

**THE PRESENT STATE OF
ENVIRONMENTAL AND RESOURCE ACCOUNTING
AND ITS POTENTIAL APPLICATION
IN DEVELOPING COUNTRIES**

**Edited by
Hussein Abaza
Assistant Policy Adviser to the Executive Director**

February 1992

**Environmental Economics Series
Paper No. 1**

Views and interpretation of this paper are those of the author(s) and do not necessarily reflect
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United Nations Environment Programme
(UNEP)

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ACKNOWLEDGEMENT

Acknowledgement is made to Derek Eaton, a Research Economist, for the extensive research and preparatory work he has undertaken towards the preparation of this paper.

The paper was prepared as a background document for the Workshop on Environmental and Natural Resource Accounting held at the UNEP Headquarters in Nairobi, Kenya from 24-26 February 1992. The Workshop, which was sponsored by UNEP, has been organized within the framework of the Action Programme of the Committee of International Development Institutions on the Environment (CIDIE) adopted at the Twelfth CIDIE meeting held at the Inter-American Development Bank (IDB) in Washington from 29 April - 1 May 1991.

The Workshop was attended by 27 participants representing governmental and non-governmental international institutions and individual experts and resulted in a set of conclusions and recommendations in the field of environmental and resource accounting.

The Environmental Economic Series represent a compilation of experience and preliminary findings of research work. The findings, interpretation and conclusions expressed in this paper and in the other papers in this series are entirely those of the author(s) and should not be attributed in any manner to UNEP.

Abstract

An essential step towards achieving sustainable development is through the sound and efficient management of natural resources. One way to achieve that, is by accounting for the depletion and degradation of natural resources. It has become increasingly apparent that the current System of National Accounts (SNA) does not adequately reflect the depletion and degradation of natural resources. Environmental and resource accounting provides the means by which resource depletions and degradation may be identified and evaluated and the true cost of development measured.

The paper reviews the various approaches to environmental and resource accounting to deal with the shortcomings of the SNA. It reviews the experience of several industrialized countries in environmental and resource accounting reflecting the different priorities and objectives of the countries concerned.

Based on the review of the various approaches to environmental and resource accounting and the experience countries have had in its introduction, the paper recommends the use of environmental and resource accounting as a useful instrument for assisting countries achieve sustainable development.

To that end it recommends that: a methodology for determining and prioritizing the information needs to be addressed by environmental and resource accounting should be developed; serious consideration should be given to using the System for Integrated Environmental and economic Accounting (SEEA) of the United Nations Statistical office as a standard approach; the development of guidelines for the implementation of ERA; the further development of physical resource accounting and valuation techniques; and the establishment of a central focal point for information on ERA.

1. INTRODUCTION

As a result of increasing environmental awareness over the last few decades and the need to account for resource depletion and degradation, it has become increasingly apparent that the current System of National Accounts (SNA) does not adequately reflect these issues. Various approaches to environmental and resource accounting (ERA)¹ have therefore been proposed to deal with two shortcomings of the SNA that have been identified with respect to the environment.

Firstly, the SNA currently treats certain defensive expenditures (measures undertaken to combat or control the negative side effects of production and consumption)² incurred by industry as intermediate expenditures while those undertaken by households and Governments are generally treated as final expenditures. Secondly, although the depreciation of built capital is deducted from Gross National Product (GNP) to arrive at Net National Product (NNP), no allowance is made for the depletion or degradation of a resource (El Serafy and Lutz 1989:1), part of which may be conceptually viewed as the depreciation of natural capital.

In addition, many of the goods and services provided by environmental and natural resources are not traded in markets. These goods and services are thus not reflected in the SNA, primarily because they do not have monetary valuations assigned to them by markets. Often where natural resources are traded in markets, the markets do not internalize all of the goods and services supplied by these resources due to, for example, the structural limitations of the market mechanism (Gilbert *et al.* 1990:2). The rationale for ERA is thus to help correct either one or both of the shortcomings of the SNA and to attempt to account for the true costs of resource use.

It is now realized that countries can no longer carelessly exploit their resource base for the purposes of development without due regard for the future. The environment provides valuable resources and services for the economy many of which are life-supporting and have no available substitutes. The economy thus depends on the environment, and in fact, is based upon it. We must remember that not all forms of natural capital can be substituted with built varieties and that some level of natural resources must be maintained intact.

In this regard, ERA provides the means by which resource depletion and degradation may be tracked and evaluated and the true cost of development programmes better estimated. For many developing countries which depend to a

1. The term, "environmental and resource accounting" (ERA), is used in this paper although others have employed terms such as "environmental accounting" (EA) and "natural resource accounting" (NRA). Even though some would assign different meanings to these terms, they often overlap and are treated here as being interchangeable.

2. Discussion and treatment of defensive expenditures entails a certain amount of arbitrariness since no strict definition of these expenditures exists; in the extreme, almost all expenditures may be viewed as defending against something.

large extent on depleting their resource base for current consumption and investment requirements, information on the changing state of that resource base is of utmost importance in order to enable these countries to plan their development. In addition, information provided by the SNA that does not incorporate resource depletion and degradation will provide erroneous signals to policy-makers about the state of the economy. Thus, ERA can also provide the means by which information in the SNA can be corrected or supplemented to reflect the environmental basis of production and consumption activities.

If adjustments to the national accounting methodology are to be made for resource depletion and environmental degradation (beyond the isolation of defensive expenditures), then physical data is an essential first step (El Serafy and Lutz 1989:5). To this end, ERA can provide "the framework for the development of databases to track resource depletion, environmental degradation, and material-energy throughputs" (Friend and Rapport 1990:4). However, opinion has often been divided between those who feel that "a comprehensive physical inventory system must be in place before any changes can be proposed in national accounting methodology" (the approach being pursued, for example, by France) and those who "would want to see national accounting methods adjusted gradually as measurements become available" (El Serafy and Lutz 1989:5). But these differences in opinion usually stem from diverse views on what the primary function of ERA should be. Different objectives for ERA lead to varying (though not necessarily mutually exclusive) approaches.

By providing more accurate information on the environmental aspects of economic development, ERA could assist in the formulation of economic policies for sustainable development. More specifically, one may identify two broad functions of ERA. The first of these involves the establishment of a more comprehensive database on environment-economy interactions while the second addresses the formulation of improved measures of the overall level of economic activity better reflecting its sustainability or unsustainability (the distinction between these types of functions was made by Peskin with Lutz 1990:2).

In aiming to fulfill the first function, ERA may promote the incorporation of information concerning the availability of natural resources and environmental carrying capacity into the formulation of development projects and policies by all the authorities concerned. Most development activities constitute interventions in nature, but unfortunately, knowledge of the complex interactions that occur in ecosystems is such that the consequences of these activities are often not predictable. Multiple feedback effects and non-linear relationships among the components of the natural world can defy the most sophisticated systems analysis. The final effects of development projects are sometimes irreversible and often synergistic. In countries struggling to develop, and where such development is often highly dependent on an increasingly fragile resource and environmental base, there exists therefore an acute need to maintain an updated inventory of the nation's resources in terms commensurate with an accounting framework *i.e.* in

a regular, consistent and systematic manner. ERA can assist in partly filling this information gap by providing a system for predicting and evaluating, in measurable quantitative terms, the effects of various interventions on the environment and natural resource base, as well as for subsequently recording what the resultant effects actually are.

Secondly, ERA can assist policymakers in monitoring the achievement of sustainable development through the calculation of improved indicators of the level and sustainability of economic activity, thus operationalizing the concept of sustainability at a macro level. The true concept of income, as stated by Hicks, is sustainable by definition, being "the maximum value which [one] can consume during a week, and still expect to be as well off at the end of the week as [one] was at the beginning" (Hicks 1946:172, quoted in Daly 1989:8). Thus, the "central defining characteristic of income is *sustainability*. The term 'sustainable income' ought therefore to be considered a redundancy" (Daly 1989:8).

Extending this to the national level, the nation's income becomes "a practical guide to the maximum amount that can be consumed by a nation without eventual impoverishment" (Daly 1989:8). Thus it can be argued that income should be measured as "the flow of goods and services that the economy could generate *without reducing its productive capacity - i.e. the income that it could produce indefinitely*" (Pearce *et al.* 1989:108). This proper concept of income eliminates the confusion of capital and income, recognizing that income should be considered as a "stream of services obtained from [capital] stocks" (Friend and Rapport 1990:4). At present, because of the environmental shortcomings in the SNA, GNP/GDP provides incorrect signals to policy-makers and analysts on the sustainability of economic activity by overstating a country's income and by ignoring the consumption/liquidation of natural assets. However, differences exist among experts as to exactly how measures of economic activity should be adjusted to reflect sustainability goals (Bartelmus 1989; Harrison 1989:24).³

Within these two broad functions of ERA, it is possible to identify more specific functional objectives of ERA (see Peskin with Lutz 1990:18). These could include, among others, the collection and generation of data for the improved formulation of policy with regard to the use of a particular resource, the identification of environmental/economic interactions or the calculation of an environmentally-adjusted GNP. The first two of these functional objectives fall under the broad function of a more comprehensive database on environment-economy interactions.

3. El Serafy insists on the correction of both GDP and NDP in the SNA according to the Hicksian definition of income (El Serafy 1989) while some others appear to be content with calculating a new measure of "sustainable social net national product", "sustainable income", or a revised NDP figure (Daly 1989; Pearce *et al.* 1989:108; Harrison 1989). The common feature of these latter methods is that they all propose using the existing measures of GDP and/or NDP and deducting the consumption/depreciation of environmental assets/capital and/or defensive expenditures.

The third falls under the broad function of calculating improved indicators of the level and sustainability of economic activity.

The aim of this paper is to summarize the present state of environmental and resource accounting, particularly with regard to its possible application to developing countries. The paper consists of five main sections including the Introduction. The following section outlines the major developments in expert opinion on ERA, particularly as evidenced by the results of Expert Group Meetings convened by UNEP and the World Bank between 1983 and 1988 and ongoing work. The third section summarizes the existing experience in ERA in the various countries that have implemented such systems, and the fourth section provides conclusions on the existing experience and situation with regard to developing countries. Finally, the last section concludes by identifying areas of future work and recommendations for the future implementation of ERA in developing countries.

2. BACKGROUND

As far back as the early 1970s, various industrialized countries began to implement ERA systems while others considered what possible similar courses of action to take (see Section 3). In 1983, UNEP convened a consultative meeting on ERA "to ascertain whether environmental accounting could be developed as a public policy tool" (Ahmad *et al.* 1989:xi). To follow up on this issue, additional workshops were convened, in collaboration with the World Bank, in 1984 (Washington), 1985 (Paris), 1986 (Washington and Paris) and 1988 (Paris). The major papers presented and conclusions were published under a single volume, "Environmental Accounting for Sustainable Development", edited by Ahmad *et al.* (1989).

A revision of the SNA itself was initiated in the early 1980s (mandated by the UN Statistical Commission) to consider how improvements could be made to the system with as few changes as possible to the core accounts (Lutz and El Serafy 1989:88). In March 1988, the World Bank presented to a SNA Expert Group Meeting a discussion note on the treatment of defensive expenditures and resource depletion and degradation. The SNA Expert Group decided that it would be premature to incorporate changes to the core of the SNA to better reflect issues of environmental sustainability since many conceptual and practical matters remain to be resolved (Lutz and El Serafy 1989:88-9). From a conceptual point of view, little consensus exists on the proper definition of environmental goods and services and defensive expenditures. The latter are especially open to a very wide interpretation and could also raise the issue of changes to the SNA to better incorporate other nonmarket activities (for example, household production). From a practical standpoint, it is not yet possible to value, in monetary terms, all of the functions provided by the environment and natural resources (although work is progressing rapidly in this area; see, for instance, Hufschmidt *et al.* 1983, Barde and Pearce 1991, and Nash and Bowers 1988).

A Joint UNEP/WB Expert Meeting on Environmental Accounting and the SNA (the last in the series of workshops listed above) was convened in November 1988 to bring together national accounts experts and environmental economists. At the meeting, it was decided that, "Replacing GDP with a more sustainable measure of income is not yet feasible" and that, "[f]or the time being...satellite accounts linked to the SNA should be created in which adjustments and alternative computations can be made" (Lutz and El Serafy 1989:89). The Meeting recommended that the revised volume on the SNA to be issued in 1991 should have a section which describes and outlines satellite accounts for environmental accounting.⁴ It was also agreed that these accounts should be compiled in physical terms, and that monetary evaluation should take place where possible. In addition, a consensus

4. This recommendation was subsequently adopted by the SNA Expert Group Meeting in January 1989 (Lutz and El Serafy 1989:89-90).

was reached that two (or possibly three) NDPs (Net Domestic Product) should be calculated (*ibid.*)⁵:

$$\begin{aligned} \text{GDP} - \text{consumption/depreciation of [human]-made capital} &= \text{NDP}_1 \\ \text{NDP}_1 - \text{consumption/depreciation of natural capital} &= \text{NDP}_2 \end{aligned}$$

Although the subsequent SNA Expert Group Meeting in January 1989 adopted the Hicksian definition of income, it was decided that, "GDP [Gross Domestic Product] will continue to be defined under the revised SNA without adjustment for the degradation of natural capital from the process of production and consumption" (*ibid.*). This effectively implied that work would have to concentrate on defining an alternative sustainable income concept to GDP in a separate handbook on ERA.

At the UNEP/World Bank Meeting in 1988, it had been generally agreed that ongoing and future work should focus on developing a technical draft manual/handbook on ERA and that this should be partly based on concurrent pilot studies (see the Report of the 1988 Meeting). More specifically, six broad areas of future work have been identified (Lutz and El Serafy 1989:90):

- (a) The development of a draft manual in the handbook series of the SNA on environmental satellite accounting based on the framework drawn up by Bartelmus *et al.* (1989). (The preliminary draft has been completed, as discussed in Section 3)
- (b) An evaluation of existing approaches to environmental accounting. (This has been completed by Peskin with Lutz (1990), as mentioned in Section 3)
- (c) Pilot studies in several developing and industrial countries using the Bartelmus *et al.* (1989) framework and existing data.
- (d) Working groups and expert meetings should be convened to review the results of the draft manual and the pilot studies.
- (e) In-depth case studies on developing countries involving new data generation and institution building should be initiated.
- (f) Further efforts to assess the environment and natural resource base, its changes in quantity and quality, and its linkage to monetary

5. While members of the workshop recognized that many technical imperfections in this new NDP concept remained to be resolved, it was generally agreed that its immediate development and use be promoted given its wide popular and political appeal (see the Report of the November 1988 meeting--UNEP/World Bank 1988).

accounting through the development and extension of the techniques of physical resource accounting.

At this point, (a), (b) and (c) have essentially been completed. The first draft of the handbook (prepared by the Statistical Office of the United Nations) proposes a system of "integrated environmental and economic accounting" in which the currently-defined GDP is maintained but an "Environmentally adjusted Net Domestic Product (EDP)" is calculated (United Nations 1990:135). The Draft Handbook was discussed at the Special International Association of Research in Income and Wealth (IARIW) Session on Environmental Accounting in May 1991 (thus also partly completing (d)) and is currently being finalized for publication by the Statistical Office.

With respect to (c), the framework was tested by the Statistical Office of the United Nations, together with the World Bank, in Papua New Guinea and Mexico and the results should be published by early 1992.

With respect to (b), the World Bank published, in 1990, a review of industrial country experience in environmental and resource accounting (Peskin with Lutz 1990).

In-depth case studies under (e) are yet to be undertaken.

In addition, UNEP has undertaken to further the development of some of the conceptual issues involved in environmental and resource accounting by commissioning a paper on the classification and valuation of environmental assets (Gilbert *et al.* 1990) which falls under (f).

3. SUMMARY OF EXISTING EXPERIENCE IN ERA

The experience of several industrialized countries in environmental and resource accounting is at the moment quite varied, reflecting the different priorities and objectives of the countries concerned. In the interests of maintaining consistency with the existing literature on ERA, the present paper uses the following categories for classifying different approaches to ERA, as developed by Peskin with Lutz (1990:6-14):

- 1) identification and reclassification of environmental expenditures (Japan);
- 2) physical resource accounting (Norway, France);
- 3) depreciation of marketed natural resources (Repetto *et al.*); and
- 4) full environmental and natural resource accounts with valuation (The Netherlands, Peskin, United Nations Statistical Office).

Implementation of ERA has been largely confined to systems which may be classified within the first and second categories. With respect to the third category, a case study of Indonesia was undertaken by the World Resources Institute (Repetto *et al.* 1989). Approaches within the fourth category remain in the developmental stage with the exception of the Netherlands which has recently begun implementation of such an ERA system.

What now follows is a brief presentation of the relevant features of the main approaches undertaken so far (given that these experiences have been extensively reviewed by Peskin with Lutz 1990). Due to the difficulty in obtaining information, the list of approaches cannot be regarded as complete; although the main initiatives are covered. Before proceeding, it should be noted that the classification system is not rigid. Some approaches transcend the boundaries established by Peskin.

Japan (Category 1)

The system of ERA that was used in Japan draws heavily on the concept of Measures of Economic Welfare developed by Nordhaus and Tobin (1972). The approach calculates Net National Welfare as an adjusted GNP by deducting pollution abatement expenditures and by deducting the costs of pollution using the elimination cost method (Peskin with Lutz, 1990:A-I-13). This method involves arbitrarily choosing a quality standard for a specific pollution problem. The costs of pollution are then taken to be equal to the cost required to restore the actual levels to that of the standard.

The procedure was, however, never institutionalized nor made into a permanent activity of the national statistical office. Instead, the adjustments to GNP were confined to a one-time only report completed in 1973. It is worth noting that, in calculating Net National Welfare, the Japanese also incorporated adjustments for other non-environmental aspects of welfare, including *inter alia*, leisure, non-market activities and urbanization.

Norway (Category 2)

In 1975, the Norwegian Government began work on a system of ERA that focuses on accounting for particular resources in physical stock and flow terms. The Norwegian resource accounts classify resources as being either material or environmental resources. The material resources accounts, which are further subdivided into mineral, biotic, and inflowing resources, record both the stock and flows of the resource, as well as the use made (by sector) of the resource (see Table 1). Accounts have been developed for various minerals, fish, forests and energy. The environmental accounts focus on recording the state of air and land in a systematic format.

The accounts are used in forecasting and budgeting future use of the resource; however, recent reviews of the Norwegian experience indicate that the accounts have been more successful in some areas than in others, the most successful application being the energy accounts (OECD 1988, Alfsen *et al.* 1987). The lesson provided by Norway is that the development of resource accounts should be issue driven.

The reviews also revealed that the accounts have not been put to much use in national policy formulation. Alfsen *et al.* (1987) attribute this mainly to the inadequate institutional arrangements with respect to environmental management in Norway. On the other hand, Pearce *et al.* (1989) indicate that the lack of valuation of the resources, and hence links with the SNA, may also play a role. In transferring this experience to developing countries, one should therefore not expect ERA to influence planning and policy formulation in the absence of Government commitment to the environment and adequate institutional arrangements for this commitment to be realized. Links with the SNA may play a role in assuring the significance and importance of ERA.

France (Category 2)

France has developed the most comprehensive system of ERA to date, known as the Comptes du Patrimoine Naturel. The objective of the French system is to record all the interactions between the economy and the environment, as well as the changing state of the natural environment itself. The system attempts to measure not only the economic, but also, the ecological and social values of the environment.

Similar to the Norwegian system, there are stock and flow accounts for individual resources, known as central accounts for components/elements, and there are accounts which describe the use made of resources, known as agent

Table 1: Structure of the Norwegian Material Resource Accounts

I. RESERVE ACCOUNT:		
<u>Beginning of period:</u> (opening stock)	<i>Resource base</i> Reserves	Developed Non-developed
	- Total gross extraction during period	
	+ Net adjustments of resource base (new discoveries, reappraisal of old discoveries)	
	+ Net adjustments of reserves (new technology, cost of extraction, transport etc., price of resource)	
<u>End of period:</u> (closing stock)	<i>Resource base</i> Reserves	Developed Non-developed
II. EXTRACTION AND TRADE:		
	Gross Extraction (by sector)	
	- Use of resource in extraction sectors	
	= Net Extraction (by sector)	
	Import (by sector)	
	- Export (by sector)	
	= Net Import (by sector)	
	Net changes in stocks	
	For domestic use: Net extraction + net import + net changes in stocks	
III. USE:		
	Domestic Use	

Source: Adapted from Alfsen *et al.* (1987:22).

accounts. However, the agent accounts also contain information on any expenditures related to the management of natural resources (thus combining elements of Category 1 as well). In addition, the French system also has central accounts for ecozones (or other geographic regions). Peripheral accounts describing all the relationships among individual resources and between individual resources and human activities ensure that all the linkages are captured (Cornière 1986). The structure of the Comptes du Patrimoine Naturel is shown in Figure 1.

The French system has been implemented only on a very partial basis with the final form left open to ongoing development (Theys 1989). Pearce *et al.* (1989) argue that since a critical review appears to have not yet been undertaken, the relevance of the system to policy analysis and formulation is still uncertain, although the approach certainly appears promising.

The French system can be used to formulate a national wealth account that incorporates natural resources, and thus, can be used to calculate some measure of sustainable income. In addition, the system also affords a more complete picture of the complexities of the environment, through its set of ecozone accounts. The disadvantage of the French approach--its large data requirements--must be kept in mind when considering options for developing countries.

Repetto *et al.* (Category 3)

The first application of ERA to a developing country was undertaken by Repetto *et al.* (1989) and sponsored by the World Resources Institute. As such, it remains the only example of an approach in Category 3 (*i.e.* depreciation of marketed natural resources).

The study collected existing data in three natural resources of Indonesia: petroleum, timber, and soil types and accompanying agricultural practices. Stock and flow accounts were compiled for the first two of these resources. Then based on this information, GDP was adjusted by deducting the value (as measured by net economic rent) of the net depletion of the resources. For soil resources, an estimate of losses in agricultural productivity due to soil erosion was arrived at through the use of a GIS system, as well as a fair amount of estimation. This loss was then deducted from GDP to yield NDP. The study found that this "NDP" measure grew at an annual average for 4.0% over the years 1971-1984 versus an average annual growth rate of 7.1% for conventional GDP (see Table 2).

The Repetto *et al.* study has been criticized for being too partial and for using inappropriate valuation methods (as reported in Peskin with Lutz 1990:A-II-5-6). The primary purpose of the study appears to have been the illustration of what magnitudes are potentially involved in adjustments to GDP through natural resource accounting, as well as a demonstration of what can be done with modest expenditure and existing data (Repetto *et al.*:4, 53). Indeed, the main criticisms of

Figure 1: Structure of the French Comptes du Patrimoine Naturel

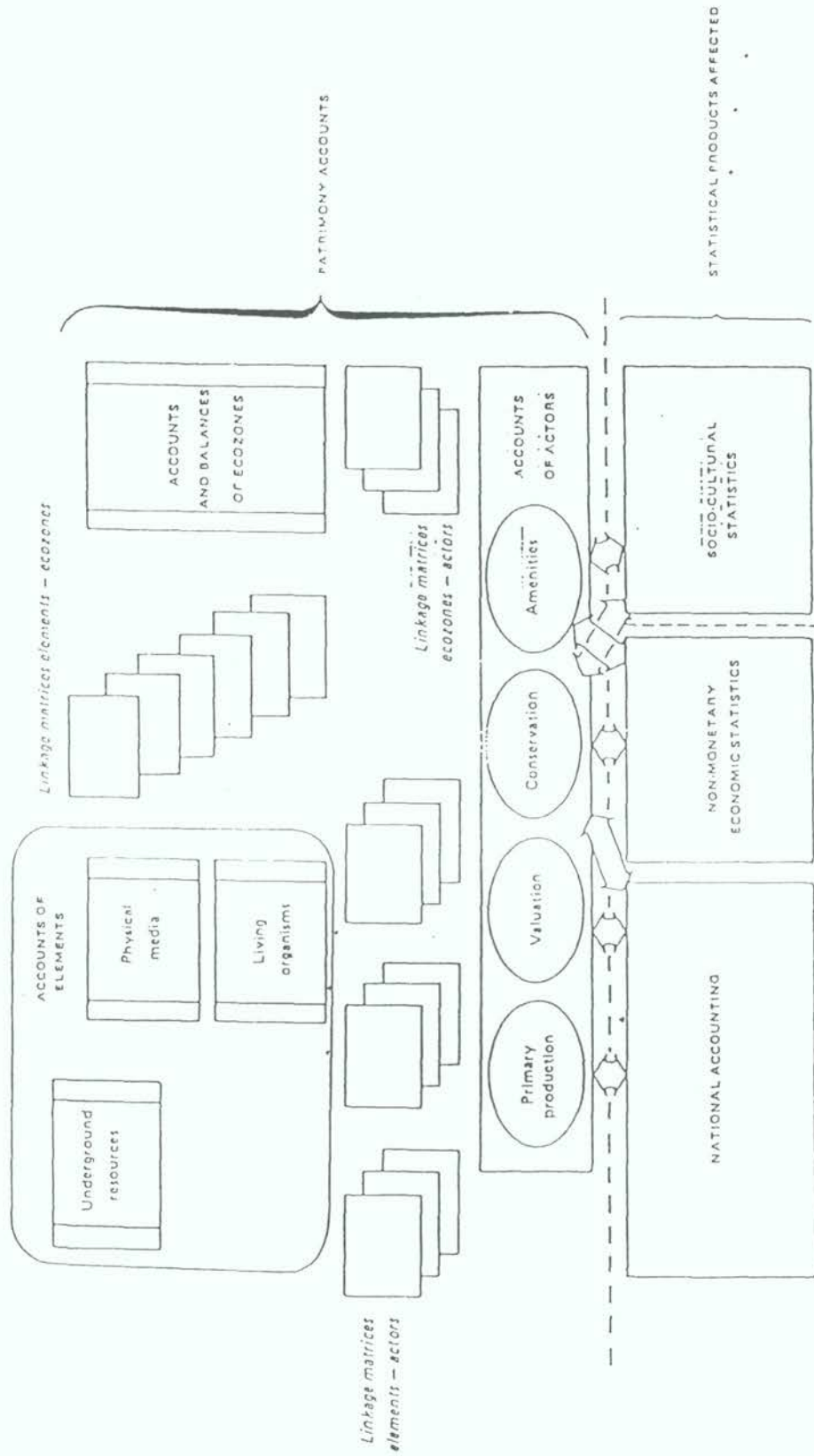


Table 2: Comparison of GDP and "NDP" for Indonesia based on case study by Repetto *et al.* (1989)
(1973 Rupiah, billions)

YEAR	GDP ¹	NET CHANGE IN NATURAL RESOURCE SECTORS			NET CHANGE	NDP
		Petroleum	Forestry	Soil		
1971	6,545	1,527	(312)	(89)	1,126	6,671
1972	6,067	337	(354)	(83)	(100)	5,967
1973	6,753	407	(591)	(95)	(279)	6,474
1974	7,296	3,228	(533)	(90)	2,605	9,901
1975	7,631	(787)	(249)	(85)	(1,121)	6,510
1976	8,156	(187)	(423)	(74)	(684)	7,472
1977	8,882	(1,225)	(405)	(81)	(1,711)	7,171
1978	9,567	(1,117)	(401)	(89)	(1,607)	7,960
1979	10,165	(1,200)	(946)	(73)	(2,219)	7,946
1980	11,169	(1,633)	(965)	(65)	(2,663)	8,506
1981	12,055	(1,552)	(595)	(68)	(2,215)	9,840
1982	12,325	(1,158)	(551)	(55)	(1,764)	10,561
1983	12,842	(1,825)	(974)	(71)	(2,870)	9,972
1984	13,520	(1,765)	(493)	(76)	(2,334)	11,186
AVERAGE ANNUAL GROWTH	7.1%					4.0%

NOTE: Negative values appear in parenthesis

1. In constant 1973 Rupiah.

Source: Repetto *et al.* (1989:6).

the study could be met with the use of more sophisticated valuation techniques and with more extensive coverage.

However, El Serafy has also criticized the Repetto *et al.* study for its inadequate treatment of the petroleum sector (Peskin with Lutz 1990:11). El Serafy maintains that for the depletion (or liquidation) of non-renewable resources, a "user-cost" approach to separating proceeds into a capital and an income component comes closer to measuring true income (which is by definition sustainable) than the depreciation approach (El Serafy 1989:12-3). Given that the adjustments to GDP made by Repetto *et al.* are dominated by those for the petroleum sector (see Table 2), El Serafy maintains that the Repetto *et al.* study cannot be seen as providing an indication of the potential magnitude of such adjustments, if properly effected (letter from S. El Serafy to Y.J. Ahmad, 28/Dec/90).

It is worthwhile making note of the similarity between the Norwegian ERA system and the approach of Repetto *et al.* Both approaches are based upon physical stock and flow accounts of individual resources. Whereas the Repetto *et al.* approach concentrated on valuation of these stocks, the Norwegian system focuses on recording the sectoral use made of resources. The United Nations Statistical Office's draft *Handbook* is the first approach to combine these two features, although planned elements of the French system could conceivably incorporate both of them.

The World Resources Institute has recently been involved in further studies undertaken in Costa Rica (in collaboration with the Tropical Science Centre) and in China. The former is particularly interesting since it reportedly represents a significant methodological and empirical advance in ERA (letter from R. Repetto to H. Abaza, 29/Aug/91). The Costa Rican study, which covers forests, fisheries and soil degradation, is due to be published shortly by the World Resources Institute.

The Netherlands (Category 4)

The system of environmental statistics of the Netherlands focuses primarily on the economic problems caused by pollution. Recently, the Dutch Government has been studying the feasibility of implementing an ERA system based on an approach originally developed by Hueting (1980; Peskin with Lutz 1990:A-I-15).

In Hueting's approach, the losses of function of environmental resources (or mediums, such as water, air and land), due to competition between the various uses of these resources, are identified. Collection of the relevant physical statistics was begun quite a few years ago; however, linkage with the SNA has recently been initiated. Hueting's approach proposes adjusting GNP by deducting the costs

of measures required to reduce environmental damages to a "sustainable" level.⁶ These measures include both technical cleanup procedures and reductions or changes in economic activity (Peskin with Lutz 1990:4).

SNA Satellite System for Integrated Environmental and Economic Accounting (SEEA) of the United Nations Statistical Office (Category 4)

As noted in Section 2, the Statistical Office of the United Nations Secretariat has been working on a system of satellite accounts to the SNA and is currently finalizing the *SNA Handbook on Integrated Environmental and Economic Accounting* (United Nations 1990). In addition to expanding on the previous framework on monetary accounting (Bartelmus *et al.* 1989), the *Handbook* devotes considerable attention to the issues of physical accounting.

The approach, known as the Satellite System for Integrated Environmental and Economic Accounting (SEEA), is closely linked to the SNA:

Information needed for environmental analysis is presented in the SEEA separately but together with the relevant SNA aggregates. In this manner, original (unadjusted) SNA data can be directly compared with environmentally adjusted statistics and indicators, facilitating the linkage with the central framework of the SNA. Such linkage of SEEA with SNA aggregates aims at better interaction of the analysis of environmental concerns with the established economic analysis (United Nations 1991b:13).

Due to the impossibility, with the present state of knowledge on the subject, of portraying the dynamics of the natural environment, the draft *Handbook* claims that the "complete integration of existing environmental and economic data systems therefore seems to be impossible at this moment" (United Nations 1990:35).

The following are the main features of the SEEA (United Nations 1991b:13-14):

- Segregation and elaboration of all environment-related flows and stocks of assets of traditional accounts;
- Linkage of physical resource accounting with environmental accounting and balance sheets;
- Assessment of environmental costs and benefits;
- Accounting for the maintenance of tangible wealth;

6. Sustainability will be defined primarily on ecological grounds as opposed to being determined by economic criteria (Peskin with Lutz 1990:A-I-17).

- Elaboration and measurement of indicators of environmentally adjusted [national] product and income.

The SEEA envisages accounts in both physical and monetary terms. The summary presentation of the monetary accounts is presented in Figure 2. The SEEA stresses the indispensability of physical information on environment-economy linkages (*ibid.*:18); however, the approach does not aim at a comprehensive description of the impacts of the activities of production and consumption on the environment. Rather the physical accounts use elements of physical natural resource accounting, materials/energy balances and input-output compilation, linking these with the monetary flows and assets of the SEEA to focus on the "economic use of the environment" (United Nations 1990:76). Thus the physical accounts do not constitute a complete set of physical resource accounts (such as France's ERA system). Rather they consist of stock and flow accounts for important products, natural resources and residuals. The asset accounts in physical terms comprise both economically produced and non-produced (natural) assets. The framework for physical accounts is depicted in Figure 3.

An important characteristic of the SEEA is its flexibility with respect to alternative approaches to ERA (United Nations 1991b:15). This feature will allow the SEEA to make use of information that may be generated by separate ERA efforts such as physical resource accounting at a sector or regional level for example. In this sense, the architects of the SEEA realized that various approaches to ERA often overlap and that information from one system will often be able to feed into other systems.

The SEEA was discussed at the Special IARIW Session on Environmental Accounting, held in 1991. The Session confirmed the feasibility of integrated environmental accounting and recommended that it be implemented on a step-by-step basis with the initial focus being on the depletion of natural capital stocks (letter from P. Bartelmus to H. Abaza, 25/Sept/91). A pilot project to test the SEEA framework was undertaken in Papua New Guinea in January 1991. It was found that "environmental accounting is not only feasible but provides, even in tentative form, an invaluable information base for integrated development planning and policy formulation" (United Nations 1991b:12). In addition, the SEEA framework has been tested in a World Bank pilot project in Mexico. The results of both these case studies should be published by early 1992.

Peskin (Category 4)

The approach developed by Peskin (1989a), based on neo-classical economic theory, treats the environment as another productive sector of the economy, in addition to the three conventional sectoring groups--industries, Governments and households. In one sense, the approach is similar to that of Hueting (1980; see

Figure 2: United Nations Statistical Office's SEEA--Summary Presentation

produced		non-prod. natural assets
except natural	natural (biota)	
991.3	83.1	1744.4

OPENING STOCKS (MARKET VALUATION)

Use/Value Added (Table 4.2)	Total	Final Consumption		Capital accumulation			Rest of the world	
		households	government	produced assets		non-produced natural assets	exports/imports	flow of stocks
				except natural	natural (biota)			
Use of products	591.9	175.0	-42.5	68.0	1.4	-7.3	73.7	
Gross Domestic Product (GDP)		233.4						
Consumption of fixed capital		26.3		-23.0	-3.3			
Net domestic product (NDP)		267.1						
Use of natural assets	-1.6	59.8	-5.0	5.1	-0.9	-73.0		-4.7
Environmental adjustment of final demand		22.2		-5.1				
Environmentally adjusted Net Domestic Product (EDP)		185.1						
+ (plus)								
SUPPLY/ORIGIN (Table 4.1)								
Supply of products	691.9	517.4					74.5	
Origin of residual	-1.6							-1.6

+ (plus)		= (equals)	
-25.3	0.9	81.2	
138.1	12.6	22.8	
		382.8	
1149.1	93.8	2165.5	

Adjustment of natural assets accumulation to market valuation
 Other volume changes (market valuation)
 Revaluation due to market price changes

CLOSING STOCKS (MARKET VALUATION)

Source: United Nations (1991b:16).

Figure 3: United Nations Statistical Office's SEEA--
Framework for Physical Accounts

	(1) Production activities (industries)		(2) Final consumption, stocks of consumer and military durables		(3) Domestic assets				(4) Rest of the world	
	env. protection activi.	other	households	government	(3.1) Economically produced assets			(3.2) Non-produced natural assets	economic activities	non-produced natural assets
					env. protection activi.	other prod. purposes	produced biota			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. OPENING STOCKS			X	X	X	X	X	X		
+2. USE/DESTINATION										
2.1 Use of products	X	X	X	X	X	X	X		X	
2.2 Destination of non-produced nat. res.	X	X	X					X		
2.3 Destination of residuals of ec. act.	X				X			X		X
-3. SUPPLY/ORIGIN										
3.1 Supply of products	X	X			X	X	X		X	
3.2 Origin of natural resources								X		X
3.3 Origin of residuals of ec. activities	X	X	X	X	X	X	X		X	
=4. OTHER VOLUME CHANG.										
=4.1 New finds, etc.								X		
=4.2 Changes due to natural and multiple causes (incl. disasters, wars etc.)					X	X	X	X		
=5. CLOSING STOCKS			X	X	X	X	X	X		

Source: United Nations (1990:78a).

section on the Netherlands). Both approaches consider the environment as providing various services or functions. When competing uses of the environment for these services rise beyond a certain level, a welfare loss, or "loss of function" occurs. Both the Peskin and Hueting approaches attempt to measure the benefit enjoyed by a user of an environmental service by estimating the costs that the user would incur were they forced to not make such use of the environment or to reduce their use to a certain level (Peskin 1991:183).

Thus, as well as accounting for economic depreciation of environmental assets and natural resources, the benefits from using environment services (as well as the disbenefits usually sustained by other users of the same environmental resource) are valued using conventional direct and indirect valuation procedures arising from the economic literature on valuing the environment. Peskin's approach may be viewed as a type of satellite accounting approach that leaves the original entries and aggregates of the SNA intact but supplements them with further entries. The framework was partially implemented using U.S. data for the years 1972 and 1978 (Peskin 1989a).

Aside from the criticism that Peskin treats all environmental degradation as depreciation (raised by S. El Serafy in a letter to Y.J. Ahmad, 28/12/90), Peskin's approach would also require extensive data and survey requirements. As Peskin admits, the use of these techniques may not be appropriate or feasible in many developing countries (Peskin 1989b:63).

Other Industrial Country Experience

In the **United States**, official ERA efforts in the past focussed on the identification and collection of data on pollution abatement expenditures (Category 1). Recently, the Bureau of Economic Analysis (BEA), the agency responsible for the national accounts, has begun to develop satellite accounts for selected natural resources (oil and gas and timber) taken as case studies. This work is part of a larger effort to modernize and extend the national accounts to be more in line with the United Nations System of National Accounts. These accounts will record the stocks of natural resources and the using up and the additions to those stocks thus placing it within Category 4. In developing and implementing this framework, BEA will confront such general conceptual issues as : (1) what valuation measures are consistent with other parts of the accounts; (2) should the using up of natural resources be fashioned after the treatments accorded fixed capital or inventories; and (3) whether discoveries or other increases in stocks of natural resources be recorded, and if so, how? (United States Department of Commerce, Bureau of Economic Analysis). Also, the U.S. Environment protection Agency (EPA) has undertaken a pilot project involving the construction of a set of accounts for the Chesapeake Bay Region using Peskin's approach (Peskin 1991:189)

Canada is reportedly initiating a programme on ERA including the construction of satellite accounts although the exact form of these accounts has yet to be determined. Initial indications are that the approach will focus on expenditures on pollution abatement and control and data on the stocks and flows of environmental resources (thus placing it within Category 4). It is anticipated that these stocks and flows will also be valued in monetary terms to construct a satellite National Balance Sheet (Peskin with Lutz 1990:A-I-4-6).

Finland is developing a set of resource accounts to cover forests, energy and land use. The approach, which may be classified within Category 2, is based primarily on the Norwegian system, the main idea being to develop physical accounts on natural resource stocks and flows using the principles of materials/energy balances and input-output techniques (Muukkonen 1990:62-69).

Other countries which have not initiated the construction of the accounts are considering doing so. The Government of **Sweden** established a Commission for Environmental Accounting in 1990 to investigate the possibilities for establishing an ERA system. The Commission has recommended the establishment of energy accounts along the lines of the Norwegian system and the formulation of information (presumably in monetary terms) on the linkages between the environment and the economy (Statistics Sweden 1991). The **Australian** Bureau of Statistics is interested in satellite accounting but is reportedly waiting for further recommendations from the United Nations (Peskin with Lutz 1990:3, A-I-1). In addition, the Federal Statistical Office of **Germany** is considering the development of a set of satellite accounts but it appears as though the approach has not yet been determined (*ibid.*:5).

The **Statistical Office of the European Community** has begun work on the European System for the Collection of Economic Information on the Environment (SERIEE). The primary aim of the system is to provide detailed information, in both physical and monetary terms, on the internal expenditure on the management and protection of the environment (thus placing the approach within Category 1). It is envisaged that such accounts could eventually be linked to information on the use of natural resources and resource accounts (Statistical Office of the European Communities 1991).

Other Developing Country Studies

Gilbert (1990) has undertaken a case study of Botswana using a system that provides a flexible approach to organizing data on natural resources and the environment, and the links to economic activity. As stated by Gilbert, ERA is viewed as "a methodology for presenting environmental, resource and economic information. Its aim parallels and extends that of national income accounting" (Gilbert 1990:307).

The approach is derived from an ERA framework developed within "a larger modelling and information system" which is elaborated in Gilbert and Hafkamp (1986). These accounts aim to assist economic and environmental management "in a multi-objective and multi-disciplinary context." Thus, the framework maintains a flexibility that allows the designer and/or the user to identify possible links between variables and to ensure that the evolution of the accounts remains issue and use-driven (Gilbert and Hafkamp 1986:10, 24).

In terms of Peskin's classification system, Gilbert's framework best fits within Category 2 as an example of physical resource accounting. However, as with the French approach, Gilbert's framework could be designed to include information usually covered by Category 1 approaches. In addition, physical stock and flow accounts could then be valued and further links with the SNA established, as is done by Repetto *et al.*, and as could be done with the Norwegian system.

The framework (depicted in Figure 4) consists of three sets of accounts. Stock accounts describe the quantity and quality of natural resource stocks in physical units. Resource user accounts describe "the use of these stocks within the economic-environmental interface" in both physical and monetary units. Finally, the Socio-economic accounts provide more detailed information on demographics, environmental policy, and the use of resources (Gilbert 1990:308-13).

Gilbert achieved a partial implementation of the framework using some data for Botswana. Unfortunately, the existing data was not very extensive, and thus, the accounts constructed are not yet of much practical use. Gilbert admits as much and states that "further development of the accounts with access to more data and in cooperation with Government authorities is needed to further expand the accounting structure and permit a more thorough evaluation" (Gilbert 1990:327).

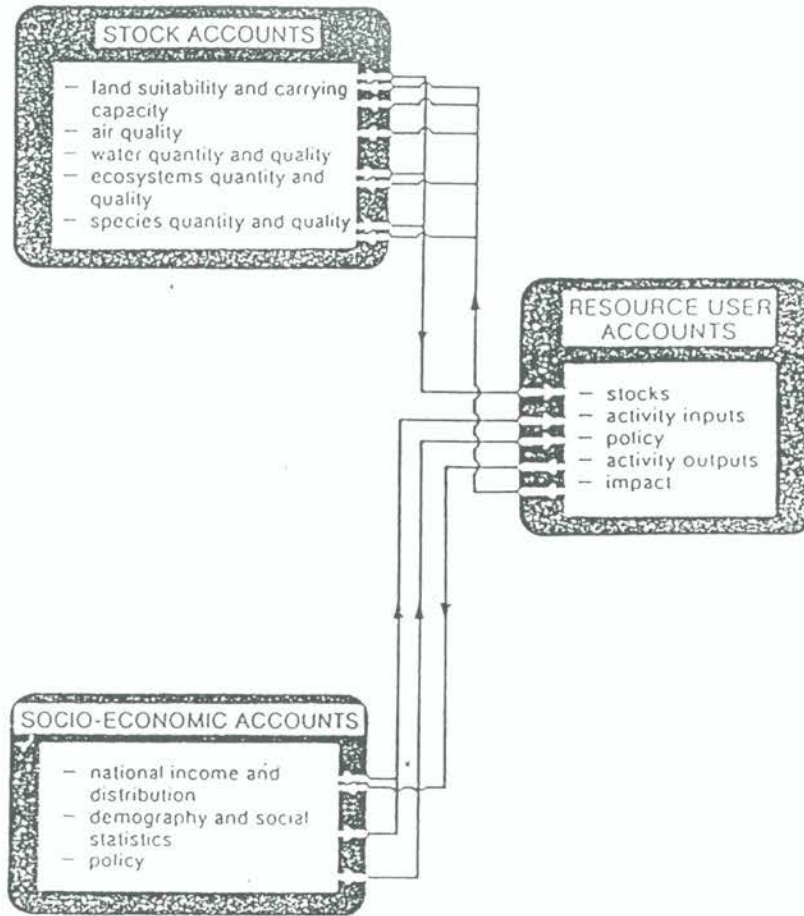
The UN Economic Commission for Latin America and the Caribbean (ECLAC) and UNEP have been investigating the use of natural patrimony accounting for Latin America and the Caribbean. A regional seminar on resource accounting held in March 1990 concluded that methodologies should be adapted to specific cases. The seminar was also presented with two case studies in ERA--one carried out in Argentina and the other, in Mexico. The results, summarized below, are presented in CEPAL (1991). These case studies are examples of applications of ERA to limited areas with interesting and valuable environmental features, as opposed to an entire country.

The **Argentina** study (Sejenovich *et al.* 1991) examined a forest area with one aim being to value all the uses provided by the forest ecosystem and its resources to humans including, among others, timber, fauna, preservation of biodiversity, tourist and recreational services. Valuation was undertaken by estimating the costs of

improving productive functions and of maintaining ecosystem functions. The value of the existing forest was then used to model alternative management and exploitation scenarios.

The **Mexico** study (Carabias *et al.* 1991) examined a "biological corridor" recently declared a protected area. The study calculated adjustments to the gross product of this region for the environmental costs of using the resources for agriculture and forestry (using market valuation of replacement cost) and constructed physical balance sheets for individual resources. The study also carried out projections on future use of the area's resources. The accounts are intended to support the planning process partly by providing a revised measure of the region's income according to the Hicksian concept of income.

Figure 4: Structure of Gilbert and Hafkamp's (1986) Resource Accounts



Source: Gilbert (1990:309).

4. CONCLUSIONS BASED ON EXISTING SITUATION AND EXPERIENCE

1. For developing countries in particular, ERA provides a useful tool for sustainable development. These countries are typically highly dependent on their natural resource base for meeting their own needs as well as for financing development through exports of raw materials. In order to be able to plan their development according to the limits set by their resources, developing countries need to have some system for tracking the changing stocks of natural resources, particularly those that are crucial for development. If countries are using renewable resources in an unsustainable manner, they should have some indication of this as well as some indication as to what a sustainable use for those resources would be. If countries are depleting their stocks of non-renewable resources, there is an even greater need for these countries to have some indication as to how long their stocks are expected to last and what portion of their income is derived from the liquidation of those capital stocks in order to enable them to determine their future development alternatives/options. ERA can provide this information which can be of use in formulating development plans, in evaluating development projects which involve exploiting the resource base of the economy, and in determining whether economic growth and the development path are sustainable.

2. If sustainable development and sustainable use of the resource base is not considered to be a Government objective (possibly for political reasons) or an objective of society, then the need for ERA becomes less clear. The need for ERA follows specifically from adopting sustainability as an objective and a recognition that sustainability implies that natural resources need to be carefully managed to provide options for future generations. It could also be argued from a narrower perspective that the information provided by ERA will assist in a more efficient functioning of markets for resource use, and that without such basic information, markets cannot be expected to determine the optimal allocation of natural resources.

3. If ERA is such a useful tool, it may fairly be asked why haven't more countries, both developed and developing, implemented ERA programmes. It seems that there are a variety of factors to which this may be attributed (apart from the political reason elaborated in paragraph 2. above):

- As the case of Australia would seem to illustrate, some countries may want to wait for an **internationally recognized approach** to ERA as opposed to choosing between existing frameworks or devising their own. Uncertainty concerning the "most appropriate framework" may have inhibited Governments from establishing ERA programmes. From the point of view of developing countries, it is

understandable that they should want to wait until they are clearly presented with standardized options for ERA;⁷

- Many countries, particularly in the developing world, may also be **unaware of the need** for ERA and lack basic information about its usefulness;
- There is very little **information** available on the requirements for implementing ERA in terms of financial, technical and human resources;
- ERA may often be expensive for developing countries to implement and thus, to do so, many countries will need **financial assistance**;
- Many developing countries lack the necessary **professional staff** to implement ERA.

4. Evaluating different approaches adopted to date in various industrial countries is made difficult, and in some cases irrelevant, by the fact that different approaches vary in their objectives. As previously mentioned, ERA may seek to address either one or both of the deficiencies in the SNA with respect to the environment through the provision of improved measures of economic and social performance and the provision of an improved database on environment-economy interactions (Peskin with Lutz 1990). In addition, many approaches have not been completely implemented and therefore, it is difficult to determine at this point how well they may eventually fulfill their stated objectives. Consequently, this also makes it hard to establish their effect on policy formulation.

5. Peskin's review of existing experience concludes that the data requirements and subject matter of the different approaches are quite similar (Peskin with Lutz 1990:22). There are essentially only two broad areas in terms of coverage: environmental degradation/pollution and resource depletion and degradation, with some approaches combining coverage of both. Thus, once it is decided which areas will be the subject of a system of ERA, the underlying physical data may be assembled. The formal structure of the accounts themselves may evolve overtime. However, "extensive debate over the relative merits of each approach, as a prerequisite to implementation, may be unnecessary or even counterproductive" (Peskin with Lutz 1990:22).

7. It is intended that the SEEA (which is soon to be published in the SNA Handbook Series) will provide an international standard and model for countries to use. A particularly attractive feature of the SEEA is its flexibility in terms of being able to accommodate information from various other approaches dealing with diverse areas of concern. In pilot studies, it appears that the SEEA has so far proved feasible and useful in the context of developing countries.

6. The relevance for developing countries of experience in industrialized countries is conditioned by the fact that many of the industrialized country systems focus on accounting for environmental pollution--its physical manifestations and its associated costs. It is likely however that ERA in developing countries will usually focus primarily on the depletion of natural assets since developing countries tend to be highly dependent upon their natural resource base for development. (Some industrialized countries do however have systems which monitor resource stocks and flows.)

7. At this point in time, the techniques of physical accounting for natural resource depletion and degradation are in a process of ongoing development and refinement. Methodologies for accounting for all of the functions provided by natural systems are not yet complete. Indeed, this is not surprising, given the complexity of natural systems and the lack of knowledge concerning their dynamics. Most of the experience that has been accumulated lies in the area of recording stocks and flows of resources such as minerals or forests as marketable inputs to production. Less work has been done in accounting for the degradation of natural cycling systems (where France has arguably done the most) or in accounting for other functions provided by resources such as forests. As further experience is accumulated, these techniques will be further developed and extended. It should however be emphasized that the existing state of techniques in ERA can provide a useful tool for sustainable development.

5. RECOMMENDATIONS FOR FUTURE ACTION

1. Though techniques for the application of ERA will continue to undergo further development and refinement, this could not be used as an argument against the immediate use and application of ERA. At the moment, ERA can provide a useful instrument for assisting countries to achieve sustainable development. Moreover, the application of ERA should be regarded as part of a continuous process of developing these techniques.

2. A methodology for determining and prioritizing the information needs to be addressed by an ERA system should be developed since some countries will require assistance in determining their ERA needs. The approach(es) to ERA adopted should depend on the natural resources to be accounted for and the particular information needs. Thus, the first step in such a methodology should be to identify for which environmental assets⁸ information is required. A set of conditions for identifying "vital" assets has been proposed by Gilbert *et al.* (1990:13); an asset which satisfies any one of the following conditions may be considered a vital asset:

- the asset is an important source of income;
- the asset is an important source of subsistence, direct employment or income opportunities;
- other industries are dependent on inputs or services from this asset;
- there are minimal opportunities for substitution; and
- degradation of the asset leads to unacceptable effects on human safety, health and/or non-material welfare.

While the latter two conditions are more qualitative, the first three are potentially quantitative (although this has not yet been done). The second step in determining the information needs should be to determine what information is required about the vital assets. This two step process will assist in ensuring that ERA systems meet the actual and most important needs and do not result in the generation and compilation of unused statistics--a luxury developing countries can barely afford;

3. With much recent work having concentrated on the SEEA approach developed by the United Nations Statistical Office, serious consideration should be given to the possibility of using the *SEEA Handbook* as a standard approach to ERA, in the form of satellite accounting to the SNA. It should be emphasized however that this would not exclude the use of other approaches to provide specific information not incorporated in the SEEA.

8. Environmental assets comprise individual resources, as well as abiotic flow assets (e.g. solar, tide and wind energy), abiotic cycling systems (e.g. biogeochemical cycling systems such as water systems) and complex assets such as ecosystems and soil. ERA need not therefore be limited to "individual" resources such as trees or minerals. A system for classifying environmental assets is to be found in Gilbert *et al.* 1990.

4. Guidelines for implementing ERA in developing countries should be formulated, concentrating on the following issues:

- (a) The promotion and development of awareness among developing countries on the need for ERA;
- (b) The identification of financial, human and technical resources, including data systems, required for ERA;
- (c) The identification of institutional arrangements most suitable for the application of ERA;
- (d) The formulation of modalities for the integration of ERA into the planning process; and
- (e) The identification and development of funding arrangements required to introduce ERA in developing countries.

5. The techniques of physical resource accounting and valuation need to be further developed with particular emphasis placed on the methodologies of accounting for the various services that are provided by environmental assets. Much work is required in accounting for the services that are not provided through market mechanisms. As mentioned in paragraph 1 above, this is an ongoing exercise that should be undertaken parallel to, and in conjunction with, the implementation of ERA.

6. A central focal point for information on ERA should be established where detailed information on past and ongoing experience in ERA is maintained. A major function of this focal point would be to provide information and documentation on ERA on request. Such a focal point could even publish a manual detailing techniques in ERA (particularly with regard to physical accounting and valuation). This manual would be constantly updated based on the results of ongoing application and research.

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