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OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

September 30, 1992

Honorable William K. Reilly
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Subject: Science Advisory Board's comments on the Office of Policy, Planning, and Evaluation's (OPPE) study of environmental accounting, *Cheasapeake*.

Dear Mr. Reilly:

The standard systems of national economic accounts provide a picture of the flows of economic activity and summary measures of a nation's overall economic performance, such as the Gross Domestic Product (GDP) measure. These accounts are consistent measures of economic inputs -- capital, resources, and labor-- and outputs -- the creation of goods and services. These measures provide valuable information on economic activity, but they do not necessarily reflect appropriately the use of natural resources and the environment. Concerns about the inability of conventional economic accounting systems to reflect accurately natural resource depletion and degradation of environmental quality have led many economists to explore the possibility of implementing accounting systems that "take nature into account." Several approaches have been proposed and implemented on a case study basis, including some recent efforts to implement the United Nations proposed satellite System for Integrated Environmental and Economic Accounting (The United Nations Statistical Office developed a system of economic measures --national accounts-- which categorizes economic activity as production, income and outlay, capital accumulation, and capital finance. Satellite accounts are special accounts or measures designed to supplement and broaden the basic analytical structure and link, in this case, monetary and physical/environmental data.).



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This interest in environmental accounting led EPA to begin an environmental accounting study focused on the Chesapeake Bay region. Prior to initiating the effort, it was felt that sufficient data were available to support a reasonable application of accounting methods. For this study, a "Nature" sector was added to the traditional sectors (industry, government, and household), and additional accounting entries, reflecting environmental services, environmental damages, and environmental depreciation, were used with conventional accounting entries in a double entry account system. The Charge (enclosed) to the Environmental Economics Advisory Committee (EEAC) for this review was developed by the OPPE and encompassed six major conceptual issues based on the *Chesapeake* study, with each issue including a variety of sub-issues--some highly specific and technical, others more broad and generic in nature.

The Committee met on April 15, 1992 to examine the draft *Chesapeake* report (along with selected background materials) and participate in a briefing by the OPPE staff. Based on that process, the Committee felt that the issues raised in the Charge were too extensive to be addressed within a single application of environmental accounting. Moreover, the available documentation did not provide specific details on important conceptual and empirical aspects of the implementation. Some of the most important shortcomings include:

- No evidence of a comparative evaluation of the implications of how ecological linkages in the Chesapeake Bay area were represented in the case study.
- Failure to distinguish between consumer surplus estimates for discrete changes in the specific aspects of the environmental resources in the Bay region and the marginal value of the incremental changes in these measures.
- Double counting of the values generated by the services of environmental resources when they contributed to several different types of economic activities. This arises because the models used to estimate these values

reflect multiple contributions simultaneously and do not allow the parts to be separated.

- No examination of sensitivity in results to important assumptions inherent in the depreciation methods selected to reflect losses in natural and environmental resources as services that support economic activities.

The Committee felt that addressing these and other specific questions in the context of refining the *Cheasapeake* application would be a major undertaking that was not warranted because of the preliminary nature of this pilot study and the limited contribution such refinements could make, given the information base, to the likely long-term role of environmental accounting in EPA's activities. After discussions with the OPPE staff, the Committee decided that the most useful course of action would be to frame this report in terms of broad comments on the topic of environmental accounting *per se*, rather than address the specific considerations raised in the *Cheasapeake* report and the associated Charge.

The Committee's comments follow:


- a. Environmental accounting seeks to incorporate the amounts of natural and environmental resources used as inputs or provided as outputs into the measurement of the product accounts. Economists generally have used one of two approaches. The first (and in some respects the most direct) involves trying to remove resource depletion from GNP by using market prices and the amounts extracted (e.g., forest harvested, mineral deposits used, etc.) as measures of the loss of natural capital. This treatment would be analogous to adjustments for depreciation with other forms of produced capital in that a reduced stock of natural resources would reduce the ability to produce aggregate income in the future. The second approach tries to attach monetary values to all natural and environmental resources, regardless of whether or not prices are available for them, and then includes these implicit values as indicators of the contributions they make to full income or full input costs.


The United Nations has shown increasing interest in including natural resources under the first approach or as "satellite" accounts measured in physical terms. For marketed natural resources, a monetary measure is usually preferable to a physical measure for these purposes.


- b. EPA should maintain a capability in environmental accounting so the Agency would be able to learn about and contribute to activities at both the United Nations and the U.S. Bureau of Economic Analysis on these issues. While maintaining capability in this area is important, EPA needs to clarify the purposes to be served by environmental accounting. Paragraph (a) of this report highlights two approaches with differing aims, embodying different conceptual and empirical problems. More consensus exists on the viability of expanding national income accounting to reflect depreciation in natural capital than to value environmental quality and natural resource amenities. If environmental accounting is envisioned as a tool to measure welfare effects (i.e. the changes in the value of resource stocks or environmental amenities), research needs to address the connection between welfare analysis, which measures social values, and national income accounting, which measures economic activity. In the meantime, it is important to recognize that environmental accounting systems as currently constructed do not provide consistent measures of welfare, and therefore do not provide useful guides to the desirability of various policy changes. Additional research might also compare current approaches with other methods for trying to take nature into account in national income accounting.
- c. *Chesapeake* is a pilot study that explores the potential of environmental accounting, and the difficulties inherent in attempting to implement (the constituent elements for) such accounting systems. The study is at an early stage and seems to be providing useful insights into both the value and limitations of this approach.
- d. The Committee thinks that research in this general area should be continued as a means of learning more about environmental accounting, but that

it should not serve as a template for a series of such studies in other geographic areas. The methodology has not yet been sufficiently developed to serve as a guide for future efforts. Rather, it should continue to be used to stimulate further thought about fundamental conceptual and measurement issues which only percolate to the surface in the context of specific studies.

We look forward to receiving your response to our comments.


Dr. Raymond Loehr, Chairman
Science Advisory Board


Dr. Allen Kneese, Co-Chair
EEAC


Dr. V. Kerry Smith, Co-Chair
EEAC

ENCLOSURES

QUESTIONS FOR ECONOMICS SUBCOMMITTEE OF THE SCIENCE ADVISORY BOARD

ENVIRONMENTAL ACCOUNTING

Primary Issues

Issue #1: Valuation

The Chesapeake Bay case study focused on non-market aspects of the environment (e.g., recreational fishing, camping, beach use). Consumer surplus measures were used, where possible, to value the final consumption services and damages that currently flow from the environment to households. Costs of pollution reduction from current levels were used to value waste disposal services. Other environmental accounting systems focus on the marketable services of the environment (e.g., sub-soil deposits, forests, fisheries), costs to attain specific standards or restore environmental quality, or on identifying and reclassifying current expenditures for pollution abatement.

Implementation of the accounts with actual data required the use of existing data. With the exception of water, damage estimates specifically associated with environmental quality changes in the Chesapeake Bay were unavailable. Instead, dollar estimates of the damages per ton of pollutant removed, based on national and/or regional studies, were used. Recreation values from geographic locations that encompassed or were located close to the Bay were used whenever possible. However, it was necessary in some cases to transfer values from other geographic locations. Finally, it was necessary to use average dollar per ton estimates for effluent removal to calculate waste disposal services.

Conceptual Issues:

- Should environmental accounting entries be made consistent with the marginal valuation basis (price times quantity) underlying conventional accounting or should welfare-type (consumer surplus) measures be used?
- Should some measure of costs (e.g. restoration costs) be used to value environmental damages or should benefit measures continue to be developed and used?
- Should the focus continue to be on nonmarketed, human uses of the environment, on more fully accounting for the role of natural resources in economic production, or on some other aspect of the environment, for example, ecosystem values, values for habitat, values for biodiversity, etc.?

Implementation Issues:

- For which situations it appropriate to transfer benefit estimates from one study to another and what procedures should be followed in performing the transfer?
- Is the use of an average cost estimate for marginal costs appropriate?
- Given the nonlinearities of certain atmospheric processes (e.g., ozone formation), is the use of dollar per ton damage estimate appropriate?
- How should effects be described when economic values are not available?

Issue #2: Modeling

An important feature of environmental accounting is the ability to link economic activities and the environment. With regard to the Bay, given the present state of linkage data, the development of data for the accounts would require not only an extensive data collection effort, but also a large body of new scientific research and a redirection of much of the current Bay scientific and modeling efforts. The case study shows that the data needed to establish the linkages between human activities and the environment and between the environment and human activities often do not exist. For example, it was not possible to determine the impact of reductions in human generated nutrients on Bay water quality separately from natural fluctuations in nutrient loads. Similarly, the impact of Bay water quality changes on participation in recreational activities could not be determined.

As a result it was necessary to infer accounting information in the absence of new and existing data. In the case of water, it was assumed that a 20 percent reduction in effluent from the 1982 baseline would result in a 20 percent improvement in water quality and that this improvement would result in water quality that was acceptable. Participation rates and recreational values were assumed to be unchanged over this time period. Air pollution reduction targets were based on national reductions that had occurred by 1990 (NO_x from mobile sources) or that were mandated under the Clean Air Act Amendments of 1990 (all VOC sources, SO_x and NO_x point sources). Costs for air and water pollution control relied on average cost per ton estimates rather than explicitly modeling these costs. Finally, different databases were used for water discharges and air emissions for 1982 and 1985. There were substantial changes in aggregate and sectoral totals, especially for water discharges.

Conceptual Issues:

- Is it necessary to explicitly model such linkages or will the development of parallel systems (i.e., economic and environmental) suffice?
- What criteria should be established to determine when modeling is required?
- Can the accounts serve the function of coordinating future scientific research and data development?
- Is it appropriate to value environmental and economic interactions when they are not explicitly modeled?
- When explicit models are not used, how should the results be characterized?
- What priority should be given to maintaining consistency in basic data?

Implementation Issues:

- Were the following assumptions that were required by the analysis appropriate?
 - A 20 percent reduction in nutrient loads would result in a 20 percent improvement in water quality (i.e., setting the water target)
 - A 20 percent improvement in water quality would result in acceptable water quality (i.e., assigning a damage estimate)
 - That emission target reductions and costs are the same as for the U.S. as a whole
 - Constant costs per ton of effluent or emissions reduced
 - Constant damages per ton of emissions reduced
 - The use of population to scale water damages
 - The use of population to scale state estimates of participants in recreational activities and to develop time trends

- Participation rates and values are not affected by changes in the level of Bay water and air quality
- How should the substantial differences in air and water databases be accounted for?

Issue #3: Coverage and Reliability

In an ideal world there would be two principal activities required to implement a set of credible accounts for the Chesapeake Bay: (1) developing new and existing data and (2) transforming new and existing data into a form required by the accounting framework. In the real world, a third activity must be added: (3) inferring accounting information in the absence of new and existing data. The more the program can support type-(1) activities as opposed to type-(3) activities, the higher the quality of the final product. However, this increase in quality comes at a high cost.

The Bay has been the subject of considerable research over the past few years. Therefore, it was felt that the existence of available data would permit a reasonably low cost application of accounting methods. Since many environmental problems are local in nature, it was felt that examining a regional entity defined by environmental imperatives would allow better coverage of environmental problems. However, the accounting exercise in the Chesapeake Bay region revealed that the data are not as complete or as refined as one might hope for. Further, data on several environmental problems/issues, such as solid waste, toxic contamination of sediments, biodiversity, and habitat loss were not readily attainable.

Conceptual Issues:

- Does this type of political unit and analysis represent a better way to address economic-environmental interactions?
- Is a national scale for environmental accounting appropriate given the heterogeneous types of services provided by the wide array of environmental and natural resource assets in the United States?
- In the face of global environmental problems, such as stratospheric ozone and climate change, would a set global environmental accounts be appropriate?
- What are the standards of accuracy and reliability that should be applied to environmental accounting?

- How comprehensive should the accounts be in their coverage of environmental media?
- How should attributes of the environment that are not included in the accounts be characterized?

Implementation Issues:

- Should sensitivity results be included?
- Should a rating of the quality of various estimates be included?
- Are the results sufficiently reliable that they can be used to guide policy?

Secondary Issues

Issue #4: Accounting framework

There are a number of strategies that have been suggested for introducing environmental and natural resources into conventional economic accounting systems. Following the classification scheme developed by Henry Peskin, these strategies may be classified into four groups: (1) cost accounting, (2) physical accounting, (3) depreciation accounting, and (4) input-output accounting. In general, cost accounting involves the assembly of data describing expenditures to abate pollution. Physical accounting can refer to either an accounting of the physical change in environmental and natural resources (e.g., change in natural resource stock from its opening balance to its closing balance), or an accounting of the generation and deposition of specific pollutants. Depreciation accounting measures changes in the value of the stock of natural resources. Input-output accounting combines a physical accounting of pollution generation and consumption of natural resources by production sector with information on pollution treatment activities taking place within sectors.

Conceptual Issues:

- What type of framework would be appropriate for EPA to use?
- Should an environmental accounting system stay within the UN System of National Accounts framework or should another system be adopted?

- What are the implications of the accounting systems described for coverage of environmental problems?

Implementation Issues:

- Should the accounting framework be limited by the availability of data and existing valuation techniques?
- Can credible estimates be obtained given the data requirements of the environmental accounting approach used for the Chesapeake Bay study?
- Will the current state of the art in nonmarket valuation support this accounting framework?

Issue #5. Purpose of Environmental Accounting

Conventional economic accounting serves two distinct and important roles. The first is to provide summary measures of a nation's overall economic performance (e.g., GDP). The second is to provide information useful for the management of the economy (e.g., relationships between inputs and outputs). Many of those interested in environmental accounting are interested in developing a "green" or "eco" GDP. While this type of accounting may be useful for evaluating the effectiveness of various policies, it is less useful for planning purposes.

Conceptual Issues:

- Which role is more important for EPA?
- Should a "Green" or "Eco" GDP be developed?
- More generally, should such summary measures or indicators be developed and what type of indicators would be useful?

Implementation Issues:

- How should the more disaggregated information be presented?

- If a green GDP or some other summary measure is to be calculated, how should this be done and what should be included?
- Should "defensive" expenditures be reclassified as intermediate and hence subtracted from GDP to arrive at the green GDP?

Issue #6: Economic or ecologic viewpoint

Environmental accounting seeks to integrate environmental and economic interactions into a consistent framework. A key issue is whether an ecologic or an economic viewpoint should be used as the basis for the accounts, especially in the valuation of environmental and natural resource assets.

Conceptual Issues:

- Should economic concepts of scarcity or ecologic concepts (e.g., sustainable use) be used to value environmental and natural resource assets?
- To what extent is it possible to substitute other forms of capital for natural capital?
- Should the focus of the accounting effort be on the flow accounts or on capital stock accounts?

Implementation Issues:

- Given the time scales involved in many environmental problems, should future streams of services be discounted and what rate should be used?
- What assumptions about future service flows are appropriate? Is the "myopic" view used in the case study appropriate?
- What assumptions about rates of substitution should be used for environmental accounting?

NOTICE

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