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ENVIRONMENTAL ACCOUNTING
A Review of the Current Debate

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ENVIRONMENTAL ACCOUNTING
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Preface

This collection of papers has been put together to provide interested readers with a range of views about the role of environmental accounting in a relatively short, easy-to-read document. The importance that this topic has assumed in the last few years means that public interest is substantial. Unfortunately it also means that the state of thinking and knowledge about the topic is changing fast. Even as this collection goes to press, we know that ideas are changing, and empirical work is proceeding. Nevertheless, one has to take stock from time to time, and the papers in this monograph are as good as can be assembled at this stage.

All the papers are drawn from longer papers, which have been published elsewhere. The summaries presented here were sent to UNEP by the authors for the express purpose of putting together this short monograph.

I would divide the papers into those that raise conceptual issues, those that discuss the "nitty-gritty" methodological problems of preparing environmental accounts, and those that report on recent empirical work in preparing such accounts.

In the first category, of conceptual issues are the papers by Friend - "Towards a Pluralistic Approach in National Accounting" - and that by Norgaard - "Sustainability and the Economics of Assuring Assets for Future Generations." Friend discusses the background to income accounting as a measure of economic welfare, and the failures in trying to measure the latter by the former. Environmental issues are among those failures. Friend concludes that a pluralistic or multi-dimensional approach is required, with environmental accounts prepared in physical terms but 'integrated' with monetary accounts. A full-fledged monetary set of accounts for the environment are, he believes, not possible given the data and valuation problems. The paper by Norgaard does not deal with environmental accounting as such, but raises issues of sustainability, and intergenerational welfare. He argues that the challenge of sustainability is more one of the distribution of assets rather than of efficiency in the way in which they are allocated over time. Since accounting for the environment is typically going to concentrate on efficiency aspects, it would not, in his view serve the goal of sustainability in its fullest sense.

In the second category of papers on the methodology of preparing environmental accounts are: Markandya and Perrings (Accounting for an Ecologically Sustainable Development: A summary), and Hueting , Bosch and De Boer (Methodology for the Calculation of Sustainable National Income). Markandya and Perrings take the reader through the debates on valuation that have arisen, indicating the thinking

of various groups as well as their own preferences. It should be noted that the views they ascribe to the UNSTAT exercise in environmental accounting may no longer all hold, as the latter themselves have been under modification. This applies particularly to the treatment of defensive expenditures, where the United Nations Handbook do not recommend deductions for defensive expenditures. The other paper by Hueting *et al.* outlines the methodology proposed in the Netherlands for the calculation of sustainable income, and provides the theoretical basis for it.

In the third category are papers dealing with empirical issues. Suparmoko (Problems and Methods of Natural Resource and Environmental Accounting: The Indonesian Case) looks at the Indonesian experience, which was spurred by the World Resources Institute study on environmental accounting in Indonesia. Dijkerman (Environmental Statistics at the Netherlands Central Bureau of Statistics) reports on progress in that country. Bartelmus (Environmental Statistics and Accounting) discusses the framework for the preparation of environmental statistics as well as for a consistent system of integrated environmental and economic accounting as proposed by the United Nations. Hecht and Peskin (Natural Resource Accounting in the Developing World: A Neoclassical Approach: A Summary) provides a review of the principles of environmental accounting as well as a discussion of how it might be applied in the developing world and the experience of applying it in the Philippines. Finally Friend (Feasibility of Environmental and Resource Accounting in Developing Countries) addresses similar problems. He argues that the need for environmental accounting in developing countries is even higher than in developed ones. With assistance from experts in the field, a set of physical accounts can be prepared to provide a complementary tool for policy purposes to that provided by monetary national income accounts.

Since this set of papers were prepared, more empirical work has been carried out. Accounts have been prepared for Papua New Guinea and Mexico; and some accounts have been put together for Costa Rica, India and the Philippines. This is a growing activity but it is still necessary to explain the issues and objectives of environmental accounting. This set of papers should help.

A. Markandya
Harvard, 1993.

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Chapter I

ACCOUNTING FOR AN ECOLOGICALLY SUSTAINABLE DEVELOPMENT: A SUMMARY[1]

Anil Markandya and Charles Perrings

Environmental accounting is motivated by a desire to bring environmental issues to the center of the development debate. In pursuit of the goal of sustainable development, economic growth and environmental protection are to be seen, at least in part, as complementary activities, rather than as alternatives. However, until recently, the environmental costs of economic activities were largely ignored, or at best evaluated in an ad hoc fashion. Environmental accounting tries to monitor the environmental impacts and to develop a set of indicators of those impacts in an integrated fashion so that policy makers are better informed about environmental issues.

If one is to construct environmental indicators, one needs reliable information on the physical changes that are taking place in the environment. Such information can be processed in itself, to yield what have been referred to as physical indicators, or can be combined with valuation data, to yield monetary indicators. As far as physical indicators are concerned, environmental managers have, in the past, relied heavily on biophysical indicators. More recently, however, attention has been shifting to measures of system integrity rather than species population as indicators of ecological sustainability. Where population data are used, attention is focused on the number of species in an ecosystem and their relative size and distribution. Increasingly, attention is focused on indicators of system stress and ecological stability. These are reviewed in the main paper from which this summary is drawn.

The paper reviews different methods by which the environmental changes facing a society may be measured. It discusses why economic values, as conventionally measured, using market prices, are inadequate indicators of environmental impacts. The institutional and economic context in which such prices are determined is simply inadequate to pick up the environmental features of interest. The reasons for this are basically five:

1. The lack of properly defined markets in the relevant areas;

2. Uncertainty regarding future demands and future supplies of key natural resources;

3. The way in which societies make decisions of present versus future consumption;

4. Government interventions in markets, undertaken for other often justifiable motives, resulting in prices that are not as conducive to natural resource conservation as they should be; and

5. Incomplete information on the external effects of economic activity.

In this context, the environment is likely to receive less attention than would be desirable from a social point of view. This can be corrected by taking more explicit account of such factors. The paper proposes three areas of policy. First, it discusses the role of discounting on resource use and conservation. Broadly speaking, the current rates of discount are not consistent with devoting resources to protecting and augmenting resources with long gestation periods. In addition, they result in a higher rate of exploitation of exhaustible resources than perhaps is warranted. However, changing these rates is difficult, if not impossible, in practice. The alternative of using lower rates for "environmental" projects is equally impractical. Consequently, it is recommended that where key environmental features are at risk from economic change, a sustainability indicator be used to protect them.

The paper also reviews the use of monetary values of environmental assets and flows from those assets, based on techniques that exploit the connection between such goods and others for which values exist. This area of benefit estimation is now developed to a considerable extent and can be effective in providing useful indicators of the economic value of the environment. Not all the important services can be valued, and the techniques have their shortcomings but, by and large, most of the key services can be valued to an order of magnitude, given the use of the appropriate technique in the right way.

Where economic values are uncertain and inadequate, and even where they are not, those concerned with environmental management have relied to a great extent on biophysical indicators. In this regard, attention is increasingly shifting to measures of system integrity rather than species population as an indicator of ecological sustainability. Where population data are used, attention is focused on the number of species in an ecosystem and their relative size and distribution. Increasingly, attention is focused on indicators of system stress and ecological stability, such as those listed above.

The indicators of economic and physical changes need to be incorporated into a systematic set of accounts. On the physical side this has been attempted in

Norway and France, and is being undertaken or considered in Canada and a number of other countries. The main value of physical indicators is to "flag" areas where serious environmental damage is likely, and to indicate the inter-sectoral impacts of changes in economic activity or environmental protection. Although there are important indicators that help in this regard, the overall construction of physical accounts has not been as fruitful in this regard as the expense and intellectual efforts involved might suggest. Of course, physical data will be needed in any accounting exercise, but the construction of physical accounts along the lines carried out so far have not proved to be that useful. Chapter 4 of the main paper indicates how such accounts might be used in the agricultural sector, and in Chapter 5, the physical accounts for Botswana are used to draw some policy conclusions as well.

On the monetary side, the paper reviews the issues extensively. Given that market prices tend to be very poor indicators of the ecological sustainability of economic activity, it follows that accounts reporting economic aggregates based on market prices will be similarly deficient, even if there are no problems with the accounting conventions applied. At present, the system of accounts applied in most countries suffers from both sources of bias. Not only do the market prices underlying the economic aggregates ignore sometimes massive environmental externalities, but the accounting conventions applied ensure that no direct account is taken of changes in environmental assets as a result of economic activity. All attempts to revise national accounts to take proper cognizance of environmental effects have been resisted, and the best that advocates of environmentally-complete accounts have been able to achieve is acceptance, in principle, of supplementary or satellite accounts. A set of guidelines for the preparation of such accounts by the United Nations Statistical Office (UNSTAT) has been prepared (cf. UNSTAT, 1990). The key issues raised in developing these guidelines (many of which incidentally are still not resolved) are discussed below.

It is worth emphasizing again that the existing accounts are, in many cases, highly misleading, and that reliance on those accounts for macroeconomic policy purposes may positively endanger the ecological sustainability of economic activity. In the following paragraphs the specific failures of the dominant accounting system (the United Nations System of National Accounts (SNA)) are reported. This is followed by a discussion of the measures proposed to remedy these failures, and of measures being taken independently to provide alternative sources of information for policy makers.

Income, in the sense of Lindahl and Hicks, represents the maximum level of consumption consistent with the preservation of an asset base. In this sense, it represents a sustainable stream of benefits. Yet the measures of value added plus

depreciation of stocks in existing national income accounts are simply inconsistent with this concept of income (Daly, 1989; El Serafy, El Serafy and Lutz, 1989). This is largely due to the way in which environmental assets and expenditures are treated in the accounts.

There are two sources of difficulty in the SNA. The first is the non-imputation of the value of environmental goods and services (Peskin, 1981; Hueting, 1987; Leipert, 1987; Repetto, 1988; Daly, 1988). While SNA makes provision for imputing values for certain non-marketed goods or services, such as the flow of benefits from owner-occupied houses, it makes no provision for imputing values for environmental goods and services. The second source of difficulty is the absence of any allowance for the depreciation, depletion or degradation of environmental assets (Daly, 1989; Harrison, 1989, El Serafy, 1989; El Serafy and Lutz, 1989).

Defensive Expenditures

When faced with environmental degradation and pollution, economic agents undertake various expenditures to reduce or mitigate the impacts of these phenomena. Such expenditures are referred to as defensive expenditures and can be undertaken by firms, by the government and by private households. When undertaken by firms they represent costs of production, and any purchases related to them are treated as intermediate expenditures. Since gross domestic product (GDP) is the value of all final goods and services produced in an economy, such expenditures will not be reflected in that GDP. On the other hand, similar expenditures by households would be counted in GDP, as they are part of final consumption. As far as expenditures by government are concerned, defensive expenditures undertaken by public enterprises, where a user charge is levied, are treated as intermediate inputs, and expenditures funded out of general taxation are treated as final output, which is measured as the total value of inputs. Thus, for example, a water treatment plant operated by the public sector could add to GDP, but one operated by a private firm would not, and individual households purchasing water filters would add to GDP.[2]

Difficulties arise from the asymmetric treatment of these items according to the economic entity which undertakes them, as well as from what is taken as the point of reference. Clearly there is something unsatisfactory about the former - why should the measure of GDP depend on which sector undertakes the expenditure? If an adjustment is to be made, however, which way should it be made? One could argue that if the preventive expenditure is incurred and pollution of the natural capital stock protected, welfare is higher than if it is not. In that event, not incurring the expenditure should result in lower GDP. If one followed this line of

reasoning then one would include all defensive expenditures in GDP. In any comparison between two countries, one of which did undertake the preventive expenditure and one of which did not, it would then not be necessary to take account of the impact of the defensive expenditure on the services from the natural environment, or on the natural capital stock. The other approach is to exclude defensive expenditures from GDP, but to make the adjustments in terms of the services that the expenditures provide including those of protecting the natural capital stock, which would affect net income.

In the recent proposals for the UNSTAT satellite accounts (UNSTAT, 1990), it is tentatively suggested that all defensive expenditures be excluded from the final GDP. It is recognized that doing so entails many problems, especially for the household sector where the definition of defensive expenditure is, at best, elusive. Nevertheless the proposal is made that, using input-output analysis, it is possible to identify the value added of defensive expenditures as a component of final demand and then to exclude them. Two categories of defensive expenditure are identified: those that are part of environmental protection services, such as water purification, double glazing etc; and those that are incurred as a result of damage suffered, notably health expenditures. The latter category may, however, conflict with the estimation of pollution damage (see below), in which case care would have to be taken not to double count.

Pollution Damages

The environment provides services to households, firms and government, and when that environment is degraded, the value of these services is diminished. The services are in the form of clean air and water, the ecological functions of natural resources such as forests and wetlands, and the productivity of the land. An economy where few attempts are made to limit the damage resulting from economic activity will generate a smaller value of such services than one where more attempts are made, or where the level and composition of economic activity is less environmentally damaging. The correct way to deal with such damages is to deduct them from the value of final demand. This requires, of course that they be valued, which in turn requires that the techniques developed by environmental economists over the last 20 years and described in the main paper, be used effectively. The UNSTAT proposals for environmental accounting suggest that this be attempted, which is consistent with suggesting that defensive expenditures be netted out. The difficulties facing most countries in undertaking such an exercise would be a shortage of primary data and of trained economists able to carry out the valuations. This would be even more serious in developing countries where the scarcity of both is even greater.

Depreciation

It has long been taken as axiomatic that positive rates of economic growth are a necessary (though not a sufficient) condition for economic development, where development implies improvement in some vector of quality-of-life indices. More recently, it has been argued that positive rates of economic growth are a necessary condition for the sustainable management of environmental resources. Yet, due to the nature of the accounting conventions underpinning SNA, the reported rate of change in GDP may bear little relation to real growth in resource-based economies. It is not at all clear from the existing data that positive rates of growth currently recorded in the accounts are what they seem, or that the environmental effects of that growth are as reported. More particularly, it is not possible from the existing national accounts to determine whether an economy is genuinely growing, or is merely "living off its capital" (Daly, 1988; Repetto, 1988). Indeed, it is quite possible that much of what is currently interpreted as economic growth is merely the depletion of "natural capital" in the interests of preserving current consumption.

At present there is a remarkable asymmetry in the treatment of depreciation of produced and environmental assets. Produced assets are positively valued (at a market rate), and are written-off against the value of current output as they depreciate. Environmental assets, on the other hand, are frequently zero-valued, and are not written off against the value of current output as they depreciate, degrade or are otherwise depleted. Consequently, while the sale of environmental assets augments current income, there is no indication that it also involves costs in terms of the future capacity of the economy. A temporary income flow is obtained at the cost of a permanent wealth loss. As El Serafy remarks, this extraordinary property of SNA is only tenable under the assumption that environmental assets are both costless and in limitless supply. But this assumption bears no relation whatsoever to reality (El Serafy, 1989).

The immediate implication of the SNA treatment of environmental assets is that it is possible to generate income by exploiting a contracting resource base. Yet this contradicts the concept of income which supposedly underpins SNA. Moreover, recalling the G7 commitment to economic growth as the key to ecological sustainability, if the economic growth referred to in that commitment is the product of an SNA convention that simply denies the erosion of the national asset base, the commitment is itself a contradiction in terms. This property of SNA accordingly obscures the fact that "income" deriving from the exploitation of exhaustible environmental assets is necessarily transitory. The paper shows that this property turns out to be most significant for low income countries with minimal scope to divert "income" so derived into the acquisition of alternative assets.

There is currently a wide range of proposals to address these sources of difficulties with SNA. However, even though the inclusion of environmental measures was on the agenda of the recent review of SNA, there was little support for the integration of environmental data within a revised SNA at this juncture. Instead, it has been accepted that work will proceed on the development of satellite accounts that may be used in conjunction with SNA.

Reported below are the main proposals for reform of SNA currently being canvassed.

With respect to the treatment of depreciation there are essentially two proposals of interest, deriving from work carried out by the World Bank and the World Resources Institute. The first of these treats environmental assets in exactly the same way as produced assets. That is to say, natural and manufactured capital are regarded as equivalent for accounting purposes, and the same principles of depreciation are applied to both (see, for example, Harrison, 1989). To calculate depreciation, the current value of the depreciated, depleted or degraded part of the resource is offset against current income deriving from the use of the resource. GNP remains unaltered, but Net National Product (NNP) reflects the loss to the environmental asset base caused by current economic activity. For an exhaustible resource, the depreciation would be equal to the net value added - or scarcity rent - derived from the stock.

It has long been observed that treatment of the depreciation of exhaustible resources along these lines dramatically revises the estimates of both NNP and Net National Income (NNI). Take the case of an exhaustible resource with a zero natural rate of growth, and assume costless extraction. Both Gross National Product and Gross National Income include the value of the extracted resource, but since that amount of the resource is lost to the economy in the future, the stock of the resource may be said to be "depreciated" by the same amount. Both NNP and NNI are reduced by the net value of output, which implies that the NNI of extractive activity should be nil (Dasgupta and Heal, 1979). This is not a very satisfying conclusion, since it is clear that economies with access to mineral reserves have a distinct advantage over those which do not, and this advantage would be obscured by the NNI and NNP figures.

What is unsatisfactory about the depreciation of environmental assets on the basis of current SNA treatment of produced assets is that there is no way to record the change in the total asset base due to the conversion of environmental into non-environmental assets. If a consensus has been reached on any point in the debate on sustainable development, it is that sustainability implies the maintenance of a total asset base (environmental and produced) adequate to preserve the

opportunities available to successive generations (World Commission on Environment and Development, 1987; Barbier, 1989; Pearce, Markandya and Barbier, 1989; Pearce and Turner, 1990; Bartelmus, 1990). It would seem to be crucial to develop an accounting system which allows the total asset base to be monitored and valued.

One way to circumvent this difficulty is to concentrate on sustainable income rather than net income. The latter would be the income flow that could be maintained from the total capital base. One approach to the problem of the depreciation, degradation or depletion of the environmental asset base, deriving from the World Bank, represents an attempt to come to grips with this problem (El Serafy, 1989; El Serafy and Lutz, 1989). The method can be explained as follows. Assume there is a finite resource which will be extracted at a given rate over T time periods, at the end of which it will be exhausted. The net income derived from this source can be estimated (assuming future prices are known), and the total flow converted into a single present value, given some rate of discount. However, this income stream will come to an end after T periods, and what one would like to know, is what perpetual income stream one could obtain if one were to invest the present value of the income stream from the exhaustible resource. For simplicity, suppose that the entire resource is being depleted over five years, and each year's depletion has a net value of $100. Given a rate of discount of 5 per cent, this income stream has a present value of $533. With that sum one could obtain a perpetual income stream worth $25 per annum. Hence the El Serafy argument is that $25 be deducted from the income of the resource in calculating the figure that should be used in deriving NNI. Clearly this figure will be higher the closer a resource is to liquidation, and the lower the rate of discount applied.

Implicitly what the method is doing is calculating sustainable income by valuing the resource through the income stream it will generate. However, one may ask whether this method can be implemented effectively, since neither the future depletion nor the future price is known. Also, how would one treat future discoveries? Alternative ways of valuing stocks of a resource (cf. Landefield and Hines, 1985) are: (a) to take the net rent obtained today multiplied by the estimate of the stock; and (b) the market value of the stock itself. For many resources, however, estimates of the market values do not exist. In these circumstances, the UNSTAT has recommended the use of the present value of the future income stream to obtain a value for the stock.

Where sustainable income cannot be measured as suggested by the El Serafy method, the issue of how to treat changes in the price of the resource *in situ* arises. In the case of produced assets, depreciation is calculated after allowing for increases in the value of existing stocks. Thus, if the value of the stock of a

natural resource is increased, should that increase be netted out from the depreciation? The difficulty with doing so is that, for economies heavily dependent on natural resources, there could be large fluctuations in measured NNI, based on price movements of the natural resource stocks. One has only to look at how much annual fluctuation there is in mineral prices to realize that a net income measure for oil producing countries, based on adjusting for changes in the value of the stock would provide little useful information about the present or sustainable levels of welfare for that country.

Various alternatives have been proposed for this problem, and these can be seen in the example in Table I below, which is adapted from Repetto *et al*, 1989. A resource with a stock of 100 units at the beginning of the period is depleted by 15 units but regenerated by 5 units. Hence only 10 units are used up in net terms. At the same time the price rises from $1 per unit to $3 per unit, with an average price of $1.6 over the period. How should one include the activities from these accounts in calculating net national income, assuming that all values are net of any extraction costs? One possibility is to add to income the net change in the value of the stock (i.e. $270). That, after all, is the amount by which net wealth has increased from this source. However, such adjustments could result in massive

TABLE 1 ADJUSTMENTS TO INCOME MEASURES ARISING FROM CHANGES IN THE VALUE OF A NATURAL RESOURCE

	Physical Units	Unit Value	Value
Opening Stock	100	1.00	100
Additions	5	1.60	8
Reductions	-15	1.60	-24
Net Change	-10	1.6	-16
Revaluation: Opening Stock(100x(3-1)) Transactions (10x(3-1.6))			 200 14
Closing Stock	90	3.0	270

annual changes in national income measures that would be a poor indicator of

economic activity, which is often what one is interested in. A second option is to concentrate on resource depletion alone, in which case one would deduct 15 x (1.6) = $24 from gross income ($1.6 being the average price of the resource). A third possibility is to take all resource changes, in which case GNP would be reduced by 10 x (1.6) = $16. No one has really resolved these issues although UNSTAT has suggested that all changes in the value of stocks due to discoveries, price changes and depletion be excluded from the income accounts. In adapting the Indonesian accounts Repetto, *et al* have taken the third of the above approaches - *i.e.* used the net change in the resource multiplied by the average price over the period, but the rationale for this is still not fully worked out.

Depreciation, Defensive Expenditures and Pollution: An Integrated Approach

In some work being undertaken by UNSTAT, which is still in the early stages of development, an attempt is being made to define a framework within which one might correct for changes in the value of natural assets as well as defensive expenditures and any residual pollution. It involves the addition of specific stock accounts to SNA, defining opening and closing balances of produced and environmental assets (Bartelmus, 1990; Bartelmus, Stahmer and van Tongeren, 1989, UNSTAT, 1990). It is suggested that these stock accounts would be linked to the standard flow accounts through accounts of "tangible wealth accumulation." The stock accounts are intended to measure environmental costs comprising both the quantitative depletion of environmental assets and qualitative environmental degradation. Specifically, they include:

1. Renewable biological assets (products which depend on natural growth processes, such as agriculture, forestry and fishing);

2. Scarce renewable resources in the public domain (marine resources, tropical forests etc.);

3. Non-renewable resources (land and mineral deposits); and

4. Cyclical resources (air, water).

The valuation of the depletion or degradation of environmental assets in this approach would depend on whether they are complements or substitutes in economic production. Substitutes would be valued at the replacement cost (the market value of producing the substitute resource). Complements would be valued at the marginal willingness to pay to preserve the resource.

In this approach GDP would be adjusted directly by subtracting: environmental protection services (i.e. defensive expenditures) from final demand; net depletion of tangible assets; net environmental degradation. The cost of depletion of environmental assets and the degradation of ecosystems would be offset by the accumulation of produced assets. The resulting quantity is referred to as Sustainable GDP (SGDP) (Bartelmus, 1990). Sustainable NDP (SNDP) is then SGDP less consumption of fixed capital. That is:

SGDP = S + Ee - (IC + Ce) - (Dr + Dnr + De) + Ue
SNDP = SGDP - CC

where:

S = the total supply of goods and services;
Ee = the supply of environmental services that are not priced;
IC = intermediate consumption of goods and services;
Ce = environmental protection expenditure in final consumption (defensive expenditures);
Dr = the value of produced assets destroyed in natural disasters;
Dnr = the net change in the value of non-renewable assets used in economic activities, resulting both from additions to the environment (an increase) and from depletion and degradation (recorded as a decrease);
De = the decrease in the value of environmental assets from transfers, depletion and degradation due to economic activity. This would include, for example, increases in air pollution, or losses in water and soil quality;
Ue = counterpart value of economic assets affected by disasters (recorded as their "use" by or "export" into the environment);
CC = consumption of fixed capital.

It is important to note two things about such accounts. First if environmental degradation of resources is deducted from gross income, the value of the services provided by those resources should be included in the income in the first place. For marketed goods, such as the sale of minerals, this is not an issue, but for non-marketed items it needs to be done. In the latest UNSTAT proposals, "disposal services" are valued in terms of the restoration costs of the environment destroyed, which is also an estimate of Dnr. In other words, both services and depreciation are set equal to each other. Second, in calculating the total supply of goods and services, account should be taken of reduced services due to environmental damage. This adjustment would be based on the estimated damage as discussed above.

This approach is to be tested in a number of countries, before any attempt is made

to use it as the basis for a set of satellite accounts. Moreover, it should be recognized that the key issues of how the valuation is to be carried out, and the "nitty gritty" questions of which items are included and which are excluded, all of which are at the heart of the problem, have yet to be resolved. As the authors emphasize, the proposed concepts are still tentative, and sustainable income would not replace the existing accounts. Nevertheless, one basic principle does seem to be firmly entrenched at this stage. It is that exploitation of the environment which results in the depletion or degradation of environmental assets and their supporting ecosystems imposes a cost on society and that this should be offset against (produced) capital accumulation, with due allowance made for the substitution possibilities inherent in the system. Moreover, these costs should be registered in GDP, and should not appear as depreciation in the calculation of NDP.

Natural Resource and Patrimonial Accounts: National Experience

In the absence of any immediate sign of change in the national production and income accounts, a number of countries are developing separate satellite accounts covering changes in environmental conditions, usually in physical rather than monetary units. This approach is not inconsistent with the later modification of the national accounts to include monetary values for environmental goods and services, nor does it necessarily lead in that direction. It is partly motivated by caution deriving from the limits to our ability to value environmental goods and services, especially in the developing countries where data are scarce and where there are few well-functioning surrogate markets to provide a basis for the valuation of environmental amenities/disamenities (Pearce and Markandya, 1989a). Although there is considerable faith that the range and accuracy of techniques will improve, there is only limited confidence in the results obtained so far (cf. Dixon *et al*, 1988). The inference that has been drawn from this by many environmental economists is that it may be sensible to move toward the monetarization of the accounts incrementally, by identifying impacts for which monetary valuations may feasibly be determined, and by modifying the valuation of environmental goods and services as estimation techniques improve.

Work on Natural Resource Accounts (NRA) is being undertaken in a number of countries. Both Norway (Longva, 1981; Friend, 1983; Gamasjordet and Saebo, 1986; Alfsen *et al*, 1987; Lone, 1988) and France (Friend, 1983; Theys, 1984; 1989; Weber, 1983; Corniere, 1986) have already established resource accounting frameworks to supplement the national accounts, and are proceeding with their construction. In conjunction with this, the OECD is undertaking pilot studies of forest resources in Norway and inland water resources in France (OECD Environment Committee, 1988). Canada has devised an environmental statistics framework (Rapport and Friend, 1979) as a prelude to resource accounts. In both

Japan and the United States of America satellite accounts measuring various aspects of pollution in monetary terms have been constructed by researchers (Cremeans, 1977; Repetto, 1988). Australia has initiated a sequence of case studies giving priority to resource sectors where accounts would assist management (Wright, 1989), and the United Kingdom is giving active consideration to changing their accounting procedures following recommendations in Pearce, Markandya and Barbier (1989).

France's patrimonial accounts are slightly broader in concept than the resource accounts in Norway. In addition to the environmental base, these accounts also cover cultural heritage. Jointly, these two phenomena are referred to as the "national environmental heritage" (Theys, 1984): the state of nature which the present generation inherits from the last generation. The patrimonial accounts are still being developed but it is expected that they will eventually provide a means of estimating both the total natural resource requirements of a given rate of economic growth, and the specific environmental implications of a change in the structure of demand for environment-based commodities. As with the natural resource accounts being developed elsewhere, the basic data is derived from annual balance sheets for environmental assets measured in physical units. In this sense the biophysical data tend to be weighted in favor of population or stock data, as opposed to ecological data. The intention is to develop a complete inventory of the environmental heritage before seeking an adjustment of the national accounts.

The development of natural resource accounts represents the most systematic work yet undertaken on environmental indicators. As one might expect, such work is more advanced in the high income countries than in the low income countries (where manpower and financial constraints tend to be highly restrictive).

Conclusions on Monetary Accounting

In conclusion, therefore, as far as the monetary accounts are concerned, there are many issues of methodology that arise, and have yet to be resolved. In particular, the treatment of environmental protection expenditures, the treatment of pollution damage, and the treatment of depreciation and degradation of the natural resource base are the most important. The arguments for and against different methods of dealing with these items are discussed. There is no "right" way to adjust the accounts, but it is important, for comparisons over time and across countries that a consistent method be employed. Agreement on these issues has to be reached through a body such as UNSTAT, and that process is under way. Some of their proposals are commented on in the report.

One idea that has captured the imagination is that of sustainable income. This measures the level of consumption that a society could undertake in perpetuity, given its man-made capital and its natural resource base. The most important implication of this notion is that one should concentrate on net income concepts, rather than on gross income, as is conventionally the case.

Experience with the monetary accounts has shown that previously estimated changes in GDP can be seriously wrong, and that countries with large natural resource bases, or with profound environmental problems can be overestimating the welfare of their citizens. But knowing this in retrospect is not enough. What is required is the estimation of net income *ex ante*, under alternative policies, so that choices between the policies can be made in a more rational manner. So far that has yet to happen.

Overall Conclusions

What lessons can one learn from the experience so far? The first is that physical data bases are important for both physical and monetary accounting systems. In this regard, efforts to build accounting systems in developing countries will need support from those who are specialized in measuring changes in forest biomass, soil erosion, water quality, and other such resources.

Second, there is an important role for physical indicators of system resilience and integrity but more work needs to be done on how such indicators are to be integrated into a policy-making framework.

Third, for monetary accounting, especially in developing countries, it is important to have the final draft of SNA guidelines for satellite accounting. However, the process of collecting the relevant data can be started now, and support will be needed from institutions such as FAO. As with most research projects, one tends to work in countries where programme data are relatively good, but these tend also to be countries where the need is not the greatest. An integrated programme of physical data base setting up and environmental accounting should be proposed for some of the less well endowed countries with serious environmental problems, particularly in Africa and Latin America.

Notes

1. This summary is drawn from a longer paper with the same title, which is available from FAO, or from the London Environmental Economics Centre, 33 Endsleigh Street, London, who printed it as a discussion paper.

2. Intermediate expenditures can, however, result in increases in GDP through induced effects (cf. Harrison, 1988). Assuming less than full employment of resources this could be true, but is being ignored in the above argument

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Chapter II

ENVIRONMENTAL STATISTICS AND ACCOUNTING[1]

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Increased concern with environmental issues has created world-wide demand for a broad range of environmental statistics and indicators. The World Commission on Environment and Development (WCED, 1987)and, more recently, the United Nations Conference on Environment and Development (Rio de Janeiro, 3-14 June 1992) stressed the interactions between environmental concerns and socio-economic activities, requiring an integrative approach to "sustainable development." Such integrated development requires support through integrated data bases.

Many industrialized countries already collect environmental statistics in well-established programmes. However, in much of the developing world, such programmes are not yet carried out. Environmental data in these countries are generally spread among a large variety of different sources. Thus, there is an urgent need for coordination and harmonization of data collection and dissemination.

The environment statistics programme of the United Nations Statistical Division (UNSTAT) has been established with the objective of developing and promoting consistent methodologies that could be widely applied at national and international levels. Parallel to the development of largely non-monetary environmental statistics, an integrated economic-environmental accounting approach for incorporating environmental costs and benefits into conventional national accounts has also been explored by UNSTAT. The following provides a description of the work carried out in both areas.

Environmental Statistics

Survey of Country Practices

As early as 1977, UNSTAT conducted a world-wide survey of environmental concerns, country practices, data needs, and plans and priorities for establishing environmental statistics in developing countries. Environmental statistics were found to be multi-disciplinary in nature and to encompass the natural sciences, sociology, demography, and economics. In particular, environmental statistics should:

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* The views expressed by the author are his own and do not necessarily reflect an expression of opinion on the part of the United Nations.

1. Cover natural phenomena and human activities that affect the environment and human living conditions;

2. Refer to the media of the natural environment, *i.e.*, air, water, land/soil, and to the man-made environment which includes housing, working conditions and other aspects of human settlements; and

3. Provide a synthesis of data from different fields and statistical sources to facilitate integrated socio-economic and environmental planning and policies.

A number of efforts were undertaken to develop a system or framework for environmental statistics, either for a planned programme of environmental statistics, or to organize available data into a coherent statistical publication. These efforts were also surveyed by UNSTAT in order to identify those common characteristics which could be incorporated into a widely applicable international framework (United Nations, 1982). While countries differed in their approaches to developing and organizing environmental statistics, there were common elements in the structures of their frameworks and publications. Based on these common characteristics, the next step was, therefore, to present a systematic approach to the organization and development of environmental statistics.

Framework for the Development of Environmental Statistics

At the international level, initial attempts sought to develop a system of environmental statistics parallel to those in the economic and socio-demographic fields, namely the System of National Accounts (SNA) (United Nations, 1968) and the System of Social and Demographic Statistics (SSDS) (United Nations, 1975). However, as in the case of SSDS, the absence of a common *numeraire* and the lack of a generally accepted theory prompted UNSTAT to abandon the system approach in favor of a framework for the development of environmental statistics.

The objectives of the United Nations Framework for the Development of Environmental Statistics (FDES) (United Nations, 1984) are thus to assist in:

1. Reviewing environmental problems and concerns and determining their quantifiable aspects;

2. Identifying variables for statistical descriptions of the quantifiable aspects of environmental concerns;

3. Assessing data requirements, sources and availability;

4. Structuring data bases, information systems and statistical publications.

FDES relates components of the natural and human-made environment to information categories as illustrated in Table 2. The natural environment includes the environmental media of air, water and land/soil, as well as the biota found in these media. The human-made environment is represented by human settlements which consist of physical elements, namely shelter, infrastructure, and services to which these elements provide the material support.

TABLE 2 FORMAT OF THE FDES

Format of the FDES

Components of the Environment	Information Categories			
	Social and Economic Activities, Natural Events	Environmental Impacts of Activities/Events	Responses to Environmental Impacts	Inventories, Stocks, and Background Conditions
1. Flora				
2. Fauna				
3. Atmosphere				
4. Water (a) Freshwater (b) Marine Water				
5. Land/Soil (a) Surface (b) Sub-surface				
6. Human settlements				

Source: United Nations (1984)

The information categories were based on the recognition that environmental problems are the result of human activities and natural events. They reflect a dynamic sequence of action, impact and reaction, referring to social and economic activities and natural events, their impacts on the environment and the responses

to these impacts by the government, non-governmental organizations, enterprises and individuals. A more static category of natural resource stocks and background information was added. Such information is to provide the links to natural resource accounts and monetary environmental accounts (see below) and to bring into perspective human interaction with the environment by means of social, demographic and economic background material.

FDES does not specify statistical parameters, indicators, classifications, tabulations, or methods of data collection. It presents "statistical topics" which are those aspects of environmental concerns that can, at least in theory, be subjected to statistical description and analysis. Statistical concepts, definitions and methodologies were to be suggested in further methodological reports in different environmental areas, based on FDES, in order to avoid, as far as possible, thematic overlap and inconsistencies in concepts and methods among various statistical fields.

Methodological Reports of Environmental Statistics

Two generic reports on statistics of the "human-made" and "natural" environment have been prepared by UNSTAT. They represent a further elaboration of FDES, providing lists of variables that could be used in the assessment of its statistical topics. More detailed recommendations of statistical tabulations and analysis for selected areas of environmental statistics will be presented in further technical publications.

The statistical topics of the report on Concepts and Methods of Environment Statistics: Human Settlements Statistics (United Nations, 1988) are presented in the FDES format in Table 3. The report proposes concepts, definitions and classifications for statistical variables that describe environmental and related socio-economic aspects of human settlements. The criteria used in selecting these variables were:

1. Relevance to environmental aspects of human settlements and to corresponding FDES topics;

2. Data availability and access;

3. Degree of sensitivity to change in environmental and human settlements conditions; and

4. International comparability.

TABLE 3
Framework for the Development of Environmental Statistics— Human Settlements

Social and Economic Activities, natural events A	Environmental impacts of activities/events B	Responses to environmental impacts C	Stocks, inventories and background conditions D
1. Settlements, growth and change.	1. Conditions of shelter, infrastructure and services.	1. Human settlements policies and programs.	1. Stocks of shelter and infrastructure.
1.1 Population growth and change.	1.1 Housing.		1.1 Housing stock.
1.2 Construction of shelter and infrastructure.	1.2 Access to infrastructure and services.	2. Pollution monitoring and control.	1.2 Non-residential buildings and other physical infrastructure.
1.3 Utilities (energy and water supply).	1.3 Human settlements sprawl and dispersion.	2.1 Environmental standards.	2. Environmental inventories.
1.4 Transport.		2.2 Monitoring.	2.1 Emissions.
1.5 Land use in human settlements.	2. Conditions of life-supporting resources.	2.3 Treatment, disposal and reuse of discharge.	2.2 Hazardous work environment and industries (not developed).
2. Other Activities.	2.1 Ambient concentration of pollutants and wastes.	2.4 Expenditure for pollution control.	2.3 Human settlements vulnerable to natural disasters.
2.1 Emissions and waste discharge.	2.2 Biological and ecological impacts (not developed).	3. Prevention and hazard mitigation of natural disasters.	3. Background conditions.
2.2 Hazardous activities at work-place (not developed).	2.3 Microclimates (not developed).		3.1 Land use.
3. Natural events.	3. Health and welfare conditions in human settlements.		3.2 Demographic and social conditions.
	3.1 Exposure and health effects.		3.3 Economic situation.
	3.2 Settlements-related damage and accidents.		3.4 Weather/climate conditions.
	3.3 Perception of the quality of life in human settlements.		

Source: United Nations (1988)

TABLE 4

Framework for the Development of Environmental Statistics — Statistics of the Natural Environment

Social and Economic Activities, natural events A	Environmental impacts of activities/events B	Responses to environmental impacts C	Stocks, inventories and background conditions D
1. Use of natural resources and related activities.	1. Resource depletion and increase.	1. Resource management and rehabilitation.	1. Biological resources.
1.1 Agriculture.	1.1 Biological resources.	1.1 Protection and conservation of nature.	1.1 Agriculture stocks.
1.2 Forestry.	1.2 Cyclical and non-renewable resources.	1.2 Management and conservation of natural resources.	1.2 Forest stocks.
1.3 Hunting and trapping.	2. Environmental quality.	1.3 Rehabilitation of degraded environments.	1.3 Fish stocks.
1.4 Fisheries.	2.1 Atmospheric pollution.	2. Pollution monitoring and control.	1.4 Fauna and flora inventories.
1.5 Minerals, mining and quarrying.	2.2 Water quality.	2.1 Pollution research and surveillance.	2. Cyclical and non-renewable resources.
1.6 Energy production and consumption.	2.3 Soil and land quality.	2.2 Standards, control and enforcement.	2.1 Hydrological systems.
1.7 Water use for human activities.	2.4 Quality of biota and ecosystems.	2.3 Environmental clean-up and rehabilitation.	2.2 Climate.
1.8 Land use and environmental restructuring.	3. Human health and environmental disasters.	2.4 Public pollution control facilities.	2.3 Lithosphere.
2. Emissions, waste loadings, and application of biochemicals.	3.1 Human health and contamination.	3. Prevention and hazard mitigation of natural disasters.	2.4 Mineral resources.
2.1 Emissions and waste loadings in environmental media.	3.2 Impact of environmental disasters.	4. Private sector responses.	3. Energy stocks.
2.2 Application of biochemicals.		4.1 Enterprises.	3.1 Non-renewable energy sources.
3. Natural events.		4.2 Households.	3.2 Renewable energy sources.
			4. Ecosystems inventory.

Source: United Nations (in prep)

A second report on Concepts and Methods of Environmental Statistics: Statistics of the Natural Environment (United Nations, 1991) provides an extensive list of statistical variables from which statistics that meet particular data needs, socio-economic and environmental conditions, and statistical capabilities can be selected for purposes of establishing a national statistical system and programme of data collection and dissemination. As its companion report on human settlements statistics, this report is based on FDES. The common framework facilitates cross-references between the two reports so as to indicate the interrelationship between "human-made" and "natural" components of the environment. Table 4 presents the statistical topics for statistics of the natural environment.

The two reports do not make recommendations on how to implement a statistical programme. They do provide, however, at least a starting point for the selection of appropriate statistical series. They should also help to determine relevant classifications, data sources and tabulations in further methodological work on selected high-priority areas of environmental statistics. An intergovernmental Working Group on the Advancement of Environmental Statistics, established under the auspices of the Statistical Commission of the United Nations, is assisting UNSTAT in these efforts. The Group has focused its work on land use statistics, statistics of water use and water quality, and statistics of air pollution and energy use.

Compilation of International Series of Environmental Statistics

UNSTAT has not yet embarked on international data collection in the field of environmental statistics. The results of regional workshops and pilot country studies undertaken by UNSTAT suggest that international programmes of data collection would best be promoted, and where feasible, conducted by the regional commissions of the United Nations. Global data compilation could be established once enough countries, especially in the developing world, have established their own environmental statistics programmes. To the extent its resources permit, UNSTAT will continue to assist developing countries in establishing environmental statistics programmes and data bases by backstopping technical cooperation projects and through training workshops and seminars.

An "experimental compendium" entitled Environment Statistics in Europe and North America has been issued by the ECE (United Nations, 1987). A second edition of this compendium was published in 1992 (United Nations, 1992). The Economic Commission for Africa (ECA) is in the process of compiling an "African Compendium of Environment Statistics" which is expected to be published shortly. The Economic Commission for Asia and the Pacific (ESCAP) has launched an environmental statistics programme promoting data collection in member countries.

The Economic Commission for Latin America and the Caribbean (ECLAC) has proposed the establishment of a "Statistical Environmental Database for the Caribbean Region." Other international compendia include the Environmental Data Reports by the United Nations Environment Programme (UNEP, 1991), World Resources 1992-93 by the World Resources Institute (WRI, 1990) and the Environmental Indicators by the Organisation for Economic Cooperation and Development (OECD,1991).

Integrated environmental-economic accounting

National accounts have provided the most widely used indicators for the assessment of economic performance, trends of economic growth and of the economic counterpart of social welfare. However, major drawbacks of national accounting have raised doubts about the usefulness of national accounts data for the measurement of long-term sustainable economic growth and socio-economic development. These drawbacks include the neglect of:

1. Scarcities of natural resources which threaten the sustained productivity of the economy;

2. The degradation of environmental quality from pollution and other human activity, and its effects on human health and welfare; and

3. Accounting for environmental protection expenditures which tend to increase national product but which may instead be considered as social costs for the maintenance of environmental quality.

Towards an SNA Satellite System of Integrated Environmental and Economic Accounting

The feasibility of physical and monetary accounting in the areas of natural resources and the environment was first explored in workshops jointly organized by UNEP and the World Bank. The workshops led to a consensus that enough progress had been made to link environmental accounting to the United Nations SNA, and to include certain aspects of environmental accounting in the ongoing revision of SNA.

In response to this conclusion, UNSTAT presented an "SNA Framework for Integrated Environmental and Economic Accounting" at the twenty-first session of the International Association for Research in Income and Wealth (IARIW) (Lahnstein, August 20-25, 1989) (Bartelmus, Stahmer and van Tongeren, 1991). It was decided at that session to convene a special IARIW Conference on

environmental accounting which met in Baden (Austria) from May 27 to 29, 1991. The Conference discussed in depth different approaches to natural resource and environmental accounting and proposed a step-by-step approach to their implementation within the framework of national accounts.

At its twenty-fifth session in 1989, the Statistical Commission of the United Nations endorsed the preparation of an "SNA Handbook on Integrated Environmental and Economic Accounting" (United Nations, in prep.). UNSTAT has now prepared an "interim version" of the Handbook. Various components of the draft Handbook have been tested in pilot projects in Mexico (van Tongeren *et al.*, 1991), Papua New Guinea (Bartelmus, Lutz and Schweinfest, 1992) and Thailand. It was found in these studies that environmental accounting is not only feasible but can provide, even in tentative form, a valuable information base for integrated development planning and policy formulation.

The recent revision of SNA (United Nations, 1992a) presented a unique opportunity to examine how the various concepts, definitions, classifications and tabulations of environmental and natural resource accounting[2] can be linked to or incorporated in SNA. Considering that no international consensus has yet been reached on how to incorporate environmental costs and benefits in national accounts, it appears premature to radically change a well-established system of economic accounts that serves many different, in particular short- and medium-term, socio-economic analyses. The standards of environmental and natural resource accounting will therefore be elaborated in an SNA satellite system rather than in the SNA core accounts. Satellite systems of national accounts generally stress the need to expand the analytical capacity of national accounting for selected areas of concern in a flexible manner, without overburdening or disrupting the core system (Schafer and Stahmer, 1990). On the other hand, the revised SNA already accounts in its balance sheets for natural resource stocks and changes therein as far as those stocks provide actual or potential economic benefits to their owners.

Scope and Contents of the System of Integrated Environmental and Economic Accounting (SEEA)

The proposed SNA satellite System of integrated Environmental and Economic Accounting (SEEA) follows, as far as possible, the principles and rules established in the SNA. It seeks to be flexible, however, regarding alternative approaches to integrated environmental-economic accounting and analysis. It is based on SNA's production boundary, follows its analysis of costs and outputs, and incorporates the same accounting identities between supply and use of products and between income and (final) expenditure. Information needed for environmental analysis is presented in the SEEA separately from, but together with, the relevant SNA

aggregates. In this manner, original (unadjusted) SNA data can be directly compared with environmentally adjusted statistics and indicators.

The focus of traditional systems of national accounts on market transactions has effectively excluded the accounting for the costs of changes in the quality of the natural environment and the depletion of natural resources. The incorporation of those costs in production and income accounts permits the calculation of an adjusted concept of value added which is compatible with long-term environmentally-sound and sustained economic growth.

The main features of the SEEA can be summarized as:

1. Segregation and elaboration of all environment-related flows and stocks of traditional accounts

Satellite accounts, in the narrow sense of detailed accounting for expenditures and revenues in major areas of social concern, have been pioneered by France (Institut National, 1986). There is now an increased interest in segregating all flows and stocks of assets in national accounts related to environmental issues and in estimating the total expenditure for the protection or enhancement of the different fields of the environment. One objective of this segregation is to identify the increasing part of the Gross Domestic Product (GDP) which reflects the costs necessary to compensate for the negative impacts of economic growth, *i.e.*, the so-called "defensive expenditures" (Leipert, 1989).

2. Linkage of physical resource accounting with monetary environmental accounting and balance sheets

Physical resource accounts aim at covering comprehensively the total stock or reserves of natural resources and changes therein, even if these resources are not (yet) affected by the economic system.[3] The proposed accounting for these resources in SEEA is considered as the "hinge" by which comprehensive physical resource accounts could be linked to the monetary balance sheet and flow accounts of SNA. Systems of environmental statistics such as those proposed by the United Nations (1988 and 1991) should facilitate achieving compatibility between physical and monetary accounts by specifying those environmental parameters that could be valued in monetary terms. Non-monetary data in physical accounts are considered to be an integral part of SEEA and are fully elaborated in the Handbook of Integrated Environmental and Economic Accounting.

3. Assessment of environmental costs and benefits

In contrast to the narrow approach to satellite accounting mentioned above, a broader framework for satellite accounting covering additionally "external" environmental costs and benefits is proposed in SEEA. Taking the current state of knowledge and data availability into account, the system focuses on expanding and complementing the SNA with regard to two major issues, namely:

- The use (depletion) of natural resources in production and final demand; and

- The changes in environmental quality, resulting from pollution and other impacts of production, consumption and natural events on one hand, and environmental protection and enhancement on the other.

Possibilities of extending SEEA for the analysis of environmental welfare effects, *i.e.*, the "damage costs" of the impairment of human health, recreation and other aesthetic or ethical values, has also been discussed in the Handbook.

4. Accounting for the maintenance of tangible wealth

The general paradigm of sustainable development stresses the need to fully account for the use of both "human-made" and "natural" assets which extends the concept of capital formation into one of capital accumulation. Additionally, this extension could also reflect the transfer or "discovery" of natural capital for economic use.

5. Elaboration and measurement of indicators of environmentally-adjusted product and income

Consideration of the costs of depletion of natural resources and changes in environmental quality permits the calculation of modified macroeconomic aggregates, notably an Environmentally-adjusted Domestic Product (EDP). The possibility of introducing an Environmentally-adjusted National Income (ENI) concept by accounting for further welfare effects of environmental impacts and environmental protection are currently being considered.

The proposed system attempts to describe the main interrelationships between the environment and the economy. However, in line with the production boundary of SNA, phenomena that take place wholly within the environment, *i.e.*, outside the economic system, are excluded. Such phenomena are probably better dealt with by complementary physical resource accounts and systems of environmental statistics and monitoring. Also, welfare effects from the degradation

environmental quality that affect "human capital", *i.e.*, human health and welfare, are only tentatively discussed. The main emphasis is on the implications of the environment for production, value added, final and intermediate demand and tangible wealth. Complete accounts for all institutional sectors are not yet presented. Transactions related to income distribution and those concerning intangible assets, including exploitation rights and financial assets, are thus excluded. A more comprehensive analysis of the interrelations between the economy and environment would require a further expansion of all institutional accounts, showing not only the flows of goods and services but also of income and finance.

Structure of SEEA

Table 5 illustrates the general structure of the system which consists of three basic components. Table 5.1 and 5.2 show the supply and use of goods and services; Table 5.3 comprises the asset accounts with opening and closing assets and the items linking them. Tables 5.2 and 5.3 are connected via the accounts of capital accumulation. The figures shown in the table are largely fictitious, serving only illustrative purposes.

The supply/origin table (Table 5.1) contains an additional row which shows the involuntary "imports" of residuals (wastes, etc.) of foreign economic activities which had been transported to the domestic economy (-1.6). Alternatively, flows of cross-boundary residuals could also be treated as "transfers" from/to the domestic environment, thus affecting an environmentally-adjusted national income aggregate rather than domestic product.

The use/value added table (Table 5.2) is extended by rows and columns. The table shows not only the traditional GDP and NDP (Net Domestic Product) but also further corrections due to the use of natural assets (depletions of natural resources, degradation of environmental assets by residuals and agricultural, recreational and other practices). This use is valued by the costs which would have been necessary to keep the natural capital intact. These costs are interpreted as the decrease in value of the natural assets comparable to the consumption of human-made fixed assets.

The deterioration of the natural assets could be caused by current production activities (59.8), consumption activities (household consumption 17.1) or by scrapped produced assets (5.1). The government's restoration activities diminish the impacts of the economic activity on the natural assets (-5.0). These activities could affect the domestic environment (natural non-produced assets: -73.0 and

loss of ecological functions of the produced biological assets: -0.9), or could generate residuals that are transported to the rest of the world (exports: -4.7). The value of the deterioration of the domestic as well as the foreign natural assets caused by domestic sources (59.8 + 17.1 + 5.1 = 82.0) represents the environmental costs that are deducted from NDP to obtain the Environmentally-adjusted net Domestic Product (EDP) (185.1).

The asset accounts (Table 5.3) show the produced assets (including cultivated biological assets) and the non-produced assets which contain only natural assets (wild biota, land, subsoil assets, water and air). Market valuation is applied to the produced assets. For non-produced natural assets, three different categories of valuation are proposed in the SEEA:

1. Market valuation which rearranges only environmental changes already recorded in the balance sheets of SNA;

2. Maintenance valuation which estimates the costs that would have been incurred to keep the environment intact during the accounting period; and

3. Contingent valuation for assessing environmental "damage costs" borne by households and enterprises.

Deducting environmental costs from conventional macroeconomic indicators does not mean that these costs are actually internalized at the microeconomic level by individual economic agents. These costs are imputations which do not affect supply and demand patterns and corresponding price formation during the accounting period. Deducting such imputed values generates aggregates whose valuation has not gone through the mill of price formation in the market and therefore are not strictly comparable to the value of market transaction presented in the national accounts. The function of indicators, modified by such imputations, might thus be more alert to structural distortions of the economy and unsustainable trends in its growth than to the provision of an accurate picture of past economic activity.

As mentioned earlier, SEEA addresses also the physical counterpart of the monetary environmental accounting system. As far as the use of natural resources is concerned, the feasibility of environmental accounting in physical terms has been demonstrated by the work on natural resource accounts, in particular, in Norway (Norwegian Central Bureau of Statistics, 1987). These accounts show the stocks and flows of materials which are used as primary inputs of economic activities. They are a suitable complement to materials/energy balances which describe the

TABLE 5

Structure of SEEA

Tangible Assets (Table 5.3)		
Produced		Non-produced Natural Assets
Except Natural	Natural (biota)	
991.3	83.1	1744.4

OPENING STOCKS (MARKET VALUATION)

+ (plus)

Use/Value Added (Table 5.2)	Total	Domestic Production (Industries)	Final Consumption		Capital Accumulation			Rest of the World	
					Produced Assets		Non-produced natural assets	Exports/ Imports	Flow of Residuals
			Households	Government	Except natural	Natural (biota)			
Use of products	591.9	224.0	175.0	42.5	68.0	1.4	7.3	73.7	
Gross Domestic Product (GDP)		293.4							
Consumption of fixed capital		26.3			-23.0	-3.3			
Net domestic product (NDP)		267.1							
Use of natural assets (ecological valuation)	-1.6	59.8	17.1	-5.0	5.1	-0.9	-73.0		4.7
Environmental adjustment of final demand		22.2	-17.1		-5.1				
Environmentally Adjusted Net Domestic Product (EDP)		185.1							

+ (plus)

SUPPLY/ORIGIN (Table 5.1)									
Supply of products	591.9	517.4						74.5	
Origin of residual	-1.6								-1.6

+ (plus)

Adjustment of natural assets accumulation to market valuation		0.9	81.2
Other volume changes (market valuation)	-25.3		22.8
Revaluation due to market price changes	138.1	12.6	382.8

= (equals)

CLOSING STOCKS (MARKET VALUATION)	1149.1	93.8	2165.5

Source: Bartalmus, Stahmer and van Tongeren (1991)

transformation of natural resources within economic processes. Both types of accounts should be linked to the monetary data of the national accounts to provide a sound statistical basis for integrated environmental-economic accounting.

It is easier, however, to describe the transformation process of materials and energy sources in the economic sphere than to give a complete picture of the consequences of economic activities (e.g. from emission of waste residuals) on the environment. This is the main reason why FDES contents itself with listing environmental and related economic variables under information categories, without referring to specific functional relationships among them. A comprehensive assessment of interacting social, demographic, economic and environmental variables is therefore probably better carried out within relatively flexible systems or frameworks of environmental statistics than by means of accounting balances.

Physical data are thus necessary for describing the environmental-economic linkages and for supporting integrated environmental management in limited thematic and geographical areas. They are not sufficient, however. The danger of using only figures in physical terms lies in the development of huge data masses for describing environmental phenomena without reaching general conclusions on their relevance for economic development and human welfare. Physical variables can normally not be aggregated due to the use of different statistical units (e.g., tons and cubic meters) and the lack of knowledge of the relative importance of the variables. In many cases, the only way to obtain comparable data on different physical resources and environmental impacts is to value the physical assets and the corresponding cost of their depletion and degradation in monetary units. Valuation is thus a crucial but still controversial aspect of environmental accounting, requiring further exploration with a view to obtaining widely acceptable standard methodologies.

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Notes

1. This paper was prepared for the 48th Session of the International Statistical Institute (ISI), Cairo, September 9-17, 1991.

2. See Ahmad, El Serafy and Lutz (1989) for an overview of different concepts and approaches, and Peskin and Lutz (1990) for a survey of environmental accounting practices in industrial countries.

3. See, for example, the Norwegian approach to natural resource accounting (Alfsen, Bye and Lorentsen, 1987) or the more complex (including *i.a.* interactions in the biophysical environment) French "natural patrimony" accounts (Institut National, 1986a).

Chapter III

ENVIRONMENTAL STATISTICS AT THE NETHERLANDS CENTRAL BUREAU OF STATISTICS[1]

Hendrik Jan Dijkerman

The Netherlands Central Bureau of Statistics (CBS) has compiled statistics on the Dutch environment for over 20 years. Initially the emphasis was on data for air, water and soil pollution and the costs of clean-up measures. Later, statistics were included on waste materials, manure, companies' expenditures on the environment and the costs and financing of environmental control. Substance balance sheets were compiled and CBS had the major task of taking national inventories of flora, vegetation and avifauna.

CBS environmental statistics form a coherent system. Figure I follows the sequence: human activities, burden on the environment, changes in the environment, and effect. Some thirty environmental statistics and a number of related statistics compiled by CBS quantitatively express the results of various human activities on each component of the sequence.

The data for many of the statistics are obtained through written surveys. In a number of cases, field inventories are carried out by volunteers. In others, CBS receives data from surveys from other authorities, like the Ministry of the Environment. Nearly all environmental statistics contain data for a period of at least ten years; for some statistics, however, data are available for fifty years or more.

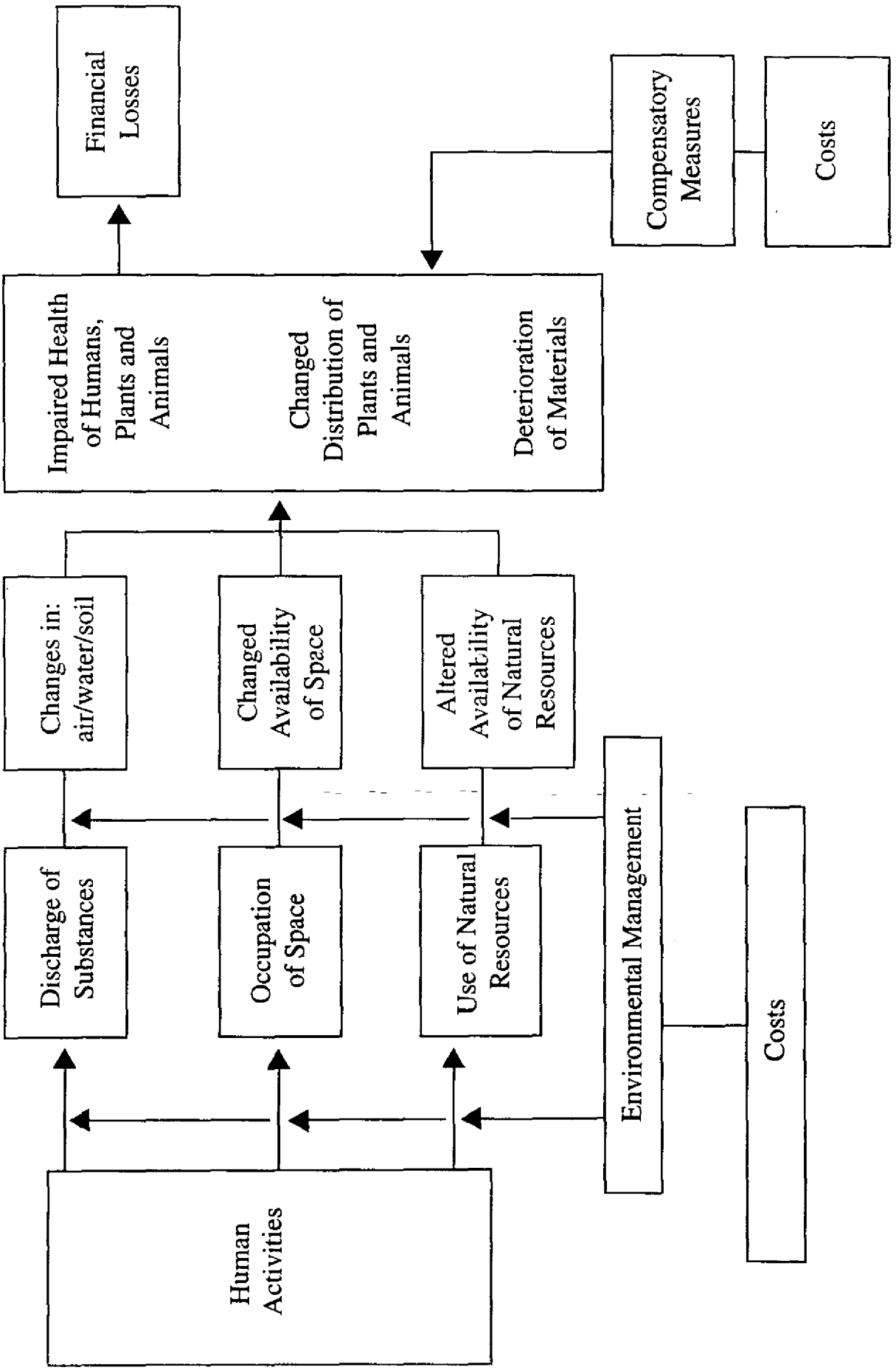
Three out of four of the CBS air pollution statistics address the emissions of a number of substances regarded as major air pollutants: emissions from furnaces, industrial emissions and emissions from traffic. In the statistics on ambient air monitoring, measurements from permanent monitoring stations are used to assess the status of ambient air nationwide.

Three statistics describe the protection of surface water quality. They provide information on the discharge and treatment of waste water, the state of surface waters and the costs of public sewage treatment. Combining the data on discharges and treatment allows the construction of a flow chart of waste water flows in The Netherlands, which in turn reveals the ultimate burden on surface water.

FIGURE 1

Environmental Statistics Flow Chart

(Excluding feedback and secondary relationships)



The statistics on waste and related problems (statistics on industrial waste, hazardous waste and waste oil, vehicle wrecks, waste collected by or on behalf of municipalities, and waste treatment plants) include information on the quantity and composition of solid waste generated, and methods of collecting and disposal of waste material, including reuse.

CBS has compiled two sets of statistics on the production and use of manure in The Netherlands. One set concerns the production of animal manure; the other looks at a number of other aspects of animal excrement and includes data on the use of other fertilizers. Manure surpluses are calculated by combining these data.

The Substance Balance Sheets give a qualitative and quantitative description of the "flow" of particular substances in The Netherlands. They provide an overview of the import, export, production and use of substances, both as final goods and as inputs to other products. These data are used to estimate how much of these substances end up in the environment. So far, balances have been compiled for PCBs, mercury, phosphorus, copper, selenium, organotin compounds and nitrogen.

The statistics on the maintenance of watercourses, use of chemical pesticides by public authorities, and sales of pesticides for agricultural use provide information on the quantity and type of pesticides used. They also contain data on the organization of professional pest control, the costs of pest control, and on the nature of the objects treated and of the pests being controlled.

CBS has a wide range of information on land use in The Netherlands. The exploitation of natural resources, however, is limited to forestry, energy supply, and the extraction and consumption of water.

Changes in the occurrence and distribution of plant and animal species are generally regarded as the most fundamental indicators of anthropogenic effects on the environment. CBS has compiled statistics on flora, vegetation, avifauna and butterflies in The Netherlands. The statistics on "physical aspects of countryside and landscape management" reveal the topographical features of (protected) nature reserves and the management measures applied to them.

Various steps are taken to prevent or reduce any further environmental strain and deterioration. Some of these measures, and their associated costs, are recorded by the environmental statistics. The costs of environmental protection are described in the statistics on the costs and financing of environmental control. The statistics on the costs and financing of landscape management focus on the financial aspects of environmental and landscape protection. Investments and expenditure made by industrial firms on the environment are described by the

statistics on industrial expenditure for environmental protection.

These environmental statistics are published regularly in the CBS Statistical Bulletin; a selection of the statistics is included in the Statistical Yearbook. CBS also issues a number of publications devoted entirely to the environment. Some of these cover the general area of the environment as a whole, while others are more detailed, focusing on individual aspects. Every two years, CBS compiles a review of the existing quantitative information on the environment in The Netherlands. This publication is issued in both Dutch (Algemene Milieustatistiek) and English (Environmental Statistics of The Netherlands).

To disseminate the most recent information to interested parties as quickly as possible, CBS issues the Environmental Quarterly. This periodical contains the latest figures on subjects covering the whole range of environmental statistics and articles on environmental topics not covered by special CBS publications on the environment. Reviews and analyses are also included.

More specialized environmental publications are generally published every year or once every 2-3 years, depending on the environmental statistics involved.

Notes

1. This paper is a summary of a larger publication by the same author, produced by the Department for Environmental Statistics of The Netherlands Central Bureau of Statistics.

Chapter IV

FEASIBILITY OF ENVIRONMENTAL AND RESOURCE ACCOUNTING IN DEVELOPING COUNTRIES[1]

ANTHONY M. FRIEND

> GNP is a flimsy concept in developed countries, and for various reasons, even very much more so in underdeveloped countries.[2]

Data collection in developing countries needs to be reoriented toward physical accounting of natural resource stocks, monitoring of state of the environment, and data which describe the linkage of environmental goods and services and socioeconomic development. This paper discusses the desirability of Environmental and Resource Accounting (ERA) in context of a comprehensive framework of national accounting. It is pointed out that the traditional national accounts in developing countries are, in essence, adaptations of the economic accounting systems developed for industrial countries. Major flaws in this approach are:

1. Production in the informal economy is largely unreported;

2. The income concept is inappropriate where obligatory arrangements and village "self-sufficiency" take care of basic needs; and

3. Equitable access to environmental goods and services is a key element in socio-economic well-being.

The paper demonstrates the complementarity of environmental and economic accounting and its critical connection to indicators of sustainable development. Some of the applied work in Botswana, China and Costa Rica suggests that this work has direct relevance to social development policies and further suggests, therefore, that priority be given to the development of ERA in international and bilateral aid programmes. The Brundtland Report emphasized the need to monitor ecological capital and the rates of depletion of natural resources. ERA clearly is the appropriate framework for the data needs for sustainable development.

Introduction

The current data collection systems in developing countries are in danger of being out of phase with the emerging paradigm shift in socio-economic development. One reason is undoubtedly institutional inertia. However, the imperatives of the System of National Accounts (SNA) framework (United Nations, 1988) should not be underestimated. To bring data back into phase, statisticians need to concern

themselves with the development of the appropriate "meta-language" consistent with the new, but yet unclear, policy directions of the twenty-first century. What seems obvious, even now, is the critical role of Environmental and Resource Accounts (ERA) in the overall body of national statistical systems. A prerequisite for this to happen, rather sooner than later, is a reordering of data collection priorities and technical assistance in ERA research and development.

Clearly, the first step is to assess the current state of ERA. While several Natural Resource Accounts (NRA) have been produced for developing countries, they are characteristically based on heroic assumptions, imaginative interpretation of data and crude estimators to bridge critical data gaps.[3] Indeed, National Income Accounting (NIA) in its infancy employed imaginative uses of very thin databases.[4] Considering the high profile of environmental degradation in developing countries, the lack of interest in environmental statistics is somewhat surprising. Environmental statistics are mistakenly viewed as a luxury. Here it is argued that, on the contrary, environmental indicators, next to measures of poverty, are the most critical variables in the long-term assessment of economic health.

A second question that needs to be aired is that of political commitment and the closely-linked institutional inertia. Resource data are treated as strategic information and tend to be filtered for public consumption; this is a particularly sensitive point as resources are a major source of export earnings. This is further exacerbated by the tendency of natural resource ministries to account for their own performance. When has a forestry department published figures showing that their harvest practices are not sustainable? The fragmented responsibility in resource management inevitably leads to the failure to integrate resource data, made worse by institutional mandates directing data collection activity to "client," administrative, and regulatory needs.

A question of great importance in the development of ERA is the data demands from national planning agencies and the support of the Overseas Development Administration (ODA). The great success of the Brundtland Report was to put sustainable development in the vocabulary of the international aid agenda. The World Bank and development aid agencies are becoming increasingly conscious of the importance of continuously monitoring the state of the environment and resource depletions in order to assess the long run success of development aid. Yet, despite the general acceptance of the rhetoric on sustainable development there is still a great deal of reticence in abandoning the comfortable development models, as manifest, for example, in spectacular large-scale engineering solutions.

ERA and the SNA

For the most part developing countries are highly dependent on natural resources for their economic well-being. Yet, Central Statistical Offices (CSO) struggle to compile a system of economic accounts designed for industrial countries and moreover, aimed at monitoring short-term trade cycles. This not only underestimates the contribution of the informal economy but grossly simplifies the implied goals of development (e.g., growth in Gross National Product (GNP)).[5] However, its most serious aspect is the myopia engendered by ignoring the "externalities" of development. In other words the relegation of environmental analysis as a peripheral issue rather than an integral part of the development model. The dominance of the social sciences in defining the nature and scope of national statistics has undoubtedly contributed to the failure of government planners to see the connection between the physical state of the environment and the level of social well-being.

In developing countries with a large proportion of the population engaged in the informal economy, physical production reflects better a measure of real output than the ephemeral abstractions of money incomes. Attempts to mimic highly abstract concepts of an industrial country's national accounts becomes a Procrustean bed for socio-economic statistics. This is not only because of the inappropriate concept of "income" but non-market activities are more directly dependent upon availability and access to natural resources. Thus "income" in the informal sector is more realistically conceived of as a flow of services derived from the efficient use of natural capital assets and accumulated human-made capital stock; this is, in essence, a service-use approach to national income accounting (Friend, 1991).

While cogent arguments could be made for replacing SNA in developing countries by an ERA framework, it would be like throwing the baby out with the bath water. SNA is a useful measure of the level of market activities and the growth of the "formal sector," both of which are important indicators of economic development. Moreover, the World Bank and national aid agencies would insist that their client nations apply the familiar monetary evaluation formulas for estimating the relative level of poverty among countries. The usefulness of an ERA framework on the other hand is to monitor sustainable development. ERA is also more germane to the growing interest in the measurement of the informal sector contribution to the economy. National planning agencies would clearly benefit from a dualistic "physical-monetary" approach to measuring the state of the nation.

Environment and Natural Resource Accounting

The United Nations Technical Report entitled Concepts and Methods of

Environment Statistics: Statistics on the Natural Environment (Sales No. E.91.XVII.18) describes the variables required to assess:

1. Level of human (and natural) stress on the environment;

2. Environmental response to (1);

3. Human response to (2); and

4. An inventory of environmental stocks.

The United Nations framework is an ambitious and comprehensive blueprint or, what is perhaps more appropriately referred to as "the greenprint" for the development of environmental statistics. The need to act on the reorganization of the statistical output of statistical offices in developing countries is urgent. The flavor of this urgency is echoed in the following passages from the UNCED Agenda 21 documentation (3rd Prepcom Meetings, Geneva, March 1991): "Countries, in cooperation with the relevant United Nations bodies, international and regional and sub-regional bodies, and NGOs, should/could give priority to strengthening their efforts at collecting, analyzing and disseminating relevant information." (Atmosphere, A/Conf.151/PC/WGI/I.25, 2 Sept. 1991).

"Scientific research, including forest inventories and assessments, which takes into account the biological, physical, social, economic variables..." (Deforestation, A/Conf.151/PC/WG.1/CRP.14, 3 Sept. 1991).

"Building up the knowledge base and developing an information and monitoring system of fragile ecosystems." (Desertification, A/Conf.151/PC/WG.1/L.29, 29 Aug. 1991).

"Development of specific indicators of sustainability; development of a composite indicator of sustainability; research and evaluation of the operational significance of the indicators of sustainability and translation into management techniques. (Land Resources, A/Conf.151 /PC/WG.1 /CRP.12, 30 Aug.1991).

"...assess fishing resources...strengthen global, coastal and ocean observing systems...assess technologies and information systems...prepare resource mapping atlas...prepare inventories of present and potential human activities in coastal areas..." (Oceans, A/Conf.151/PC/WG.11/1.18, 23 Aug. 1991).

"development of interactive databases, forecasting methods and economic planning models." (Water Resources A/Conf.151/ WG.11 /L 23, Annex.)

"The EC's first statement dwelt on the benefits of improved national accounting and the integration of environmental information to project economic performance." (Cdn Delegation Report on the 3rd Session of the Prepcom. Sect.23 p. 3)

The implementation of UNCED Agenda 21 is an opportunity to make the case for substantial increase in investment in environmental and resource data development and integration. The United Nations Framework for the Development of Environment Statistics (FDES) provides a template for environmental statistical programmes. While the United Nations approach is comprehensive it is also flexible, allowing for the priorities and particular needs of individual countries. Its matrix design offers a topic by topic approach in context of a holistic framework. The component sectors of the matrix are:

1. Social and Economic Activities;

2. Environmental Impacts;

3. Human Response to Environmental Change;

4. Natural Resource Stocks and Inventories.

Various studies and workshops suggest that the key problem is not insufficiency of existing data, although there are still serious gaps, but rather the lack of know-how on one side and political commitment on the other (DFD, 1982). The evident weakness in environmental/natural resource statistics, however, should not be taken as a ready excuse to delay further action but rather should be turned into a potent argument for urgency. FDES is, of course, not feasible without political support backed by key ministries like development planning. It is only in this context that international aid agencies will be willing to provide financial backing, technical support, and training programmes. The following points need to be considered in the strategy for the implementation of FDES:

1. Distinctions should be made between data collected from socioeconomic surveys and those obtainable from physical surveys and monitoring activities. While CSOs do not collect physical data themselves, it is the only agency with a sufficiently wide mandate to realize the data integration objectives of FDES;

2. The data collection role of natural resource ministries must be reoriented toward sustainable development indicators and provision of public information on the stock and flow of resources, including public access to maps and remote sensing imagery (much of this is unavailable on the excuse

that it is strategic information);

3. Research support is required for the development of a "statistical meta-language" (i.e., concepts, definitions, and classification systems) for (a) ecosystems; (b) land use; (c) agricultural practices; (d) chemical contaminants and (e) waste residuals among others; methods and techniques to transform micro-level data (i.e., individual site measures) into macro-level indicators (e.g., national totals) are also required. Computerized data management, particularly in its spatial formulation of Geographical Information Systems (GIS) opens up new dimensions in the organization and compilation of statistics;

4. FDES should be promoted as step toward a pluralistic approach to national accounting in developing countries. While the concept of GNP is an attractive measure of "modernization", it obscures the complex interrelationships of social production of goods and services in developing countries;

5. The spatial data specifications of FDES transcend the artificial boundaries imposed by jurisdictional authorities. Environmental and natural resource spatial analysis (and *ipso facto* management) are ecosystems, drainage basins, pollution/ contaminant pathways among others;

6. FDES specifies environmental variables obtainable from the traditional socio-economic surveys as well as environmental monitoring. The social focus is on environmental living conditions of urban and rural households. Of particular interest are changing agricultural practices and introducing new cultivars, water use and sources of potable water, wood fuel and other gathering activities, nutrition surveys and, of course, health information with respect to environmental diseases, e.g., incidence and spread of waterborne diseases;

7. FDES provides a framework for linking socio-economic and physical databases.

Environment Statistics and Natural Resource Accounting

There are different positions taken with respect to what constitutes a System of Natural Resource Accounts. Accounting is generally associated with evaluation thus focussing on the monetary value (or income generating capacity) of a nation's natural resource stocks. Environmental and natural resource policies are also concerned with carrying capacity and long-term maintenance of ecological capital,

thus focussing on the need for physical stock/flow accounts.

The studies undertaken in Indonesia, in Costa Rica, Botswana and China amply illustrate the general problematique (Repetto *et al*, 1989, 1991, Perrings *et al*, 1989, Li Jinchang *et al*, 1990). The two studies by the WRI were concerned about the loss of potential income due to depleted resources. The concepts employed are those of market values calculated in terms of producer surplus or economic rent. These values are then subtracted from income, thereby reducing the level of GNP. While this approach might serve as a sobering demonstration of income loss due to the failure to maintain constant capital, this is not (nor was it intended to be) a system of natural resource accounting. However, well-documented databases on physical stocks and flows of natural resources would provide a sound basis for calculating the economic cost of depleted resources and the benefits of investments in protection, rehabilitation and improvements to the environment.

The Botswana study on the other hand was intended as a demonstration of a system of natural resource accounting for developing countries. Specifically, the goal of the study was to demonstrate the feasibility of widening the economic database to include "natural capital". The investigators recommended a physical database and, where feasible, a parallel monetary value accounting. They clearly saw the purpose as critical information in national planning:

"...macroeconomic policy-making in Botswana is currently too insensitive to the effects of activities on the value of natural resources. There exists few data on the state of grazing and arable land, vegetation, water, and wildlife, and those data that do exist are not always relevant to the present planning process."

China views NRA framework as complementary to their current economic accounting based on the System of Material Product Accounts (MPA). The major attraction of this framework is that it provides a systemic approach to measure the stock and flow of China's natural resources and most critically, is capable of linking these data with the economic production parameters of the MPA system. The evaluation of natural resources is considered important in making decisions on the efficient allocation of resources. However, a major unresolved problem is how to evaluate resources in an economy based on administrative prices, in essence, an economy based on "shadow prices." It should be noted that market economies have not resolved this problem either. Economists are aware that the competitive market model is not always the most efficient allocator of scarce resources when the objective is to minimize the consumption of material and energy throughputs (Georgescu-Roegan, 1971).

Natural resource accounting is about the measurement of economic production and consumption from a material/energy perspective. Environmental statistics are concerned with changes in environmental quality, or more to the point, environmental degradation. These data systems complement each other and should be treated as an integral component of developing countries' national accounts. The problem can be reduced to that of linking socio-economic and physical databases. This is the approach taken in the United Nations FDES, although the roots stem back to the recommendation for the development of environmental statistics in the Stockholm Conference on the Human Environment (1972). The challenge was taken up by national statisticians at the first ECE (European Statisticians) meeting on environmental statistics (Geneva, March 1973).

While the industrial countries have, for the most part, incorporated the environment in their national statistical programmes, this can hardly be said for developing countries. The Brundtland Report (1987) reiterated the urgency for environmental audits and NRA in countries committed to sustainable development objectives. The United Nations Statistical Commission has repeatedly targeted this area for priority development. One may well ask the question, "why has this area not progressed despite the perceived value of these kind of data?" Part of the answer is the lack of resources for initiating new statistical programmes. However, this is not totally convincing since there already exists a substantial body of baseline statistics on the environment (DFD, 1982).[6] These include data collected in the primary industry section (agriculture, forestry, fishing and mining), household surveys, and demographic/health statistics. Add to this, the data collected by natural resource ministries, public health authorities, mapping and regional planning agencies.

Statisticians are intimidated by the complexity of organizing such widely different parameters within a consistent framework. This problem is exacerbated by the variety of different measuring units such as volume, area, energy units, parts per million and so forth. In other words, the naturally conservative CSOs avoided the unfamiliar world of natural processes and physical transformations of economic product. The United Nations Statistical Office (UNSTAT) quite rightly recognized the conservatism in data collection and emphasized in its initial efforts the development of frameworks and the "meta-language" for environmental statistics (see UNSTAT 84, UNSTAT 88, and UNSTAT 91). Nonetheless, the avoidance behaviour of CSOs could have been overcome if the demand for a socio-physical approach had been forthcoming from the powerful planning agencies as opposed to that of the much weaker environmental protection agencies.

Signs of the breakthrough are found in the increasing support by international agencies of projects on Environmental Information Systems (EIS), Natural Resource Accounting (NRA), and Environmental Audits (EA). These, on the whole, are viewed as pilot projects in the context of a world-wide effort in the development of environmental information systems. This work has hardly progressed beyond tentative experimentation with new concepts, methods, and techniques of spatial analysis and development training in the field of environmental assessments and regional planning (e.g., basin studies). Typical applications are GIS techniques of overlay mapping of physical features with socio-economic statistics and resource mapping from remote sensory imagery (e.g., GRID). At this stage, these kinds of projects have not penetrated deeply in the broad macro-level socio-economic development planning. A prerequisite for this to happen is that macro-level frameworks, like FDES, be "institutionalized" in the routine data collection of CSOs.

International Aid Agencies and Sustainable Development

The traditional "mission mandate" of donor agencies is being scrutinized with respect to the "sustainable economic development model." A major criticism is the incompatibility of maintaining ecological capital intact with the "engineering approach" to development. The Brundtland Report emphasized the need to monitor the state of ecological capital by:

"...an annual report and an audit on changes in environmental quality and in the stock of the nation's environmental resource assets are needed to complement the traditional fiscal budgets and economic development plans." (Our Common Future, 1987, p. 314).

Aid agencies do recognize the need, and therefore provide funding, for developing countries to establish reliable data collection systems. The choice of what to collect, however, reflects the prevailing development ideology, historically dominated by large-scale irrigation and hydro power schemes, transport and industrial infrastructures and social development in health and education. Consequentially aid for data collection reflects development needs; these include counting heads (census), measuring industrial output (economic surveys) , social conditions (household, health, and occupation surveys), crop and livestock production (agricultural surveys), and administrative data in the field of education and health. Geological and other resource surveys were also supported by aid programmes as a precondition for resource development. One consequence, albeit unintentional, was the acceleration in resource depletion.

Sustainable development policies clearly imply the need for ERA to complement the traditional measures of economic performance and economic well-being. Figure 2 identifies a three part programmes for technical assistance to establish ERA in developing countries. This includes:

1. Research and Training

The major scientific focus should be on modelling the dynamic processes of environmental stress and response. Major concerns are identification of key indicators of sustainable development and ecosystem health. Areas for research funding should include, *i.a.* ecosystem modeling and mapping, human health (e.g., epidemiological studies), environmental ethics and values, and spatial sampling techniques and methods. Research funding should be directed to universities and research institutes for both basic research and training.

2. Technology and Methods

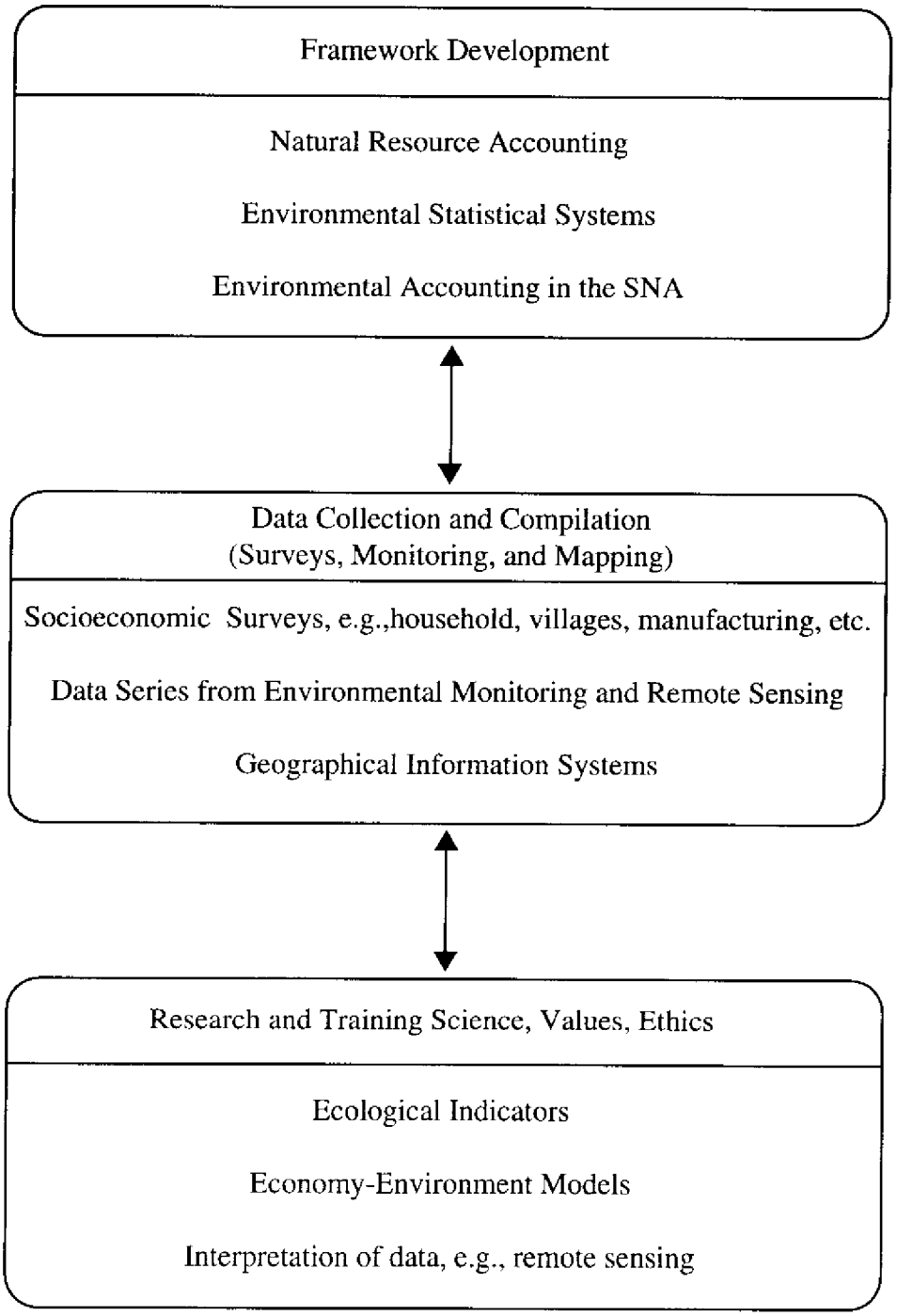
The focus here should be in developing the capacity to collect, compile, and disseminate environmental and natural resource data. The key elements are; (a) improvement of socio-economic surveys to collect relevant environmental and natural resource statistics (e.g., households, industrial establishment, and human health); (b) environmental mapping and GIS technology; and the (c) development of statistical series from environmental monitoring. The target institutions are CSOs[7], survey and mapping agencies, and departments of environment.

3. Environment and Resource Accounting

The focus is on holistic frameworks and the supporting "meta-language" of concepts, definition and classification systems. A major thematic is the integration of socio-economic statistics with biophysical data. The component parts are: (a) stocks and flows of natural resources (NRA), (b) statistics on the state of the environment (SOE); and (c) integrated environmental and economic accounting (IEEA).

FIGURE 2

Component Elements for R&D in Environmental and Resource Accounting



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Notes

1. This paper was prepared for the Environmental and Natural Resource Accounting Workshop, February 24-26, 1992, Nairobi, Kenya.

2. Gunnar Myrdal, Against the Stream. New York: Pantheon Books, 1973.

3. The World Resources Institute studies for Indonesia and Costa Rica belong to this heroic case. Indeed, while economists and statisticians may wince at the "back of the envelope methods," they have been effective in drawing attention to the hidden cost of depleting assets.

4. The early works in national income accounting, circa 1920s and 1930s, were similarly estimated from a variety of inadequate data sources and heroic assumptions, such as Simon Kuznets' U.S. National Income Accounts. Official Government Accounts were first produced in the 1940s; in Canada the first formal national income accounts were produced in 1948, and subsequently backcast to 1927.

5. Generally a shift from informal to market economy will turn up as a growth in GNP. This is nothing other than the old accounting dilemma of how to treat the marriage to the "housekeeper", *i.e.*, a change not in "product" but in institutional arrangements.

6. Two workshops on environment statistics, one held in Nairobi, Kenya (January 1982) and another in Abidjan, Cote d'Ivoire (December 1983) confirmed this hypothesis. See the proceedings of these workshops.

7. In many developing countries CSOs are under the same ministry as that of development planning. Thus, there is a correlation between the content of the data collection and the current fashion in the development model.

Chapter V

METHODOLOGY FOR THE CALCULATION OF SUSTAINABLE NATIONAL INCOME[1]

Roefie Hueting, Peter Bosch and Bart de Boer

An increase in production as measured in national income is generally called economic growth, identified with increased welfare and conceived as the indicator for economic success. All countries of the world give it the highest priority in their economic policy. At the same time, these increases in national income are accompanied by the destruction of the most fundamental, scarce, and consequently economic good at people's disposal, namely, the environment. This notion has prompted a 25 year-old search for a method of adjusting national income figures for environmental losses in order to provide society with a better indicator for the result of its economic actions.

The effort has encountered serious problems which delayed actual work on adjustment of national income for 20 years. For those problems, theoretical or practical solutions have been found. An account of these problems and their solutions provides a good description of the methodology used in the calculation of sustainable national income (SNI).

Environmental Functions

The environment must be described in a manageable way. This problem has been solved by defining the environment as human's physical surroundings (water, air, soil, natural resources, plant and animal species), possessing a number of possible uses on which humans are dependent in all of their activities. These possible uses are called environmental functions and are referred to here simply as functions. The concept of function, on which SNI research is based, forms the link between the scientific and economic aspects of the environment. This concept encompasses the preferences and availability of a function as well as the physical properties of the environment. Competing functions are normal economic goods because they fulfil the definition of scarcity: a good is scarce when something else that is desirable must be sacrificed in order to obtain that good. Examples of the competing functions of water include a convenient waste dump versus a source of drinking water. A forest has competing functions as both a source of wood and a barrier to erosion.

Shadow Prices

Shadow prices must be calculated for environmental functions that are directly comparable with the market prices in which national income is recorded. To

accomplish this, a supply and demand curve must be constructed. It is always possible to construct a supply curve. Costs of the measures necessary for the restoration and preservation of the functions, measured as a physical parameter, can be used in deriving a supply curve. The possible measures are arranged by increasing costs per unit of burden prevented. However, it has proved impossible to construct complete demand curves, since preferences for the current and future availability of functions, notably the life-sustaining functions, can only be partially quantified. This is an insolvable problem, and consequently a true economic valuation of the environment cannot be given. Therefore, every method of expressing environmental functions in monetary terms is based on an assumption regarding the preferences for the environment.

Thus, calculating the present value of future environmental costs and benefits assumes that the preferences for a sustainable use of the environment amount to zero. For example, based on a discount rate of 10 per cent, the present value of a dollar earned 100 years from now is 0.007 cents, practically zero. Sustainability in relation to the environment deals with a geological or evolutionary time scale, the pace of natural processes, and the rate of adaptation of species and ecosystems to changes in the environment. On this time scale 100 years is a very short period. Moreover, two independent policy goals, optimal allocation of production factors and an equitable intergenerational distribution of welfare, cannot be satisfied by the discount rate alone.

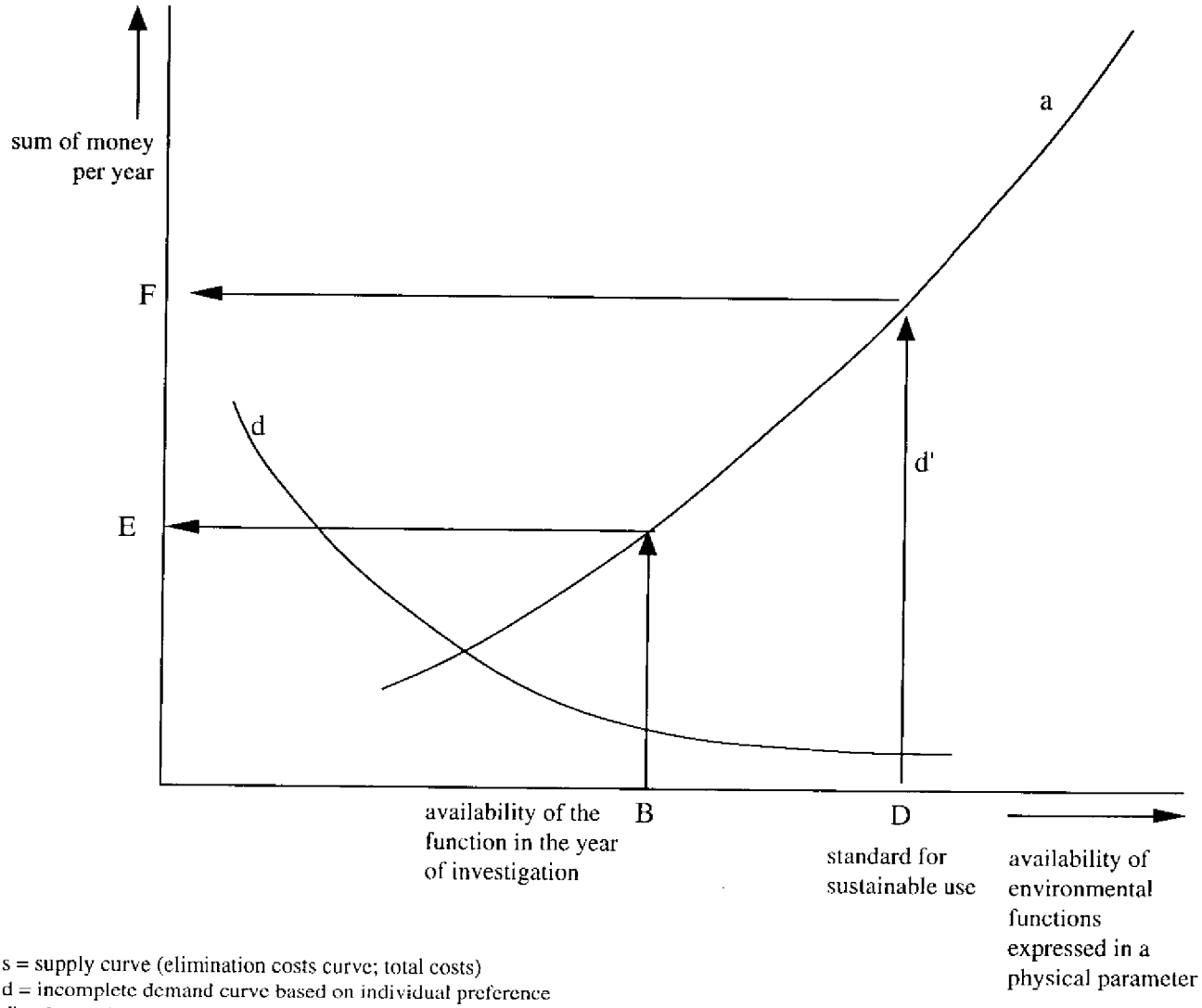
Of course, every method to express environmental losses in monetary terms is welcome, provided that the assumption regarding the preferences for environment and sustainability is made explicit. If it is not, however, the information acquired may be counter-productive, in that wrong conclusions may be drawn from it. Attributing differences in outcome to differences in methods used, as opposed to differences in assumptions, is comparable to a carpenter who estimates that a room measures 30 m^2 according to method A and 180 m^2 according to method B.

SNI research assumes that people prefer a sustainable use of the environment. This assumption seems plausible because politicians and institutions across the world have declared themselves in favor of such sustainable use.

The argument above is summarized in Figure 3 below. As shown in the figure, the investigation, in addition to establishing the point of sustainability on the abscissa, amounts mainly to formulating the measures that are necessary to bridge the distance BD and to estimating the costs of those measures. In doing so, the size of the losses as already recorded in physical units in the year of investigation (for instance 1990) is then expressed in monetary units. This corresponds to the minimum costs that must be incurred to bridge the distance between the present

FIGURE 3

Translation of costs in physical units in monetary terms



s = supply curve (elimination costs curve; total costs)
d = incomplete demand curve based on individual preference
d' = demand curve based on the sustainability standard
BD = distance that must be bridged in order to arrive at sustainable use of environmental functions
EF = costs of the loss of function, expressed in monetary terms
The arrows indicate the way via which the loss of environmental functions recorded in physical units is translated into monetary terms.

situation and the sustainable use of the environment. Comparison of this amount with the Standard National Income yields the Sustainable National Income. The supply curve is composed of four types of measures.

1. Costs of introducing and implementing relevant technical measures.

2. Costs of developing alternatives for non-renewable natural resources, such as replacing fossil fuels with solar-based forms of energy, and by substituting glass fiber for copper wire.

3. Costs of reducing environmentally-burdening activities when technical measures alone are not enough to reach the point of sustainability.

4. Costs of reducing the population (when categories 1,2, and 3 lead to an unacceptably low level of facilities per person) and the resultant drop in the volume of activities.

This categorization is based on the fact that environmental burden is determined by the number of people, the per-capita volume of activities, and the nature of those activities.

Apparently, SNI research produces a by-product, namely a programme for attaining a sustainable activity level at the lowest possible costs involved.

Non-renewable Resources

The regenerative capacity of the environment is taken as a criterion for the sustainable use of its functions. For renewable resources it is obvious how this criterion has to be applied. The regenerative capacity of non-renewables is supposed to take the form of developing substitutes for the resource and of improving efficiency by, among others, energy efficiency measures and recycling materials. The functions of the resource will remain available "forever" when, within any given period, the quantity which is withdrawn from the stock of a resource is not greater than the flow of the substitutes developed for that resource plus any "improvement of efficiency," *i.e.*, any possibilities for re-use and saving the resource. In this way, the available stock of a resource, including its alternatives, remains the same.

It appears that mainly efficiency measures have been taken in the past. If the line is continued, based on such improvements, this would mean that in a number of years we would reach the same level of production with a fraction of the present

utilization of resources. As regards energy, the present level of production ought to be attained in 60 years' time with 37 per cent, and in 315 years' time with 0.5 per cent of current consumption of fossil energy sources. It is, however, far from certain that it will be possible to achieve such great improvements of efficiency (63 per cent and 99.5 per cent). In the context of sustainability, 315 years is a very short period.

In order to decrease this risk, a reservation is made in SNI research, for which the following procedure is applied. From statistical data, one should derive the pace with which substitutes for a resource have been developed in the last 10 to 20 years, and the costs involved in this. Then the time it would take to completely replace the resource at the determined pace must be established. The time over which, given a constant level of production, the resource will be depleted must be determined as well. The depletion time divided by the replacement time yields a rough approximation of the acceleration factor needed for the development of substitutes that can replace the functions of the resource when it is depleted. This factor multiplied by the yearly costs found for developing substitutes yields the amount of the reservation.

It is often proposed to make investments in human-made capital goods in order to create a future flow of revenues that compensates the future flow of revenues foregone by the loss of resources. This, however, does not provide a sustainable solution. First, when the resource is depleted and no substitutes are developed, any investment is useless. We are dependent on only two factors: our hands and brains, and the possible uses (functions) of the environment. Second, the production of capital goods will in turn generate a burden on the environment and natural resources.

The Netherlands and the Rest of the World

Finally, SNI research focuses not only on the environmental losses within a given country but also on the losses caused abroad by production and consumption in the country. For instance, the Dutch production of meat depletes the soil in Thailand, and tropical products, such as hardwood, are imported for a price far below the costs of their sustainable exploitation. Data on sustainability costs of imported products will be collected within the framework of SNI research.

Notes

1. This paper is a summary of "Methodology for the Calculation of Sustainable National Income," The Netherlands Central Bureau of Statistics, Statistical Essays, M 44, 1991.

Chapter VI

NATURAL RESOURCE ACCOUNTING IN THE DEVELOPING WORLD: A NEO-CLASSICAL APPROACH: A SUMMARY[1]

Joy E. Hecht and Henry M. Peskin

This paper describes an approach to natural resource accounting, whose objective is to incorporate environmental concerns into development planning. Although to date this approach has only been implemented in the United States, projects are underway or under discussion to apply it in developing countries in both Asia and Africa. The paper describes the principles behind the approach, how it may be of use in the developing world, and the experience using it in the Philippines.

Principles

The overall objective of this approach is to improve the quality of policy decision-making whose goal is development. Natural resource accounts provide the information base for incorporating marketed and non-marketed services of the environment into that analysis. To the extent that human well-being is best served through protection of the environment, the resource accounts will show this, and will provide an argument for environmental protection. However, when human well-being is not maximized through environmental protection, the accounts will show this as well, and will show the costs of choosing to protect the environment nevertheless.

These are economic rather than ecological accounts. Resources are included if they are in scarce supply, so there is a positive (though not necessarily monetary) opportunity cost associated with their use. Resources in excess supply, for which one user's consumption does not impose a cost on others, are omitted even if they are invaluable from an ecological perspective.

This approach to accounting is primarily oriented towards its "management" rather than its "score-keeping" function. "Score-keeping" focuses on the bottom line as an indication of the health of a business or economy. "Management", by contrast, uses the data in the accounts to trace the evolution of specific sectors, analyze proposed policy reforms, or provide information on which management decisions can be based. It is this use of the natural resource accounts which is expected to be most important for development policy-making.

The overall objective of human well-being means that the accounts must take a macro rather than a sectoral approach. While sectoral accounts generate useful data about resource-dependent industries, they do not support the evaluation of trade-offs between those sectors and others. Similarly, the resource accounts

must incorporate both marketed and non-marketed environmental services. Although the importance of non-marketed benefits and negative externalities is widely recognized, to date resource accounting in the developing world has focused largely on marketed environmental services like commercial forestry. To permit analysis of the trade-offs among decision options, the accounts must be monetarized rather than only including physical data. Although valuing non-marketed environmental assets poses both theoretical and practical problems, it is essential in order to compare the impacts of different policy options.

Clearly data problems will be enormous in building a system for valuing non-marketed environmental resources. This approach therefore creates an account structure which will be filled in as possible with estimates and poor data, and which will be improved over time as necessary and feasible. Despite the problems, these accounts will be useful from the start, for several reasons. First, for policy-making purposes bad data are better than no data at all. Any choice implicitly values the impacts of the different options; analyses which ignore non-marketed environmental services give them a zero value, while those which allow no deterioration on the grounds that the environment cannot be valued give it an infinite value. Faced with the choice between using bad data or implicitly valuing the environment at zero or infinity, using bad data is preferable. Second, the dissemination of crude statistics can lead to identification of better information. When faced with published data, people may be willing to provide what they have, or may realize its relevance. The rough accounts will also indicate where further investment in data development is likely to be most useful, based on the importance of each estimated value in the economy as a whole.

Structure of the Accounts

The proposed accounting system is an add-on to the conventional income accounting structure, leading to the calculation of a modified form of GNP. It treats the environment as a collection of assets, each defined by the service it provides, rather than as a set of spatially distinct resources defined by location and physical features. Thus a lake would be understood as a set of assets providing services such as waste disposal, commercial fishing or transportation. Rather than valuing the lake as a single item, each service is valued separately. This approach is essential in order to allow trade-offs among the services and various depreciation schedules for the different service-based assets.

The modified account structure incorporates the environment in several ways. It includes households as a productive sector, which consumes inputs from the environment and produces outputs for its own use. Waste disposal services to business and households appear on the input side of the accounts, valued

negatively as a subsidy. The negative externalities imposed by these services are treated as final output, valued negatively on the right side of the accounts and labelled "environmental damages." Direct services to households or to society as a whole are a positive output, listed on the right hand side of the accounts. These entries are balanced by "Net Environmental Benefit," defined as services (waste disposal and direct final demand services) less damages, and appear on the input side of the accounts by convention. The system then deducts depreciation, again based on environmental services. These additional accounting entries, when incorporated into conventional economic accounts, yield modified Net National Product (NNP). To obtain a similarly modified Gross National Product (GNP), the accounts add back capital and natural resource depreciation.

Valuation

Implementing these theoretical frameworks in the developing world involves making the best estimates possible given the data available. A number of approaches may be useful, depending on the assets to be valued and the applicability of existing data and valuation models.

Non-marketed environmental services to households, such as gathered fuelwood or foods, can be valued in several ways. One approach is to value them at their market price[2]; however if no market exists, this will not be meaningful. A second approach would be to value them in terms of the time it takes to collect them; then the problem is how to value time. Where paid employment is an option, both time and non-marketed products could be valued by using data on household expenditures, employment and time-use. Some preliminary work of this type has been done on Tanzania, and more thorough data collection is under discussion for Cote d'Ivoire.[3]

Waste disposal services can be valued based on the cost which would be incurred if discharges were treated to remove the waste, since that would be the alternative if the environment did not provide the service. Empirical data on the costs of such treatment are readily available for factories, sewage treatment plants, farms, and households. The treatment costs actually incurred are already included in the national income accounts, but the potential cost (if current discharges were also to be treated) do not appear in the accounts; in estimating the value of waste disposal services it is important to include only those which are not currently incurred.

Using treatment cost data involves combining them with data on discharge levels to calculate the cost which would be incurred to bring the wastes up to specified levels of cleanliness. If discharge levels are not known, they may be estimated

using engineering process information which describes material inputs and outputs of different types of factories. Similar approaches may be taken to estimate the value of waste discharge for agriculture and municipal sewer systems. If there is no urban sewerage, it might be appropriate to estimate the cost of building the sewer system as well as the treatment plant; alternately, it might be useful to estimate the costs of low-tech, decentralized sewage treatment systems if these are more suited to the environment.

The external damages imposed by use of the environment for waste disposal can be valued in several ways. One approach is to value them at the cost of removing them. While this avoids the use of value-laden benefit estimation techniques, it equates the costs of pollution control with the benefits of cleaning the environment, making it impossible to use the accounts for cost/benefit analysis. An alternate approach is to directly estimate the costs imposed by pollution by considering medical impacts and mitigative expenditures. While such studies are expensive, parameters developed in the west may be transferable to developing countries in order to obtain rough estimates.

Services provided directly by the environment may be valued in a variety of ways. Demand for recreational services is often estimated using travel demand models. Ecotourism values of assets such as wildlife have been estimated directly in some countries and the results may be transferable elsewhere. Wildlife-based recreation has also been valued on the basis of the number of days spent engaging in such activities. A rather different kind of direct service provided by the environment is the waste water treatment by wetlands. The volume of this natural filtration is estimated from biological models, and it is valued at the cost of building facilities which would produce an equivalent rate of nutrient reduction.

Economic theory defines depreciation as the change in net present value of a future income stream over the accounting period. The depreciation of an environmental service should therefore be valued using a model of the expected future income stream, taking into account such factors as population growth, changes in the regulatory environment, and new technologies. However, because of the difficulty of building such models, existing resource accounts make gross simplifying assumptions to estimate depreciation. The unit rent[4] method values each unit of a resource at its sale value less the cost of harvesting or extracting it; the whole stock is valued at the unit rent times the quantity. Depreciation is then the difference between the opening and closing stock values over the accounting period. A more complex approach[5] assumes that in each year resource users expect future income from marketed and non-marketed services to be the same in the current year, adjusted for physical changes in the stock. Depreciation is then the difference between the net present value of the resulting stream of income at

the start and end of the period. With the benefit of hindsight, earlier years' depreciation estimates are recalculated using actual data on more recent income streams. This approach has the advantages of making the assumptions about future income streams explicit and incorporating non-marketed as well as marketed assets, but is still highly simplified.

While estimates like these will be crude, they do indicate the orders of magnitude of the different items. Thus they suggest the areas in which it will be worthwhile to invest in better databases for future accounts. Dissemination of results like these may also serve as a catalyst to the development of better data, as their utility becomes apparent.

Institutional Issues in the Developing World

This approach to resource accounting is generating increasing interest in the developing world, with systems underway in the Philippines and under discussion in Indonesia, Nepal, Sri Lanka, and elsewhere. The experience of the Philippines may offer some useful lessons. That project, which began in January 1991 with support from the United States Agency for International Development (USAID), was designed to take a broad macroeconomic perspective. The accounts were to be implemented by a team of Philippine and American economists working under the auspices of the Department of Environment and Natural Resources (DENR). Everyone involved both in this project and in the conventional accounts agreed that the project should follow a macro rather than a sectoral approach, so that it would serve general development needs and go beyond the particular interests of DENR.

In practice, however, several factors made it difficult to retain the macro focus with which the project was designed. The fact that it was under the auspices of DENR meant that the interests of the forestry service came to carry an overly important weight. As the forestry focus grew, the conventional income accountants lost interest, so the pressure to keep a broad focus dropped off. The backgrounds of the Philippine experts on the project may also have contributed. Most of them came from applied economics disciplines, primarily forest economics. Each was interested in a specific sub-sector of the forestry industry, and none was particularly interested in the broad cross cutting work which this approach entails. By contrast, the people who actually implemented such accounts in the U.S. had broad training in economics, with no particular specialization and without graduate work. Consequently they were neither wedded to a particular subject of study, nor too far along in their careers to be willing to do the basic "data-grubbing" required.

These experiences suggest that an accounting system designed to serve general development needs must be based in the ministry responsible for economic

development or national accounts. The work involved in actually implementing the accounts may be more suited to the skills, needs, and interests of graduate students in economics than to their professors consulting on the side.

The Philippine and United States experiences also showed government agencies to be reluctant to publish statistical data which are known to be inaccurate. Consultants, on the other hand may be less constrained. This suggests the utility of having the accounts start as a pilot project conducted by outsiders, who can release intermediate data and reports in their own rather than the sponsoring ministry's name. This provides an opportunity to use rough accounts as a catalyst to elicit better data without the sponsoring ministry being held responsible for the accuracy of the data.

As resource accounting becomes widespread, we will learn much more about the institutional dimensions of actually setting up such accounts within developing country governments. It will be important to continue learning from these experiences to ensure that resource accounting systems will be as effective as possible.

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Van Tongeren J., S. Schweinfest, and E. Lutz. 1991. "Integrated Environmental and Economic Accounting: A Case Study for Mexico." World Bank Environment Working Paper No. 50. December.

Notes

1. This is a summary of a paper by the same title presented at the Committee of International Development Institutions on the Environment (CIDIE) Workshop on Environmental and Natural Resources Accounting, United Nations Environment Programme, Nairobi, Kenya, February 24-26, 1992.

2. Estimates of non-marketed agriculture output are generally included in the conventional income accounts, so they are not included under the household sector.

3. See Peskin, Floor and Barnes, 1991.

4. See, for example, Repetto *et.al* (1989) on Indonesia, and Van Tongeren, Schweinfest and Lutz (1991) on Mexico.

5. See United States Environmental Protection Agency (1992) on the Chesapeake Bay Region.

Chapter VII

PROBLEMS AND METHODS OF NATURAL RESOURCE AND ENVIRONMENTAL ACCOUNTING: THE INDONESIAN CASE[1]

M. Suparmoko

Natural resource and environmental accounting is a new topic discussed frequently in Indonesia and abroad. Both economists and policy makers alike are beginning to realize that Gross Domestic Product (GDP), as a tool for economic planning, in order to become a real measurement of a country's well-being, should reflect the changes in natural resources and environmental values in its calculation.

Indonesia, as one of the developing countries aware of the role of natural resources and environment in achieving environmentally-sound and sustainable development, has decided to include natural resource and environmental considerations in the National Policy Guidelines by properly managing its natural resources and environment. Sustainable development is commonly defined as development to fulfil the needs of the present generation without compromising the ability of the future generation for their own development. To achieve environmentally-sound and sustainable development, economic policy is directed towards both increasing the standard of living from the point of view of increasing income per capita, and improving human health, which includes environmental and natural resource conservation. Natural resource conservation is defined as using natural resources properly for development in order to maximize the socio-economic welfare of society.

Natural Resource and Environmental Accounting

Repetto *et al.* have done a study on forest, oil, gas and soil resources of Indonesia. The result of this study has made Indonesia one of the developing countries known to be engaged in monitoring reserves and changes in the natural resources, especially oil and gas, and forest and soil resources. These values were incorporated into the conventional GDP, yielding a "green" GDP.

The results of this study, based on the "green" GDP of Indonesia from 1971 to 1984, indicate a lower rate of growth (4% per year) for the Indonesian economy relative to that of the conventional GDP (7.1% per year), despite some reactions and comments on the result.[2]

Since Repetto's study, much attention has been directed toward Indonesia as one of the developing countries that has attempted resource and environmental accounting. A further step has been taken by Surna T. Djajadiningrat, the

Assistant IV to the Minister of State for Population and Environment, who suggested that Indonesia has to develop its own capacity to conduct studies on natural resource and environmental accounting. This study, with the support of the Environment Management Development in Indonesia Project (EMDI Project) under CIDA was initiated in 1990 by a group from the Ministry of State for Population and Environment (KLH) and the Central Bureau of Statistics (BPS). The involvement of the BPS staff is considered crucial, not only for the data sources and methodology, but in preparing BPS early on as the sole agent for conducting the natural resource and environmental accounting of Indonesia.

This kind of approach was adopted during the development of regional income accounting in Indonesia. In the beginning, a group called the Regional Income Research Group was formed. Its members came from different agencies, such as universities, the Central Bureau of Statistics, and the National Planning Board (Bappenas). Each sub-group was assigned the task of computing a regional income accounting for different provinces by involving several people from provincial statistics office. After several years of exercises, the function of conducting regional income accounting has been transferred to the Regional Development Planning Board (Bappeda). By using the same approach it is expected that natural resource and environmental accounting will be the duty of BPS, either at the regional statistics office or at the Regional Development Planning Board.

The natural resource and environmental accounting team of Indonesia has divided the work into four stages. The first stage is to study concepts, definitions and problems related to oil and gas, and forest resources with their application to the 1988 data. The second stage will be an extension of the first stage, *i.e.*, to compute the resource stocks and the changes in stocks from 1980-1989 and to refine their computations. Based on the experiences from the first and the second stages of the project, following the pattern used by BPS, a guide book should be developed so it may be used by others, not only at the national level, but also at the regional level and among the resource departments. The third stage will then be an application of the concepts and methods to more natural resources, such as land, water, coal, fish, nickel, bauxite and tin. Finally, in the fourth stage, the accounting for environmental quality, such as water and air quality, will be implemented.

Since the introduction of natural resource accounting in Indonesia in 1989, many other institutions have become interested in natural resources accounting. The National Coordination for Survey and Mapping Agency (Bakosurtanal) is also attempting to produce figures on natural resources that are known to be available in the whole province area. But most of those agencies only attempt to produce physical resources, and do not arrive at the value account.

Methodology

As Repetto's approach seems to be the most simple one, the Indonesian team on natural resource accounting has begun work by adopting it. The basic idea is to present figures in physical and monetary terms for both the opening stock and changes in the stock, and to come to the final or ending resource stock for every year. Changes in stock include the growth of the stock due to discoveries of new reserves or natural growth, and the decrease in stock due to depletion and damages.

However, since data are not always available and suitable for the study, estimations and adjustments are always made to arrive at the necessary figures. For valuation purposes, unit rent is always used. The value of unit rent is derived from the price of resource output minus the cost of its production, including transportation costs and normal returns on capital. For output prices, if we want to understand the distribution of the benefits of resource depletion, the international price may be used. Some commodities are not sold on the international market, however, and in those cases, domestic prices are used. This is considered appropriate since we would like to see whether the government is really receiving the correct amount of royalties. The use of international prices seems to be biased towards the concessionaires. The concessionaires appear to receive too high a percentage of the unit rent as their corporate profit.

The Problems

As in many other studies, problems with data collection are encountered. Secondary data, which are usually but not always available, fit our needs. Furthermore, with more detailed figures, like cost structure for each different species for example, primary data coming from field surveys are required. Determining the value of capital stock in different resource sectors is not easy work, although investment figures are commonly available. Finally, conducting a survey for the purpose of primary data collection requires a lot of funds, which are not always available in developing countries like Indonesia.

In addition to these common problems, there is a lack of personnel interested and capable of carrying out such a study. Dissemination of concepts and methods for natural resource accounting is required, but it takes time. More people, more money and more efforts are then the key to success for the project. While natural resource accounting has already received some attention, many people in most resource departments are not aware of the concepts found in Repetto's work. Most people work on production targets designed to achieve high growth rates of

the economy. Sometimes people are not even interested in seeing the impact of natural resource depletion and degradation on the value of GDP. The GDP growth rate might be constant, but the value of the GDP will certainly decrease with resource depletion and degradation. A lower GDP may create political problems in the country. Thus there is perennial disagreement between growth and environmental aspects of life, but this is only in the short-run. However, to convince others about long-run sustainable development is again not an easy task.

Aside from Repetto's approach, a comprehensive natural resource and environmental accounting under the direction of Henry M. Peskin has begun in Indonesia. This project is sponsored by the United States Agency for International Development. The aforementioned Indonesian team will also be involved in this new approach, and this will broaden and deepen our understanding of natural resource and environmental accounting, especially in the context of Indonesian economic planning and natural resource and environmental management.

Notes

1. This paper was submitted to the Committee of International Development Institutions on the Environment (CIDIE) and United Nations Environment Programme (UNEP) for the Environmental and Natural Resource Accounting Workshop, held February 24-26, 1992, in Nairobi, Kenya.

2. Among others Peskin finds Repetto's approach deficient on three counts: a) it overestimates forestry depletion; b) assumes that all economic benefits, including those in forestry, have returns equal to common market rate of interest; and c) does not include all environmental issues. See Henry Peskin, "Environmental Accounting in Indonesia: Towards A Comprehensive System," Unpublished Paper for the Natural Resources Management Project 497-0262, May 1991.

Chapter VIII

SUSTAINABILITY AND THE ECONOMICS OF ASSURING ASSETS FOR FUTURE GENERATIONS[1]

Richard Norgaard

"Our theories ... are rays of light, which illuminate a part of the target, leaving the rest in darkness. ... It is obvious that a theory which is to perform this function satisfactorily must be well chosen; otherwise it will illumine the wrong things. Further, since it is a changing world that we are studying, a theory which illumines the right things at one time may illumine the wrong things at another."[2]

This paper presumes the international discourse on the sustainability of development is concerned with a) the rights of future generations to the services of natural and produced assets; and b) whether formal and informal institutions which affect the transfer of assets to future generations are adequate to assure the quality of life in the long-run. Sustainability is primarily an issue of intergenerational equity. The non-economic discourse on sustainability is clearly about caring for the future.

Conversely, this paper contests the implicit premises of economics as now practiced. First, in the face of the sustainability debate, many academic and practicing economists still assume that technology will offset resource depletion and environmental degradation. Technological optimism may or may not be appropriate, but it is not inherent to economic reasoning. Second, existing theory on intertemporal resource allocation, often cited to justify practice, tacitly assumes that current generations hold all rights to assets and should efficiently exploit them. Third, there has been an implicit assumption that the mechanisms affecting the maintenance and transfer of assets to future generations are both working optimally and are unaffected by current economic decisions. The interplay between institutions and environmental management is now well recognized, but analyses to date have only addressed market distortions and the internalization of externalities. While new technologies have dramatically increased people's ability to use resources and degrade ecosystems, no analyses have been undertaken of the adequacy of institutions for protecting the rights of future generations. This paper addresses each of these working premises of economics.

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[1]The full version of this paper is available from the World Bank Publications Office as World Bank Asia Working Paper Series No. 832.

Different intergenerational distributions of assets are associated with different efficient allocations of resources. This paper is informed by three overlapping generations models. The first, available in the academic literature, is a general equilibrium model which illustrates how alternate distributions of rights to a stock of resources across generations affects the efficient allocation of resources. The second, is a general equilibrium model which illustrates a stock resource economy in which concern for the future is achieved through income transfers to future generations. The third, is a general equilibrium model which illustrates a renewable resource economy in which concern for the future occurs through the older generation's utility from the utility of the younger generation as well as its own. These models demonstrate how resource use, consumption, and prices, including interest rates, change with different levels of concern for the future.

While environmental, forestry, and resource economics are concerned with the long-term, this concern has been rooted in the presumption that market failures prevent the maintenance of resources for future generations. Hence improvements in long-term allocation have been pursued in terms of internalizing environmental externalities. While environmental externalities are no doubt a problem, sub-optimal allocations due to inappropriate distribution between generations cannot be solved solely by correcting externalities. Indeed, internalizing externalities without protecting the future can hasten resource exploitation.

Intertemporal general equilibrium models incorporating overlapping generations and resource constraints demonstrate that the efficient allocation of resources is a function of intergenerational distribution. While this "finding" is theoretically elementary, it is at odds with the understandings about allocation and valuation developed through partial equilibrium modeling undertaken in environmental, forestry, and resource economics. A few economists are now recognizing that economies may not achieve sustainability because sustainability is a matter of equity rather than efficiency. But to date, these economists advocate achieving equity through imposing environmental and resource constraints on economic efficiency conceived in a partial equilibrium framework. The models informing this discussion better illumine the problem and provide new insights by incorporating equity into a general equilibrium model and observing how equity affects efficiency. While maintaining natural capital through constraints might protect the future, thinking of the problem as one of how this generation expresses its concern for the next highlights the importance of institutions and social values affecting bequests and other mechanisms.

Many economists, as well as environmentalists, have argued that discounting the benefits received and costs borne by future generations in project analysis is contradictory with a concern for sustainability. While lower discount rates give

greater weight to the future, using rates different from market rates, or what market rates would be without distortions, results in inefficient use of capital. One of the insights from framing sustainability in a general equilibrium model is that with a transfer to future generations the efficient allocation of resources results in new levels of savings and investment, a shift in the types of investments, and a different rate of interest. Thus the discount rate, rather than being an instrumental variable for protecting the future, varies as the future is protected.

A distinction must be made between investments to improve the welfare of current generations given their consumption time preference and social decisions to transfer more resources to future generations. The benefits from changing from one level of protecting future generations to another are not discounted. Cost-effectiveness criteria are used to determine the optimal investment package to meet intergenerational transfer goals to protect future generations.

Markets themselves do not provide for intergenerational equity any more than they provide for intra-generational equity. "Trickle Ahead" is no more suitable as an operating norm for development than is "Trickle Down." There is certainly good reason to believe that historic asset transfer mechanisms, to the extent that they have not been broken down by development, are not adequate under modern technologies, current population levels, and global economic interconnectedness. While adequate levels of assets have been transferred from one generation to the next in many cultures over long time periods, very little is known about the cultural mores and institutional mechanisms which have facilitated transfers. Modern capital markets may fail to both maximize the welfare of the current generation given its consumption time preferences and meet the current generation's goals of transferring assets to future generations. Redistributive failure may occur because private redistribution has public good aspects. In addition, savers are probably unable to determine or control whether they are receiving a return from investments which will be transferred to future generations or from investments which are depleting the assets that might have been transferred to future generations. This implies that asset monitoring and guidance mechanisms are needed to supplement capital markets.

The determination of the optimal intergenerational distribution of rights to assets is impossible without an intergenerational welfare function. The widespread acceptance of sustainability as an objective of development, however, indicates that sustainability itself can be treated as a minimum criterion of intergenerational equity. Economics can assist in the interpretation of what sustainability as a minimum criterion means in practice, the extent to which it is being met, and the viability of the institutions which assure that it is being met. Economic reasoning and empirical methodologies can assist in analyses of historic and current levels of

asset transfer, in analyses of whether the quantities of assets transferred meet minimal sustainability criteria, and analyses of changes in and the current viability of institutions affecting the formation, maintenance, and transfer of natural and other assets. While there is considerable scope for economic analysis to inform social decisions with respect to sustainability, economists need to be careful that they do not fallaciously critique redistributions to future generations based on efficiency arguments which implicitly assume that the current generation has no responsibilities to the future.

Economists' historic emphasis on efficiency, implicitly taking the existing distribution of assets as a given, has limited their ability to perceive and respond to the challenge of sustainability. This emphasis logically evolved through economists' participation in progressive institutions established, in part, to circumvent the "irrational" politics of distribution. Accepting the existing distribution of income also justifies the use of data generated by markets, thereby giving economic reasoning empirical grounding and scaling. Economists can participate more effectively in the diverse social decision-making arenas in which intergenerational equity decisions are being made if they use economic analysis to complement other types of analysis rather than assume that economic reasoning is a sieve through which other forms of reasoning must pass.

From the operational perspective of development assistance agencies, addressing the sustainability of development would further the shift away from project analysis toward country level and policy analysis as well as toward increased country dialogue. At the level of project analysis, emphasis would need to be given to how projects affect the formation, maintenance, and transfer of assets to future generations as well as to efficiency analyses.

Pursuing sustainability as intergenerational equity leads to questions with respect to whether capital markets can facilitate both investments to meet the current generation's consumption time preference and transfers to meet its concern for future generations. Such an exploration reinforces the concerns expressed by theorists investigating intertemporal general equilibrium and exhaustible resource allocation that sufficient actors must have a global view for things to work out right. Such a global view must incorporate knowledge from the natural sciences and information generally beyond that provided by markets to avoid being myopic. International development agencies as major actors with excellent access to global information should play a key role in the synthesis and use of such a global view.

The paper presents sociological explanations of how economics evolved to help identify how it became the way it is and to give perspective on how sustainability challenges the discipline. The footnotes also provide considerable commentary and

extensive reference to the socioeconomic literature outside of the technocratic progressive or neo-conservative-stances that economists typically take toward politics.

Notes

1. This paper is the executive summary of the larger work "Sustainability and the Economics of Assuring Assets for Future Generations," in World Bank, Working Papers, WPS 832, January, 1992.

2. John R. Hicks, Wealth and Welfare: Collected Essays on Economic Theory. Cambridge, MA: Harvard University Press, 1981. pp. 232.

Chapter IX

TOWARDS A PLURALISTIC APPROACH IN NATIONAL ACCOUNTING[1]

Anthony M. Friend

Pluralism: A theory or system of thought which recognizes more than one ultimate principle: opposed to Monism (Oxford English Dictionary).

Is national accounting a science? Is the scientific method of proof, or confirmation of theory applicable to the national accounts? Science requires that empirical observation is consistent with the laws of nature. Do such laws exist in the social sciences? Gunnar Myrdal thought not. To him the only distinction that counted was whether the observed "facts" were relevant, or more to the point, which facts were more relevant than others (Myrdal, 1973). Economic theory has the tendency to infuse ideology with empirical observations of social behaviour (Robinson, 1962). Is the System of National Accounts (SNA), therefore, an elaborate *legerdemain* to bolster the tyranny of GNP?

Social scientists are acutely aware that interpretation (or meaning) of empirical evidence of social behaviour is contextual to a particular frame of reference. This was not always acknowledged when the Newtonian framework dominated the world of science. The eighteenth century political economists believed that universal economic laws could be discovered in the manner of celestial mechanics. The laws that govern supply and demand of commodities, for example, could be empirically determined by observing human buying and selling behaviour in competitive markets. In this way, all rational economic decisions, so it appeared, could be deduced from mechanistic behaviour not too different from the dynamics of physical equilibrium states found in nature. In other words, an economy was viewed as an elaborate homeostatic system, an image epitomized in the concept of self-regulating markets and further encapsulated in Adam Smith's Invisible Hand.

The economic model, particularly in its microeconomic guise, dictated the explanatory variables of the behaviour of the national economy. The theory of comparative advantage (the ideology of free trade) extended the "invisible hand" to the global economy. With the abandonment of the gold standard, and most severely in the Great Depression of the 1930s, the self-regulating mechanisms appeared to break down. Thus, economic behaviour, which appeared to be imbued with natural laws, was seen, as it always should have been, as the human response to a consciously designed economic system. When the supporting institutions collapsed so did the self-regulating market, the success of which could be largely attributed to the historical anomaly of the pax Britannica and the enforcement of the gold standard. This framework created the unique institutional

conditions for the free flow of finance exemplified in nineteenth century capitalism (Polanyi, 1944).

The neo-classical synthesis established a paradigm for SNA. While the national accounting community is aware of alternative interpretations (e.g., Material Product Accounts), they nevertheless defend the SNA framework on essentially positivist grounds, assuming for instance that statistical surveys of economic variables are confirmation of empirical facts. Yet, it is well known that there is no singularity in the conceptual basis of such key economic variables like production, consumption and capital accumulation nor, for that matter, has the notion of what constitutes the national product ever been satisfactorily clarified. Indeed, the question of what should be included, or excluded, from GNP has been in dispute ever since the inception of national accounting. In spite of the lively controversy among the profession, GNP is still regarded as an objective indicator of economic performance. This is a good example, perhaps, of Whitehead's fallacy of misplaced concreteness.

The purpose of this paper is to explore aspects of economic thought that explain this "misplaced concreteness" and argue for a pluralistic approach. An underlying leitmotif is that of the importance of the measure of income in assessing economic performance, emphasizing in particular the distinction between money and use value with respect to the evaluation of environmental goods and services.

National Accounting as a Measure of Wealth

The Roman Census, in essence, was a "stock accounting" of the population. This provided a database to calculate the potential tribute to be expected to flow into the coffers of Rome, or as a baseline for estimating recruitment quotas needed to replenish the depleted legions. Norman England took this one step further when it recorded the number of serfs, livestock, and area of ploughland of the manorial estates. This vast data collection programme was viewed, perhaps cynically, but nonetheless with foresight on the future of statistics, as an official record of the nation's wealth registered in the appropriately named Doomsday Book.

Thus, while national accounting can be traced to measures of inventories of productive wealth, it was Adam Smith who first recognized the importance of the combination of "flow factors," identified as capital, labor, and land, as the instrumental cause of wealth. Nonetheless, even he wrote that "the earth furnishes the means of wealth."[2] The creation of national product by combining factors of production (economic flows) with natural resources (economic stocks) became a major preoccupation of the new science of political economy. The classical framework treated natural resources, *i.e.*, soils, as a limiting factor in

economic growth models. The Malthusian theory of the geometric growth in population and arithmetic growth in food output led to the inescapable conclusion of the inability of the laboring class to rise above subsistence level. The models of the "dismal sciences" of diminishing returns from the soil led to another inescapable conclusion: the increasing appropriation of wealth claimed in the form of (unproductive) Ricardian rent.

The tradition of physical stock accounting is now largely ignored in modern national accounting systems. This is replaced by a concept of National Income measuring the (unduplicated) annual flow of goods and services produced in the economy. A concept required to describe production between two points in time is far more difficult to pin down than that of an accumulated stock of wealth at a point in time. The latter does not require an opening and closing inventory in order to allocate the year-to-year transfer of wealth; nor does it need to distinguish transboundary flows of goods and services, i.e., balance of trade. The elimination of all intermediate flows in order to avoid the sin of double counting provides yet another quandary for "national flow accountants" to resolve. For instance, should one distinguish the proportion of the car used for travel to work from that used for pleasure? Since no direct measure of income exists, some ambiguities arise from the interpretation of the surrogates employed to measure the concept of income, like assuming equivalence of economic well-being and payments to factors of production, (*i.e.*, labor, capital and land).

These accounts also play an important instrumental role in fiscal and monetary policies. Thus, financial flow accounts have been developed to monitor some of the vital signs of economic health represented by such abstract concepts as the rate of savings, the level of investments, and liquidity of the money supply. Oddly, it is the inter-industry Input/Output (I/O) Table in SNA that comes closest to a meaningful measure of national product from an environmental perspective, *i.e.*, material-energy throughputs. Yet, within the context of SNA this is regarded as intermediate product which is conveniently canceled out in the measurement of GDP. The structure of SNA (conceived of as a two-way production-consumption flow among business, households, governments and the rest-of-the-world) effectively closes the system from accounting for direct environmental contributions to the economic process. Thus, foreclosing an opportunity to link the health of the economy to the health of the environment (Daly and Cobb, 1990).

The Problem of Value: Money or Use-value

The requirement of a common denominator is a *sine qua non* to producing a single figure of the national product. The obvious choice is money, the medium of exchange. Thus, money-value became the undisputed numeraire of SNA.

Nonetheless, the credibility of GNP as a measure of economic welfare stems, in part, from the implication of money as the basis of the value system. As Joan Robinson pointed out, disputes on the nature of value are deeply embedded in economic discourse. This, she referred to as "the metaphysics of economics."

"One of the great metaphysical ideas in economics is expressed by the word 'value.' What is value and where does it come from? It does not mean usefulness - the good that goods do to us.... It does not mean market prices...it is something which will explain how prices come to be what they are. Like all metaphysical concepts, when you try to pin it down it turns out to be just a word."[3]

One dire consequence of money-value accounting is that it equates income with the quantity of market goods and services produced. The difference between exchange-value and use-value is clearly distinguishable in economic literature. Utility, or satisfaction derived from consumption, is a measure of use-value; in essence a stream of services obtained from stocks. For many economists the latter is a much better indicator of economic well-being than the flow measure used in national accounting. (Fisher, 1906, Boulding, 1949, Daly, 1976).

While the assumption in "consumer choice theory" that market values (under certain conditions) can subsume all other values has some validity, it has proven difficult to defend in the case of environmental externalities, cultural values in nature, and most conspicuously in problems associated with the intergenerational transfers of natural resources (Martinez-Alier, 1987). In order to encompass non-market values in consumer choices, a new domain of economic discourse aimed at finding socially acceptable methods of evaluating the contribution of environmental goods and services to economic welfare has been developed. The discourse focuses on methods to calculate values for common property by creating "artificial markets" for allocation of scarce environmental resources. The economic tool kits include shadow prices, willingness-to-pay, option values, contingency evaluations, present time social discounting and so forth. However, with perhaps a few exceptions (such as the application of cost/benefit analysis of specific projects), environmentalists tend to be highly suspicious of these techniques believing them to be merely a trick to turn high-order cultural values into low-order money-values (Hueting, 1980, Naess, 1989).

Apart from the metaphysical value issue, there are several other objections to the empirical basis of the money-value approach. These fall into the following categories:

1. The assumption of a single market

Economic systems are complex and multi-layered. GNP, in essence, is a normative concept conforming to an institutional viewpoint of "markets". In developing countries economies these blur into informal markets and obligatory arrangements and are aptly called the "dual economy". Growth in the use of illegal drugs and tax evasion activities suggests the existence of a thriving dual (underground) economy even among developed countries. The emerging globalization of the economy described by footloose multinationals and the round-the-clock electronic stock markets is yet another conundrum in defining what should constitute the "boundaries" of the national product.

2. The assumption of truth-value in survey questionnaires

In modern industrial states we have come to trust the responses of business, households, and governments to statistical surveys. In these surveys degrees of error are calculated on such innocuous factors as sample size rather than on assumptions about outright lies. In countries where businesses habitually under-invoice and where there are wide discrepancies between budgeted and actual disbursements of public funds (e.g., flows to Swiss bank accounts), the problem goes beyond the notion of under-reporting and borders on deliberate deception. The reporting of (unfulfilled) production quotas in the centrally planned economies must, at least until recently, have created havoc in the measurement of GNP. Suspicion, even in market economies, of the use of survey information (despite assurances of statistical confidentiality) may result in distortions in survey response. Another factor that is rarely examined is the variance in business accounting and the means employed to reconcile this with national accounting concepts. Valuation of capital assets is clearly a major problem here.

3. Price adjustment assumption

Compensating for inflation/deflation is the bane of national accountants. Comparisons of time series of real income become increasingly dubious as consumer tastes change over time and shifts in relative prices affect consumer buying habits. Attempts to maintain real income series might hide fundamental structural changes in the economy.

4. The assumption of the relationship of income and access to goods and services

There are compelling reasons to believe that growth in money-incomes (in constant prices) is not always positively correlated to economic well-being. This, in essence, is the non-inflationary part of the "money illusion." One factor that may account for this is the cost incurred by maintaining increasingly complex (and

potentially unstable) systems (Prigogine and Stengers,1984). Thus, growing bureaucracies in government and business, general inefficiencies of physical crowding (e.g., traffic jams) and costs engendered by social and technological instability (*i.e.*, security and risk) can add to money-income without equivalent compensation of desired goods and services.

What information is needed to manage the economies of the 1990s and beyond?

The well known Keynesian equations $Y = C + S$ and $S = I$ define the relationship of income, consumption, saving, and investment. Nonetheless, these relational insights are not truth statements about the real world, but identities. The significance of the Keynesian model is its potential to link economic policy to a formal equilibrium structure described by SNA. One should be reminded, however, that the dispute in his famous treatise entitled "The General Theory of Employment, Interest, and Money" (1936) was the neo-classical assumption that equilibrium forces of supply and demand (for labor) made the existence of involuntary unemployment impossible. The major part of his treatise was to demonstrate the mechanism of how a permanent state of high levels of unemployment is possible in a modern economy. This was a very pertinent issue at a time when much of the industrial world's factories were laying idle and governments felt impotent in reviving their morbid economies. The solution, according to Keynes, was for governments to stimulate the growth in effective demand through the power-boost of new public investment expenditures (*i.e.*, the multiplier effect). The Keynesian model of economic management set the agenda for policies directed at full employment which, in effect, are indistinguishable from the objectives of growth in GNP. We should recall however that the rate of unemployment is correlated to the trade cycle and the level of employment (or proportion of the population employed) to the structure of the economy. Thus, the popular view that jobs and economic growth run in parallel stems from the confusion between short-term cyclical movements in trade and long-term structural changes in the economy.

How relevant is this frame of reference to the concerns of the 1930s in the 1990s? Over-employment of natural resources and environmental externalities of production and consumption are reaching crises proportions. Popular demand for political accountability for the maintenance of ecological and natural resource assets today seems to parallel the popular demands for full employment in the 1930s. Placing the principles of sustainable development on the political agenda has raised the question of the adequacy of economic intelligence and should be taken as a signal for a new frame of reference in national accounting (Friend, Rapport, 1991).

Income, expenditure and financial flow accounts of SNA provide information about the level of market activity which can be used to monitor the trade cycle phenomenon. These data are clearly important for the short-term management of market forces and evaluation of the effects of countervailing actions of monetary and fiscal policy. The I/O accounts and the national balance sheets provide, in essence, intelligence on the structural characteristics of the economy and thus serve the needs for more long-term economic strategies. The proposed environmental satellite accounts would also provide further intelligence on environmental externalities of production/consumption processes and macro-level monitoring of depletion rates of natural resources (Stahmer, 1990). It would seem, a priori, that the revised SNA is, in fact, a well balanced economic information source for managing the economies of the 1990s and beyond.

The question that needs to be raised, however, is whether the revised SNA is a sufficient information base for the holistic management of the economy. The distinction between use-value and money-value is also a distinction between an accounting of the capacity to produce goods and services and an accounting of the enjoyment of economic product. These distinctions imply two different frames of reference for national accounting. The SNA framework is deficient in providing insight into many of the concerns about linkages between the environment and the economy. The missing links are accounts which measure:

1. Efficiency in the use of physical stocks and energy flows particularly as it pertains to the evaluation criteria for sustainable development (*i.e.*, the system material-energy balance accounts);

2. The contribution of the "free-gift-of-nature" to the national product (*i.e.*, system of natural resource accounts);

3. The non-market contribution of the informal economy to the national product[4];

4. The state of the environment[5].

The alternative use-value approach emphasizes the stream of benefits obtained from the accumulated stock of human artifacts and ecological assets. Use-value is enhanced by the maintenance of natural resource stocks and by durability and use-intensity of human artifacts. Income is conceived of as a flow of services obtained from stocks. The use-value accounting framework is, in essence, "wealth accounts" made up of the physical stocks of human-made and natural resources, and material-energy flow accounts.

The Case for Pluralism in National Accounts

The major flaw in SNA is its single-value bias. The philosophy of hermeneutics claims that observations of events are not independent of their interpretive frame of reference upon which conclusions are drawn. This seems to be a universal condition in the social sciences and is increasingly so in the case of the physical sciences (Ricoeur, 1981, Miller, 1987). Thomas Kuhn in The Structure of the Scientific Revolution also recognized the critical role of the establishments of "paradigms" in science. This, as in hermeneutics, provides a particular frame of reference for scientific research, acceptance of theory, and esteem and recognition among colleagues (Kuhn, 1972). Heisenberg's uncertainty principle finally put to rest the idea that one can ever obtain completely objective observations of the fundamental particles of matter. The social sciences similarly recognize that there are no objective or value-free facts in social observations (Myrdal, 1973).

The validation criteria are reduced to: (a) consistency in the model; (b) non-contradiction of observed facts; and (c) the plausibility of the underlying premise. What is notable is that the traditional criterion of predictability is no longer considered as either a necessary or sufficient condition of scientific proof. Economics, supposedly the most "predictable" of the social sciences, assumes a level of rationality in human behaviour that is clearly not borne out by social observation. A pluralistic approach to national accounting provides decision-making with alternative frames of reference for evaluating social performance and, perhaps more importantly, makes room for ethical values in assessing the state-of-the nation. Richard Norgaard (1989) argues that: "the use of a single framework disenfranchises or disqualifies the majority, facilitates the tyranny of the technocrats and encourages centralization. Openness to multiple frames of analysis is a prerequisite to democracy and decentralization[6]". The criticism of GNP as an indicator of economic performance would be greatly ameliorated if alternative measures of economic well-being were available. This aggregate could then be relegated to its proper role as an indicator of the health of the market economy. The concept of net domestic product, where resource depletions are subtracted to generate a "sustainable income measure," is a start towards pluralism (Bartelmus *et al*, 1989). Indeed, in the early debate, before SNA production boundaries were etched in stone, there was more openness to the concept of what constitutes national product. Kuznets, for one, thought that expenditure on public administration and security should be excluded from GNP on the grounds that it was a prerequisite for production (Kuznets, 1952).

Forty years later the controversy on what should be considered "prerequisites for production" has shifted towards questions of conservation of ecological capital and availability of exhaustible resources. One issue at hand is the introduction of

environmental accounting and its linkage to concepts of production, consumption, and capital accumulation in SNA. In order for this to happen nothing less than a shift in the "economic production paradigm" is required. Thomas Kuhn points to resistance to change in well-established paradigms. The following passage could well be describing the national accounting community:

"Their achievement was sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. Simultaneously, it was sufficiently open-ended to leave all sorts of problems for the redefined group to resolve."[7]

The opportunity for a pluralistic approach to the development of official government national accounts is greater today than at any time since their most active developmental phase between 1940s and 1960s. A major breakthrough must clearly be the development of the new science of "systems analysis." This has greatly facilitated the capacity to develop conceptual models describing complex hierarchical structures and formal sub-component linkages. Computerized data management systems have further added a quantum jump in the ease of manipulating and reorganizing data on both temporal and spatial planes. This allows for alternative re-aggregation, no longer constrained by hand cranking of statistical data.

Environmental Accounting

Two views have emerged out of the current debate on how to introduce environmental and natural resource parameters in the national accounting framework. One reflects essentially the "single value" bias of converting environmental externalities and resource depletions to money-values. The other is to focus on use-value. This implies the need for physical accounting of material/energy use, the physical stock and flow of natural resources, and state-of-environment indicators. The essence of pluralism is not to consider these as alternatives but as complements. Indeed, physical accounts would be a prerequisite database even for calculating the money-values of environmental goods and services (Friend, 1989).

The remainder of this paper consists of a brief discussion of the use-value approach to national accounting. Figure 4 shows the schematic circular flow of materials and energy in the economic process. The system requires an accounting of natural resource stocks and flows, a description of economic processes in terms of material-energy balance accounts, and a stress-response account which links the economic process with the state of the environment. A feedback loop connects the condition of the environment with the qualitative state of natural resource stocks.

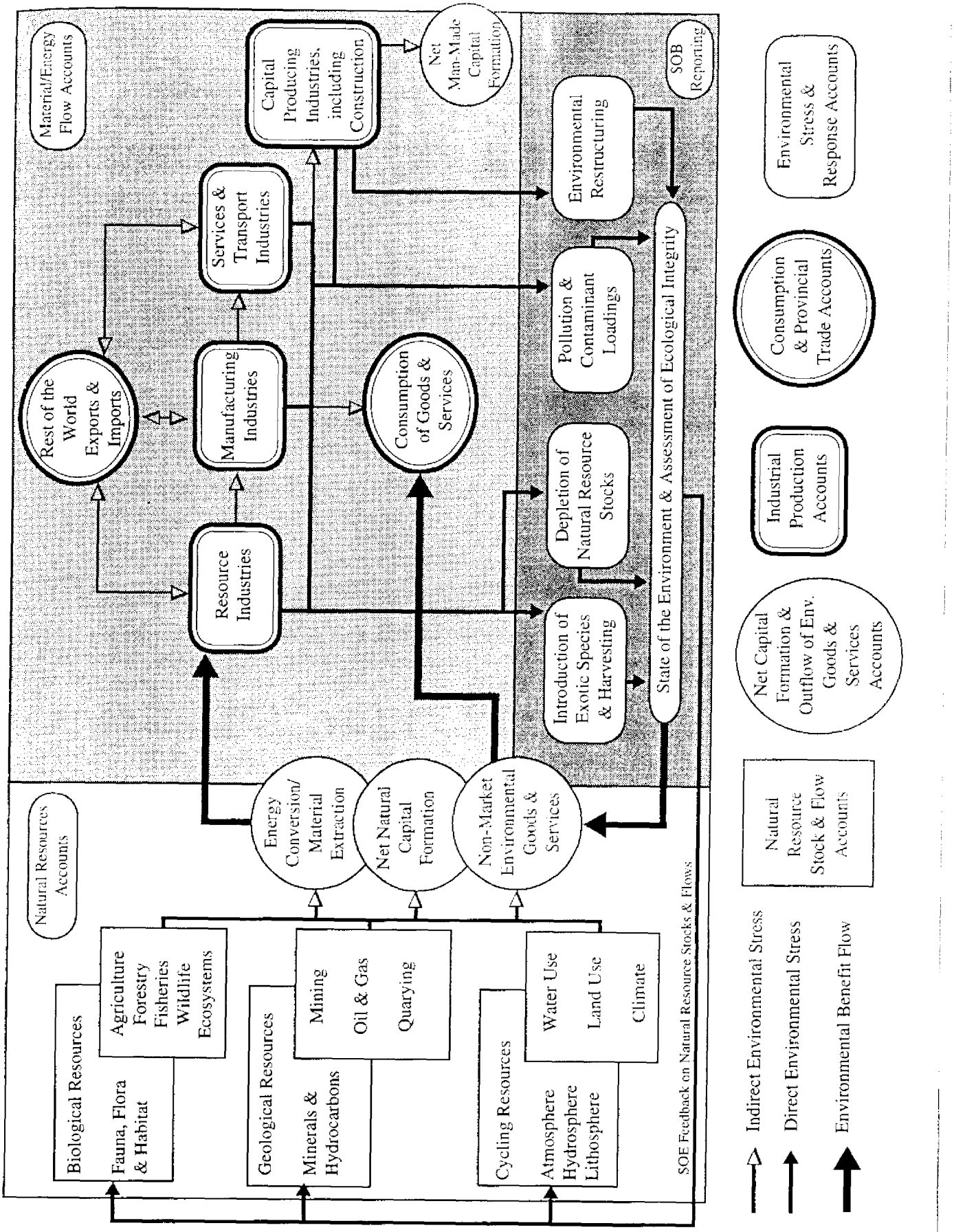
The Ayers/Kneese paper "Production, Consumption, and Externalities" introduced the notion of material-energy balance accounts (Ayers, Kneese, 1969). The idea of a Material- Energy Balance Statistical System (MEBSS) was presented by the United Nations Statistical Office (ECE Meeting on Environment Statistics, Geneva 1976) as the basis of a framework for the development of environment statistics (United Nations, 1976, Friend, 1981). MEBSS provided a detailed stock/flow accounting of materials and energy in production and consumption processes. A concept of mass-balance in economic processes defines a total accountability of the weight/volume of inputs and outputs. These are further distinguished between "economic commodities" and "waste residuals." The core of MEBSS is a tracking system of physical flows from raw materials to finished products.

Raw materials are extracted and/or harvested from the biosphere's stocks of natural resources defined broadly as the atmosphere, hydrosphere, lithosphere and flora and fauna. Production processes are defined by their physical, chemical and engineering attributes. These include refining, smelting, shaping, weaving, chemical reactions, assembly, packaging, and so forth. Transportation, storage, and construction activity are also represented in terms of physical processes. The consumption of finished goods is similarly treated as physical flows of materials and energy. Household consumption, for example, could be defined as maintenance of homes, travel to work, recreational activities, and consumption of material artifacts such as cars, clothes, toys, furniture, and electronic equipment. Since MEBSS is defined within national boundaries, the export and import of materials and energy need to be accounted for in this system.

Generation of waste residuals is tracked from sources in production/consumption processes to deposition in air, water, and land. Thus, MEBSS, in essence, is an accounting system which links the environment with the economy. While the system was rejected as an approach for developing environment statistics, being too complex, and perhaps too demanding on data needs, it remained an attractive conceptual framework for the development of natural resource accounting. The Norwegian, French and Canadian approaches to natural resource accounting were influenced by MEBSS in subsequent developmental work. With an increasing number of countries endorsing the principles of sustainable development it can only be a matter of time before MEBSS will be seen as the appropriate data framework for the implementation of sustainable development policies.

Natural Resource Accounts (NRA) are part of a broadly-based material-energy balance information system. NRA, however, focuses on depletion, replacement, and maintenance of "in-place" natural resources as opposed to the "throughput" of material-energy in the economy. This distinction should not be overdrawn since the two are ultimately connected. Reduction in material/energy throughput is a

FIGURE 4: FLOW OF MATERIALS AND ENERGY IN THE ECONOMIC PROCESS



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major policy objective in conservation and protection of natural resources.

A review of world-wide activity in environmental accounting reveals different approaches and considerable confusion, about what should be covered under the rubric of NRA (Peskin 1990). In some cases NRA are viewed as extensions and/or modifications of SNA. This perspective defines natural resources in economic terms for the purpose of integrating resources into the economic production system. Others see these accounts as broadly-based, multi-purpose information systems depicting the quantitative/spatial distribution of natural resource stocks and flows. In the latter case the main objective is to design a relevant information system for macro-level management of the nation's ecological assets. This calls for an accounting system which not only records the economic variables but also describes quantitative values of the ecological and social functions of natural resources, such as wildlife habitat or tribal hunting grounds.

While the interest of the economic constituency is in the development of NRA as a framework to assess sustainable development, the environmental constituency is concerned about public accountability with respect to the use and the qualitative state of natural resources. Figure 4 shows how both interests are accommodated by linking the extraction and harvesting of natural resources (*i.e.*, energy/material flows in the economic production system) with the state of the environment. Further distinctions arise from alternative approaches to indicators of economic performance and efficiency. This is a means, moreover, of revealing incompatibilities in national socio-economic objectives, such as assessing economic performance directed, on the one hand, at international competitiveness and growth and, on the other, at conservation and sustainable development.

The desire for monetary evaluation of natural resources stems, in part, from the mistaken belief that political commitment towards a more enlightened resource management agenda requires a demonstration that the "monetary values" assigned to social costs are greater than economic benefits. Public opinion polls, however, show that economic trade-offs are not necessarily a factor in peoples' evaluations of priorities for nature conservation or environmental quality.[8] It is noteworthy that the French Compte du patrimoine naturel recognizes the essential economic bias in these accounts and has consciously counter-balanced this by providing for (non-monetary) social and ecological "functional values" (Weber, 1986).

State-of-Environment (SOE) Reporting has by now a well-established technique for level assessments of environmental conditions and trends. This work is supported by a growing body of environmental statistics and indicators linking human activities with the physical state of the environment. While one can see many parallels between economic and environmental accounting, there are also many

differences. These become evident when one considers the vastly different time scale of environmental transformation compared to the monthly, quarterly and annual indicators of economic trends. Moreover, data obtained from environmental monitoring are unique to time and space and therefore do not always assume the normal distribution of statistical aggregates.

In spite of the complexity of integration of human activity and environmental change, the underlying logic in systems analytic techniques provides the basis for the linkage of environmental and socio-economic databases. The schematic Figures 4 & 5 illustrate the linkage parameters between SOE Reporting, natural resource accounting, material-energy balances and the income/expenditure accounts of SNA. What is required now are policies aimed at the development of complementarity and compatibility in the vast national data collection programmes currently carried out in the field of natural resources, environmental monitoring and socio-economic surveys (Friend, Rapport, 1991). A pluralistic approach to National Accounting Systems provides, in fact, a formal framework for the integration of these databases.

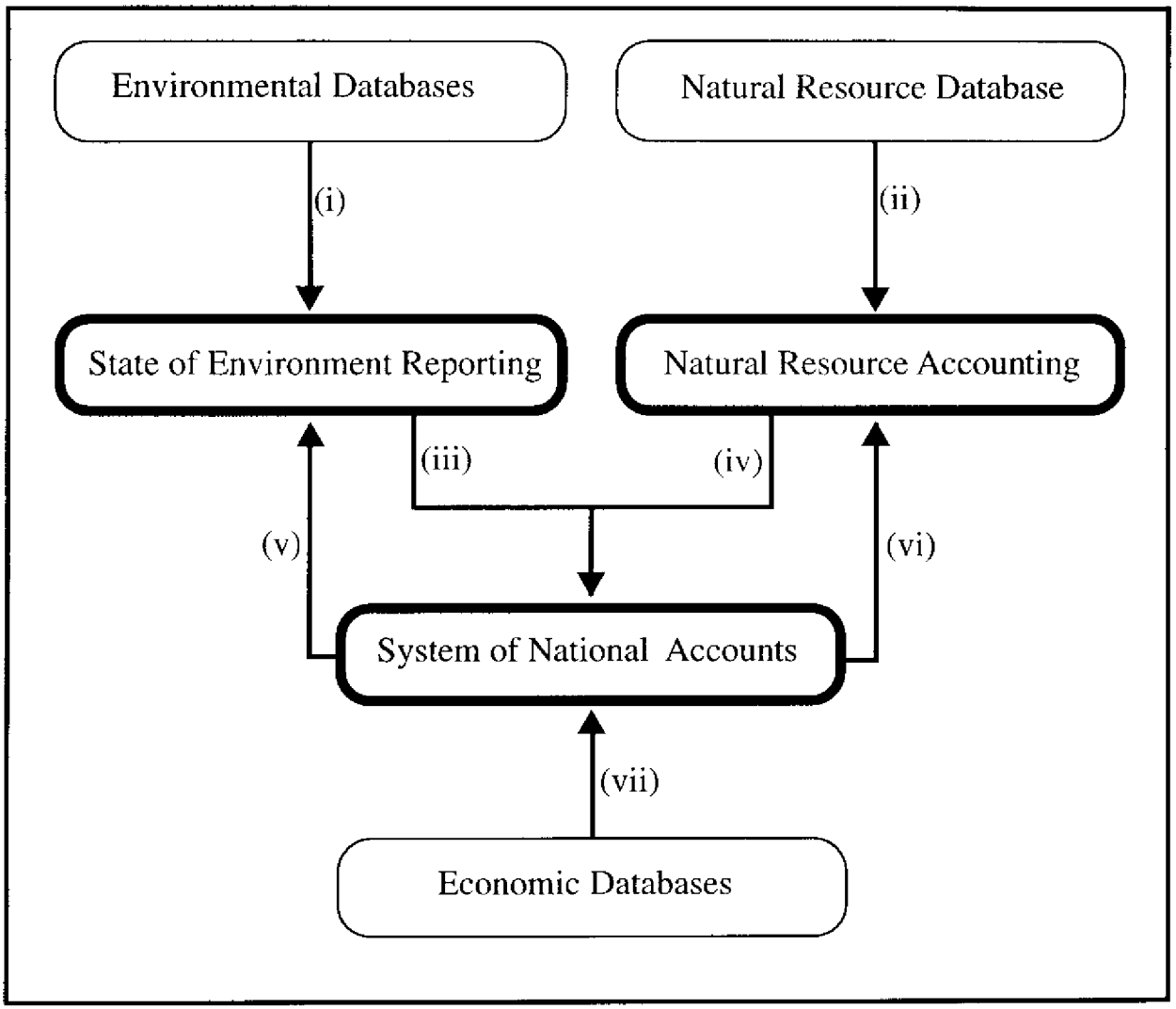
Public policies aimed at internalizing externalities and conserving materials and energy do, indeed, recognize the reality of complex interactions between environment and economy. The responsibilities, however, for management of the economy, the environment, and natural resources, are spread among different government agencies. Therefore, one can hardly be surprised that governments pursue inconsistent policies. A pluralistic approach to national accounting should not be viewed as a panacea for purging inconsistency from the national agenda, although an integrated framework encompassing the SNA, MEBSS, NRA, and SOE Reporting might help to reveal them.

Conclusion

Pluralism in national accounting may be considered a *sine qua non* for good decision-making in a complex world of environmental threats and the pervasive influence of the global economy. This paper argues for environmental and natural resource accounting to be regarded as an integral component of SNA. These would be composed of physical databases describing material-energy stock/flow balances, natural resource accounts, and state-of-the-environment reports. The last differs in that national aggregates are absent. Nonetheless, SOE reporting is included because of its capacity to link the economy and the environment and to provide the relevant spatial indicators for assessing ecosystem integrity. A world of over-employed natural resources, threats to the integrity of ecosystems, and globalization of national economies, raise the question of the compatibility of a national accounting system based on 1930s model of the economy underpinned

FIGURE 5

Linkage of Databases and a Pluralistic Approach to National Accounting



Linkage Parameters

(i) Indicators of environmental quality and ecosystem health.
(ii) Physical stock and flow of natural resources.
(iii) Economic value of environmental goods and services.
(iv) Economic value of natural resource stocks (i.e., wealth) and flows (i.e., resource inputs in production).
(v) Environmental (defensive) expenditures.
(vi) Costs of maintenance of natural resource stocks.
(vii) Goods and services produced in the economy.

by values reflecting the experience of the Great Depression. This paper contends that emerging social values emanating from the environmental movement and desires for sustainable development have subordinated the single-purpose growth objective symbolized by GNP. The proposals in the revised SNA to accommodate the social values of the 1990s by including environmental degradation and resource depletion is not only insufficient, but could prove highly controversial when justifying a particular evaluation methodology; whose discount rate? Physical measures of natural resource stocks and flows are the relevant indicators for assessing sustainable development and the impact of the economy with the state of the environment.

This paper further contends that sustainable development demands broader economic and social measures of human well-being than are currently contained in the concept of GNP. In the future, greater emphasis will be placed on the durability and material-energy efficiency in production and consumption processes. Thus, attention would be focussed on the concept of income as a flow of services derived from stocks as opposed to income generated from the employment of the factors of production. Indeed, we may say that sustainable development policies imply the reorientation of the current flow management economy towards a stock management economy. Finally, pluralism in national accounting does not imply the demise of SNA but rather its enhancement by explicitly recognizing the multi-dimensional perspective of social, ecological and ethical values in the measurement of the national product.

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Notes

1. This paper was an invited paper for the Special IARIW Conference on Environmental Accounting, held in Baden, Austria, May 27-29, 1991.

2. "Inquiry into the Nature and the Causes of the Wealth of Nations," first published in 1766.

3. Joan Robinson, Economic Philosophy (Harmondsworth, U.K.: Penguin Books, 1962,), p. 29.

4. SNA deficiencies in the informal sector are particularly significant in developing countries economies. An accounting based on use-value seems highly relevant in understanding the economic structures of these countries. For example, the self-sufficiency of the village economy in India.

5. National State of Environment Reports have been included here because it seems to the author that this should be considered as the environmental dimension of national accounts. This begs the question of whether social

accounting should also be part of SNA. In view of the author, a good case can be made for this as well.

6. R.B. Norgaard, "The Case for Methodological Pluralism," Ecological Economics, 1: 35-57, 1989.

7. T.S. Kuhn, The Structure of Scientific Revolutions (Chicago: The University of Chicago Press, 1970), p. 10.

8. A recent opinion poll in Canada had rated employment as the prime concern but when asked if environmental standards should be reduced in order to create more work, the respondents overwhelmingly rejected this proposal. It should be noted that this poll was taken when Canada was entering an economic recession and environment had dropped from first to second place in the order of national concerns.