AND THE ENVIRONMENT*

SALAH EL SERAFY
Economic Advisory Staff
The World Bank

ERNST LUTZ
Environment Research and Policy Division
The World Bank

Abstract:

The negative effects of human activity on the natural environment are becoming more and more apparent. The problems are all complex and require changes in many areas of life, from policies to projects to individual behavior. Environmental accounting is one of the possible tools that can encourage a move toward more sustainable development. Gross domestic product (GDP) figures are being widely used by economists, politicians and the media. But often, they are used without the caveat that they represent "unsustainable income" where they neglect the degradation of the natural asset base and view the sale of nonrenewable resources entirely as income. The paper describes the state of art in the field of environmental and resource accounting and suggests that further work is needed in order to properly account for natural resources and the environment and thereby help to direct us toward a more sustainable path of development.

Introduction

Most production and consumption activities have some effect on the physical environment. As economic and population growth have occurred, they have increasingly put pressure on the environment and the natural resource base. Years ago, when the pressure was still small, economists may have been excused for making no reference to the role played by the environment, both as a resource base and as a "sink" to receive the residues

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of the production and consumption process. But there is little justification for this now. Natural resources and the environment in general represent natural capital that should be considered and accounted for in parallel to man-made capital.

Economists have considered the side-effects of production and consumption activities to be "external effects". But such effects are external only if a narrow view is taken, which does not consider the effect on the resource system as a whole. Although this system is generally large, it is nevertheless finite, and in certain respects it is subject to great stress. The realization is growing that, where the environment is concerned, "there is no such thing as a free lunch" and that someone will eventually have to bear those "external costs". If a broader view is taken, environmental costs would be internalized in the production processes. In this connection it is essential to account for resource depletion and to distinguish clearly between true income generation and the drawing down of capital assets by resource depletion or degradation. This, in general terms, is the subject of this paper.

Shortcomings of the Current National Income Measures

Income accounting, if properly done, is a most useful tool for economic analysis and policy prescriptions. It can indicate the level of economic activity, its variations from year to year, the size of savings and investment, the limits society can consume out of its current receipts, factor productivity, industrial structure, comparative performance, and many other things. Development planners, economists, and politicians thus make frequent use of the national income measure of gross national product (GNP) and its variants, such as GDP (gross domestic product) and NNP (net national product) for a variety of purposes. GDP, the most commonly used variant of aggregate income, is essentially a short-term measure of total economic activity for which exchange occurs in monetary terms within a given year. It is valuable mostly for indicating short- to medium-term changes in the level of economic activity, and it is particulary useful for demand management and stabilization policies. As calculated at present, however, it is less useful for gauging long-term sustainable growth partly because natural resource depletion and environmental degradation are mostly being ignored. Furthermore, GDP is often used inappropriately as an indicator of "welfare", frequently without any caveat about its shortcomings for that purpose. The concept of welfare is much broader than a monetary measure of income. It covers many dimensions of subjective well-being other than those that involve market transactions or that can be measured in monetary terms, particularly for people whose basic material needs have been met.

As most economists know, there are several controversial issues concerning national income accounting as currently being practiced, such as the treatment of leisure, household and subsistence production, other nonmarket transactions, and the services of consumer durables. This paper does not deal with any of those issues; instead, it addresses certain environmental and natural resource issues as they relate to the proper measurement of income and variations in assets. GDP, as measured at present, does not adequately represent true, sustainable income because of two shortcomings. These concern the treatment of environmental protection costs and the degradation and depletion of natural resources. The fact that these issues are not, or not properly dealt with in the current U.N. System of National Accounts (SNA) is a serious flaw from an accounting point of view. As a result, policy advice based on measurements produced under the SNA can be faulty to the extent that GDP does not adequately reflect environmental and natural resource erosion.

The Necessity of Measuring Sustainable Income

True income is "sustainable" income. This is a key point stressed by Daly (Ahmad, El Serafy and Lutz, 1989, Chapter 2) and El Serafy (Ahmad, El Serafy, and Lutz, 1989, Chapter 3). True income can be thought of as the maximum amount that can be consumed in a given period without reducing the amount of possible consumption in a future period. This concept encompasses not only current earnings but also changes in assets: capital gains increase income; capital losses reduce income. The essence of the concept of income has been stated by Sir John Hicks as the maximum value that a person can consume during a time period and still expect to be as well off at the end of the period as at the beginning (Hicks 1946, p. 172). Prudent economic management therefore requires that governments know the maximum amount that can be consumed by a nation without causing its eventual impoverishment. It is important, therefore, that national income be measured correctly to indicate sustainable income. Environmentally speaking, adjustments of the SNA appear to be necessary in the two areas noted above, since these are currently not dealt with satisfactorily: the so-called "defensive expenditures" to protect the environment and the depletion and degradation of natural resources.

Defensive Expenditures

Action is often taken to defend the environment against encroachment by economic activity, and the SNA treats the cost of such action as generating income. Defensive expenditures can be large or small, depending on where the boundaries are drawn. This paper considers only defensive expenditures against the unwanted side-effects of production and consumption (such as pollution) but not those relating to national security, even though similar arguments would apply to them. The most obvious category to be included under defensive expenditures is the cost of environmental protection activities. Another possible category would be car repair and medical expenses as a result of traffic accidents. Leipert listed other costs that might be included, and estimated the defensive expenditures for the Federal Republic of Germany (Leipert 1986 and 1987).

Incorporating expenditures incurred to redress some or all of the negative consequences of production or consumption activities in the stream of income generated by economic activity is questionable, and it has therefore been proposed that such outlays should not be counted as final expenditure, as is currently being done, but rather as intermediate expenditure. However, national accountants have raised arguments against doing this. First, national defense expenditures, which are one type of defensive expenditures and are often more important in terms of their size, are counted as final expenditures. Also, defining environmentally defensive expenditures as intermediate ones so that they could be deducted from the national income aggregates has so far not been accepted by national accountants on grounds of consistency with current definitions and conventions under the SNA.

A conceptually different approach can be taken by considering resources such as water, air, soil, and so forth as natural capital. When such capital is drawn down or degraded, this should show up as consumption in the measurements of national income whether or not defensive expenditures are actually being incurred to correct for the negative effects and restore the drawn-down natural capital. The difference between the defensive expenditures actually incurred and the depreciation of the environmental capital would be reflected at the level of net domestic product (NDP). This approach has

been proposed by Harrison (Ahmad, El Serafy, and Lutz, 1989, Chapter 4). A similar conceptual approach has been proposed by Peskin (Chapter 11), who proposes the introduction of a nature account in addition to the standard accounts for households, industry, and government. Aside from the difficulty of reaching a consensus as to how the environmental or natural capital is to be treated conceptually, the greatest difficulty lies in actually estimating the changes in natural capital and environmental services.

Measuring Pollution within the SNA Framework

Pollution—that is, the discharge of wastes in ways that raise the cost of later activities, harm people, or reduce the enjoyment they get from their surroundings—is an important area in which the national accounts could be used to improve environmental policymaking. Blades (Ahmad, El Serafy, and Lutz, 1989, Chapter 5) distinguishes four aspects of pollution and considers the extent to which it is possible and useful to measure them within the framework of the national accounts. These aspects are the output of pollutants, the damages of pollution, the costs of abatement, and the benefits derived from such abatement.

Although it may be feasible to use national accounts to measure the output of pollutants, the information so obtained may be too general to be useful for environmental policymaking. Blades notes that although there are conceptual and practical difficulties in estimating the total costs of pollution damage, it would be possible and helpful to identify some of the main costs that are already included in the national accounts but are not shown separately at present. The costs of pollution abatement are a part of defensive expenditures. They have been measured in several countries and have been incorporated in macroeconomic models to show the effect of abatement policies on prices, output, and employment. In this area the national accounts would be a valuable tool for environmental policymaking, and Blades considers in detail the conceptual and practical problems of measuring abatement costs. Finally, although it would be interesting to measure the "market valuatión" of the benefits of pollution abatement, the practical difficulties involved are enormous, and it would generally not be feasible to incorporate such data in the national accounts on a regular basis.

Measuring the Difference between Environmental Standards and Actual Behavior

Hueting (Ahmad, El Serafy, and Lutz, 1989, Chapter 6) discusses several ways to deal with defensive expenditures and lists the pros and cons of the various options. Since he is skeptical about the usefulness of the willingness-to-pay-method, he prefers that environmental standards be determined by considerations of health and sustainable development. The costs of achieving such standards would then be estimated. These costs would show how far a country has drifted away from sustainable economic development. Although the approach has intuitive appeal, determining the costs would obviously be difficult given the uncertainties about the linkages between production and consumption activities and the environment.

Generally speaking, the issue of the treatment of defensive expenditures for national accounting assumes greater significance the higher the degree of industrialization of the country concerned. The issues of depletion and degradation, which are considered below, are not directly related to the level of industrialization, however, although they seem to be particularly relevant to countries whose economic activities are based on the exploitation of natural resources.

The Depletion and Degradation of Natural Resources

There is an evident asymmetry in how the SNA treats man-made assets and natural resources. Man-made assets—buildings and equipment, for example—are valued as productive assets and are written off against the value of production as they depreciate. Natural resource assets are not so valued or adequately accounted for in most instances, however, and their loss produces no charge in the national accounts against current income to reflect the decrease in potential future production. If a country is exhausting its renewable or nonrenewable resources, its current income will thus be inflated by the sale of natural assets that will eventually disappear. Differences in recording under the SNA may arise depending on whether a resource is publicly or privately owned. Some private companies that take a long view of the natural assets they own do make provision for the decrease in the capital stock of natural resources, and in certain countries tax legislation permits such provisions to be excluded from taxable income. No such exclusion is effected in developing countries in which natural resources are exploited by the public sector.

Underlying this asymmetry is the implicit, as well as inappropriate, assumption that natural resources are so abundant that they are costless or have no marginal value. Historically they have been regarded as free gifts of nature—a bias that provides false signals for policymakers. This approach ignores the depletion of valuable resources and confuses the sale of commercially marketable natural assests with the generation of income. Thus it promotes and seems to validate the idea that rapid economic growth can be obtained by exploiting a resource base that may be rapidly diminishing. The growth can be illusory, and the prosperity it engenders transitory, if the apparent gain in income means permanent loss in wealth, that is, if at least part of the receipts is not redirected into new productive investments. As income is inflated, often consumption is also, and the country concerned gets complacent about its economic performance; as a result the adjustment in economic policy gets delayed by the seeming prosperity. In this regard, improved income accounting would be an aid to better decision-making, but, of course, it would not guarantee that improved decisions would actually be made.

Natural capital of geological (nonrenewable) and biological (renewable) resources as well as "flow" resources (such as water and air) are needed for industrial and agro-industrial production as well as for consumption. New geological discoveries, as well as recycling and conservation, do not reverse the depletion of known stocks. The newly discovered stocks themselves come from a finite stock of resources, and they merely extend the time span over which depletion can continue. Depletion of renewable natural resources can have serious indirect effects by reducing the sustainable flow needed for industrial inputs and ecosystem services.

Similarly, crop production at the expense of soil erosion cannot be sustained. Only careful husbandry of environmental capacities can ensure sustainable and potentially larger flows of income in the future. The optimistic argument that human ingenuity is bound to find substitutes for the natural resources being depleted may be generally valid, but it would be imprudent for society to base its behavior on such optimism and would be wrong for economists and accountants not to take rational precautions in case this does not occur.

Two main conceptual approaches to deal with the depletion or degradation of natural resources have been proposed: the depreciation approach and the "user cost" approach. The *principle of depreciation* of man-made capital can be applied straightforwardly to the consumption of capital embodied in renewable and nonrenewable resources. Since geological and ecological information on depletion or degradation comes in physical

units, these must be priced or valued in some way before some adjustment can be made to GDP to arrive at a corrected net product. Valuation could be based either on the principle of replacement cost, where replacement is possible, or on (the discounted value of) willingness to pay. Present conventions would value the depleted or degraded resource at current prices where available. If such a correction were effected, the gross product would remain unchanged, but the net product would be adjusted to reflect the depreciation of environmental capital that has occurred during the accounting period.

Because the depreciation approach would leave GDP unadjusted and because it would wipe out from the net product the entire proceeds from natural resource sales, the *user cost approach* has been proposed as a way of properly taking account of depletion of mineral resources. Possession of a natural resource conveys on its owner an income advantage that is denied to those without a natural resource, and it is not satisfactory to arrive at a measurement of zero net income as produced by the depreciation method. The user cost approach avoids the difficulties of putting a value on the stock of the resource, but it relies on the conscious assessment of current extraction rates in relation to the total available stock, measured in physical terms. Depending on the rate of depletion and on a discount rate, the revenue from the sales of a depletable resource, net of extraction cost, can be split into a capital element, or user cost, and a value added element, representing true income. The capital element represents asset erosion, and it has been proposed that it should be hypothetically (El Serafy 1981) or actually (Ward 1982) reinvested in alternative assets so that it continues to generate income after the resource has been totally exhausted. Unlike the depreciation method, this would seek to alter the reckoning of GDP itself, not just of NDP. This method would be in harmony with accounting principles, since it would use current market prices for valuation purposes, but it would require a rule-of-thumb discount rate for converting the capital sales into an income stream. It is also rooted in a proper understanding of the economic meanings of "value added" and "rent", which should not be confused with asset sales.

How the net revenue can be split into user costs and true income is explained in El Serafy (Ahmad, El Serafy, and Lutz, 1989, chapter 3). One needs first to decide on a discount rate, r, say 5 percent. Second, one has to determine the number of periods, n, over which the resource is being liquidated. This can simply be read from the ratio between total reserves and whatever amount is extracted in the current period. Then the formula developed by El Serafy (1981) is used to calculate the ratio of true income, X, to net receipts (exclusive of extraction costs), R:

$$\frac{X}{R} = 1 - \frac{1}{(1+r)^{n+1}}$$

R-X would be the "depletion factor" (or user cost) that should be set aside and allocated to capital investment and excluded from GDP, while X would represent true, that is, sustainable, income.

This method is flexible enough to handle changing levels of extraction, movements in the discount rate, and alterations in reserve estimates. Such alterations would include new discoveries, which would change the reserve-to-extraction ratio. In the above formula this is denoted by n, that is, the life expectancy of the reserve measured in years at the current period's extraction rate. The method is not concerned with valuing total reserves, but only with the fraction of the resources being liquidated in the current accounting period, which is valued at current prices. That fraction relies entirely on physical quantities, since the price is the same in the numerator and denominator. The method can be adapted to deal with mineral extraction under conditions of deteriorating quality of the product and rising costs of extraction. Resource owners usually mine the richer deposits first, leaving inferior deposits for later periods, thus inevitably raising the cost of future extraction.

This method, like all accounting methods, does not indicate an *ex ante* optimal rate of depletion, but merely mirrors decisions already made by the resource owner about liquidating his natural resource. The owner usually determines his extraction rate in the light of many factors, including his expectation of future price changes. If he decides to extract 20 percent of his reserves in one year, then n in the above formulation is equal to 5; the income content of his net receipts, using a 5 percent discount rate, would be 25 percent; and the user cost to be reinvested is 75 percent. If, however, he extracts only 10 percent of his reserves, that is, plans to exhaust his resource over ten years, then he needs to set aside for reinvestment 58 percent of his net receipts, and will thus enjoy 42 percent as current income. The correction needed to reckon "true" income out of natural resource sales is higher the nearer the resource is to exhaustion, and lower the longer its life expectancy at current extraction rates. Only a 1 percent reduction would be necessary in net receipts to arrive at "true" income using a 5 percent discount rate if the resource is being liquidated over 100 years. The choice of the discount rate materially affects the calculation. A high discount rate, which depresses future against current valuation, raises the ratio of "true" income in current receipts. But alternative investments must be found in which to sink the depletion factor (R-X) so that it can yield that much as a return[1].

Resource Accounting

For resource accounting, data need to be collected on renewable and nonrenewable natural resources primarily for the purpose of planning their long-run exploitation in pursuit of sustainable economic activity. Several industrial countries, including Canada, France, Japan, Norway, and the United States, have developed resource accounts that are tailored to their available resources and policy priorities. Some of the important features of the French approach to resource accounting are described below.

Instead of the term "resource accounting" the French use the term "patrimonial accounting", which could be described as "accounting of the national environmental heritage" (Theys, in Ahmad, El Serafy, and Lutz, Chapter 7). This is broader than resource accounting because it includes, for example, cultural heritage in addition to natural resources. The French resource accounting approach is intended ultimately to relate economic growth to the quantities of natural resources that have to be used up or imported to make economic growth possible. Such a system would also help to optimize the economic value of available natural resources, determine the fraction of GDP that should be set aside for the efficient protection of the environment, and orient economic growth so that it does not threaten ecosystems.

When fully developed, the system would be versatile and serve various ends. It would optimize the use of natural resources as factors of production (for example, inversion of a quantitative input/output table that would indicate the intermediate use of natural resources in the productive process); it would describe the economic aspects of resource use (such as which resources would be marketed and in what quantities and values, how to improve the productivity of processing industries to optimize the use of natural resources, and what the opportunity costs are of alternatives); it would treat resource as "environmental goods" (taking into account changes in the quality of the

environment, the costs and benefits of environmental policies, and the economic consequences of alternative environmental policies); and it would take stock of the national environmental heritage and define the long-term implications of its transformations, so that it could be preserved for future generations. Since resources to develop such a system are limited, stress is placed on satisfying the needs of the policymaker. Although it would be easier to collect environmental data in the form of flexible reports on the state of the environment and country profiles, the need for developing a system of environmental accounts is paramount, so that the information is standardized, exhaustive, summed up in physical and monetary terms, and comparable in time and space. The long-term goal is to match the standards already reached by national (economic) accounting, which is such a powerful planning tool for short-term economic management.

The French approach is only one among several being pursued in industrial countries (for example, Norway has been using resource accounts for several years; see Alfsen, Bye, and Lorentsen 1987). The French approach is to build up balance sheets of resources and to monitor their change from year to year, with emphasis on measurements in physical terms. Physical measurements are clearly essential, and wihtout them accounting in monetary terms is impossible. Built into the French approach is the assumption that a comprehensive physical inventory system must be in place before any changes can be proposed in national accounting methodology. This is a point of view shared by many, but there are many others who would want to see national accounting methods adjusted gradually as measurements become available.

Linking Environmental and Resource Accounts to the SNA

The current version of the SNA which has been in effect since 1968 does not contain an explicit environmental dimension. The ongoing SNA revision was mandated by the U.N. Statistical Commission to simplify and clarify the existing system rather than introduce radical changes. The Commission has been inclined to maintain consistency in time series, even where conceptual shortcomings are involved.

Among environmentalists and economists with environmental and resource concerns, there are several schools of thought about the best approach to the accounting problem (Norgaard, in Ahmad, El Serafy, and Lutz, 1989, Chapter 8). Some advocate environmental accounting in physical terms and have little interest in establishing any linkage with the SNA. Their aim is to use indicators of physical change to influence public opinion and environmental policies. At the other end of the spectrum are those who feel that environmental accounting would not have an adequate effect unless the accounts are monetized and integrated into the SNA, which would produce an environmentally adjusted national income that is more sustainable.

Environmental accounting in physical terms is clearly essential, particularly as this would cover collecting data that indicate the direction and rate of change in the quantity or quality of a resource. At the same time, it should be recognized that "monetization", to the extent possible, is important as well and that a linkage with the SNA, leading to adjustment of the current income concepts is urgently needed. Given the current state of the art, however, more conceptual and empirical work is needed before GDP and NDP in the core of the SNA can be replaced by more sustainable GDP and NDP. That is why, as an interim step, the construction of satellite accounts, linked with the SNA should be encouraged. In those satellite accounts, environmentally-adjusted GDP and NDP could be computed, and this would not represent a threat to the historical continuity of GDP.

Constructing Environmental and Resource Accounts for Developing Countries

In order for resource concerns to be reflected eventually in the SNA and in policymaking, it is necessary to make progress now at an operational level so that government officials, national accountants, and economists alike can see how to include environmental and resource concerns in the calculations. Certain factors might facilitate resource accounting work in developing countries, since environmental problems in most of them tend to be concentrated and easily perceived. Besides, benefits can be derived from progress made in developed countries, and remote sensing methods of surveying are now available. However, environmental and resource accounting demand great amounts of data and effort, and many disciplines are required for working on these accounts. The problems are compounded in the developing countries by the still-limited political demand for this type of activity, since short-run problems are more pressing, and the relevant human resources are acutely scarce.

It is clear that the development of environmental and resource accounts will take time. This fact, however, should not keep statistical and planning officials in developing countries from initiating relevant work now, especially on minerals or forestry, where data to a large extent are already available. In the case of Indonesia, Peskin (Ahmad, El Serafy, and Lutz, 1989, Chapter 9) argues that a local research effort should start right away, supported initially with periodic consultant inputs. This task could be enlarged to cover not only environmental, but also other important nonmarket factors in an expanded accounting structure.

Repetto and others (1989) have applied resource accounting to fuel and forestry resources in Indonesia. For forestry they estimated harvesting, deforestation, and degradation net of regrowth and suggested that this be treated like depreciation of man-made assets, that is, they proposed reducing GDP by the estimated depletion to arrive at NDP. A similar approach was followed for valuing the depletion of fuel reserves where, because of the method adopted, discovery of fresh deposits sometimes raised NDP above GDP. Another empirical study (Magrath and Arens 1989) estimated the cost to the economy of soil erosion in Java. The annual amount estimated was US$ 350 million to US$ 415 million, which is slightly less than 0.5 percent of GDP. More than 95 percent of this cost was due to the on-site cost of declining productivity. These two studies have made valuable contributions, but it is clear that further empirical work is needed.

A Variety of Approaches, but a Common Theme

Some of the proponents of environmental accounting have proposed incompatible propositions for amending the SNA. This incompatibility should not detract from the central theme argued by all of them: in their present form the guidelines for income calculation under the SNA leave out important aspects of economic development that should be brought into the accounts. These guidelines now produce readings of levels of activity and growth over time that often lead to faulty policy advice. Such readings often exaggerate income and thus encourage excessive consumption and promote habits of behavior that cannot be sustained over the longer term.

An interesting argument over "desirable and practicable" adjustment is highlighted by the approaches regarding depletable resources of Harrison (Ahmad, El Serafy, and Lutz, 1989, Chapter 4) and El Sefary (Ahmad, El Serafy, and Lutz, 1989, Chapter 3). Both are in fundamental agreement about what constitutes sustainable income and what does not. Harrison would work within the existing framework of the SNA by preserving

the definition of final demand used at present but would include consumption of natural capital as a parallel entry to consumption of man-made capital, with appropriate adjustments to NDP. Further, she argues that income measures should exclude all capital consumption and therefore that net products should be used to indicate the level of economic activity and its development over time. El Serafy, by contrast, would redefine the distinction between intermediate and final demand by arguing that the sale of natural capital must not be viewed as generating value added and that at least part of that income should be excluded from GDP itself, as well as from the net product. Thus the GDP measurement could continue to be used extensively, as now is the case, to describe performance and guide economic policy.

Norgaard (Ahmad, El Serafy, and Lutz, 1989, Chapter 8) is skeptical about the economists and accountants concerned about the environment ever being able to agree on a set of corrections that would simply rectify and fill in gaps in the existing SNA to produce one aggregate figure expressed in monetary terms. He claims that the existing SNA contains contradictions because it is based on conventions and reflects consensus rather than being built on deductive reasoning. He does not view sustainability as implicit in the definition of income, which both Daly and El Serafy do, but as an "ethical" goal, representing a "separate objective of objective strategies". He believes the prevailling undervaluation of the concerns of future generations as reflecting the nonparticipation by future generations in the capital markets of today.

A more conventional view would ascribe such undervaluation to the use of too high a discount rate, which reduces the value of future net benefits almost to nothing in the more distant future. Since future generations will never be able to participate in today's capital markets, the surest way of reflecting their preferences is to use lower discount rates. The main thrust of Norgaard's argument, however, is against the economic approach to "sustainability of development" based on accounting that relies on market valuations. He espouses "methodological pluralism" in the belief that a multiplicity of perspectives would ensure that "all values are respected" so that decision-makers have information alerting them to "as many aspects of environmental and resource phenomena as possible". Norgaard, however, never spells out how such alternative value systems can be established or used; nor does he speculate on the sort of solutions they would produce.

There are other areas in which people interested in environmental accounting have disagreed, but the main message they all hope to convey is the urgent need to recognize the shortcomings of the current measures of income and to work toward a more sustainable concept and measurements.

The Treatment of Natural Resources and the Environment in the On-Going Revision of the SNA

The System of National Accounts that is currently in use is based on a document published over twenty years ago (United Nations 1968). A revision of this system was started in 1986, with a number of expert groups looking at various issues and considering how improvements could be made with as little disturbance to the SNA core system as possible. One of the important meetings dealing with the issue of environmental accounting was held in Luxemburg in January 1989.

This was the last expert meeting of many held between 1986 and 1989 on the revision of the SNA before an actual production of a complete draft of the new "Blue Book". Many outstanding issues had to be decided. On the issue of the environment,

the meeting endorsed the creation of environmental satellite accounts linked with the SNA. It was decided that the new "blue book" will describe these, and further research in this important area was encouraged. On the issue of the central concept of income, the meeting adopted the Hicksian definition with a minor addition. Accordingly, income is the maximum an individual (or nation) can consume during a period while keeping intact the stock of capital at the beginning of the period as well as any net additions of capital during the period.

There have been a number of delays in the production of the production of the revised version of the "Blue Book"; it is expected that it will be issued by the United Nations Statistical Commision in 1993.

On-Going and Future Work

Inducing production and consumption practices with less negative effects on the environment worldwide is a formidable task. Changes are needed in policies, programs, projects, institutions, the distribution of income and wealth, and human behavior. But necessary changes are often slow in coming. Improvements in any one area can make only a partial contribution to an approach where many parallel activities are needed to achieve development that is both equitable and environmentally sound. Environmental accounting is only one of many tools that are needed, and, given the lack of past effort, it will take time to develop it into an effective tool to improve policymaking. Nevertheless, serious work in this area should now be pursued actively and vigorously.

In July 1989, the World Bank's Research Committee provided funding for a project on environmental accounting, which is carried out in close cooperation with the United Nations Statistical Office. It consists of four inter-related tasks:

a) A draft handbook for environmental accounting is being prepared by the UNSO based on a framework paper by Bartelmus, Stahmer and van Tongeren (1989);
b) The existing schemes in industrial countries have been reviewed with the objetive of identifying any lessons, in particular those that might apply to developing countries (see Peskin, with Lutz [1990]);
c) Two pilot case studies are being carried out in two developing countries (Mexico and Papua New Guinea); and
d) Expert Meetings will be held to review the draft handbook based on the experiences of the case studies and other work.

Notes

1 J.M. Keynes (1936) first introduced the concept of "user cost" in relation to capital equipment. He defined it as the "maximum net value which might have been conserved... if it [the equipment] had not been used". He described this concept as constituting "one of the links between the present and the future". (See chap. 6 and its appendix of his *General Theory*). Project analysis of depletable minerals has also made use of the concept of user cost at the micro level (see, for example, Schramm 1986). Daly (1989) has pointed out that the alternative projects in which the capital element is to be invested need to be themselves sustainable.

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APPLYING ECONOMIC ANALYSIS TO ENVIRONMENTAL PROBLEMS: OPPORTUNITIES AND CONSTRAINTS*

JOHN A. DIXON
The World Bank

Abstract:

Economic analysis of environmental and natural resource management problems is receiving increasing attention. Whether the concern is with traditional pollution related issues, especially of air and water in urban areas, or with more complex natural resource management problems in rural areas, economists are increasingly being called upon to conduct analysis and offer policy advice for meeting these needs. This paper discusses the evolution of economic analysis of environmental concerns and considers some of the constraints to and opportunities for expanded economic analysis of environmental problems. Experience from both developing and developed countries is used to illustrate various points and an assessment of recent experience is offered.

Introduction

Economic analysis of environmental and natural resource management problems has become a "growth industry" of the 1990s. Increasing attention is being paid to how the concepts and techniques of economic analysis can be applied to natural resources management. This is true in both the developed and developing countries, and by national governments as well as bilateral and multilateral aid agencies and development banks.

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