ACCOUNTING FOR SUSTAINABILITY: GREENING THE NATIONAL ACCOUNTS

Peter Bartelmus
Wuppertal Institute for Climate, Environment, and Energy, Germany

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1. Sustainability: A Dichotomy of Approaches

1.1. Ecological vs. Economic Sustainability: Two Sides of the Same Coin?

Sustainable development is the globally embraced paradigm for integrating environment and development policies. There is also agreement that sustainability is impaired, in particular by the interaction of environment and economy. Figure 1 describes this interaction in terms of (re)source and sink (waste disposal) functions provided by the environment to the economy.

Environment and economy also affect human welfare through the consumption of goods and services and a deteriorating life support system. (This focus on environmental concerns leaves out important, notably social, aspects of sustainability. Conceptual and measurement problems of these aspects do not yet permit their full integration into an accounting system and are therefore not further pursued here.)

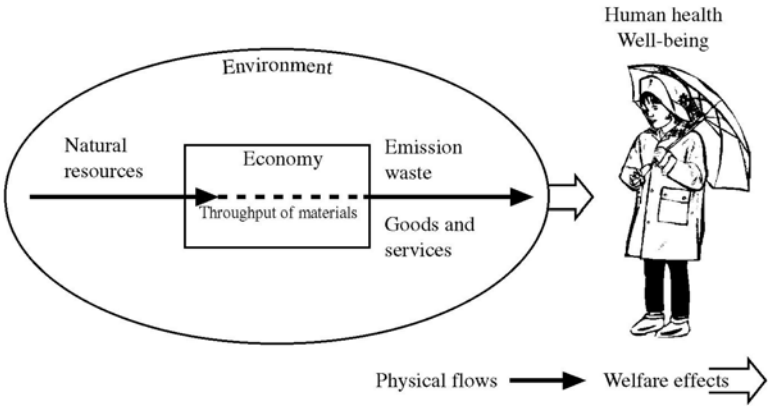

Figure 1. Environment-economy interaction and effects

Agreement ends with attempts at operationalizing the elusive notion of sustainability. Sustainable development was coined in the preparations for the Rio Earth Summit. However, definitions then advanced as non-declining welfare or the satisfaction of current and future generations' needs are vague. They do not specify the ingredients of welfare or generational needs, nor do they indicate any particular role for the environment. As a result hardly comparable indices or indicators of social progress or environmental pressures have proliferated. They include indicators of genuine progress, human and sustainable development, material throughput through the economy, carrying capacity or ecological footprints, to name just the more popular ones.

Obviously, the elusive concept of sustainability needs to be operationalized in a more systematic manner. For this, the protagonists of the environment and development discussion, i.e. environmental and economic scientists, looked into their respective analytical toolboxes so as to apply them to the other field. In doing so they imposed their own particular values on the counterpart areas. An unfortunate dichotomy between the environmentalist and economic worldview of the environment-economy interface has been the result (This crude distinction between holistic, ecological views of human activities and the natural environment, and mainstream (neoclassical) economic approaches to the environment-economy interface is, of course, a simplification of existing schools of thought. For instance, "ecological economists" can be placed somewhere in between these schools.)

Environmental economists put a *monetary* value on the loss or impairment of environmental services as a first step towards "internalizing" these "externalities" into the budgets of enterprises and households. Environmentalists repudiate the commodification and pricing of the environment. In their view, the value of the environment cannot be expressed in money, and *physical* indicators of sustainable development, carrying capacity, or material throughput are advanced. Calls for dematerializing economic activity and/or complying with social norms and standards are the policy responses of the environmentalist worldview.

Monetary measures of greened national accounts make use of a sustainability criterion, already built into conventional indicators of income, production and capital formation. As shown in section 2, the United Nations' System of integrated Environmental and

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Economic Accounting (SEEA) thus makes a cost allowance, not only for replacing depreciated produced capital but also depleted and degraded natural assets. Capital maintenance required for continuing production and consumption, i.e. for economic growth, is the *economic sustainability* criterion. Costing natural capital consumption, i.e. the loss of natural resources and of capacities to absorb waste and pollutants, permits the modification of conventional input, output, value added, capital formation and wealth indicators. Overall capital maintenance assumes weak sustainability, i.e. possible substitution of natural capital loss by investment in other production factors.

The focus of national and environmental accounts on production and capital maintenance has been criticized as replacing the ultimate goal of economics, utility/welfare maximization, with input or cost minimization. However, as discussed in section 2.4, welfare effects of environmental services and service losses are quite impossible to quantify and allocate with minimum statistical validity. Environmental—national—accounting has therefore focused on the compilation of output, income and cost data rather than measures of welfare effects of economic activity. (Note, however, that despite the warnings of national accountants, accounting aggregate such as gross domestic product or national income are frequently interpreted as welfare indicators.)

Because of its relative simplicity and consistency with (physical) environmental accounting, material flow accounts (MFA) and their main indicator, total material requirement (TMR), have become widely accepted measures of environmental pressure from production and consumption. *Ecological sustainability* is captured with the claim that TMR should be at a level compatible with the long-term ecological equilibrium of the planet. The notion of ecological equilibrium is operationalized by applying the normative concept of equal environmental space for everybody to the overall use of materials and energy. In turn, environmental space can be defined as the maximum amount of natural resources we can use sustainably and without violating global equity. The result is a sustainability standard which calls for the "dematerialization" of economic activity by halving TMR while doubling wealth and welfare: the popular notion of Factor 4. Ecological sustainability is typically strong, demanding the full preservation of biophysical environmental assets to ensure continuing delivery of their vital services.

Moving from the assessment of ecological sustainability to economic sustainability can be viewed as moving from the input side of material flows into the economy to the output side of production of goods and services and environmental impacts (see Figure 1). Are these aspects two sides of the same coin? At the most generic level, dematerialization and capital maintenance appear indeed to reflect the same underlying sustainability notion: that is, the long-term preservation of environmental source and sink functions or, in other words, the maintenance of environmental assets. The notions differ, however, for four reasons:

- extending the concept of capital consumption from produced to natural capital generates a sustainability concept which appears to be broader than dematerialization. This is because dematerialization is to reduce environmental pressure, referring thus to environmental assets only. Capital maintenance, on the other hand takes account also of the depreciation of produced (economic) assets;

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- contrary to assessing sustainability in terms of material and energy flows, the additional costing of material capital consumption avoids the setting of normative sustainability standards of Factors 4, or 10 (as proposed for industrialized countries);
- dematerialization aims at actual and potential environmental impacts in a precautionary approach. In contrast, natural capital consumption measures only actually occurred and observed environmental impacts. Nonsustainability in material flow analysis refers therefore to an unspecified *risk* of transgressing sustainability standards of dematerialization (e.g. Factor 4), which is hardly comparable to actual losses of specific natural assets;
- dematerialization does not take, at least explicitly, possibilities of substituting natural capital by other human produced or regenerative natural production factors; it thus appears to favor a strong sustainability concept. On the other hand, overall capital maintenance ignores "complementarities" in natural capital use, harboring a weak sustainability notion.

The question is whether assessing these different categories of sustainability leads to different results and policy advice.

1.2. Overcoming the Dichotomy: A Framework for Environmental and Economic Accounting

A first step towards overcoming the ecological-economic dichotomy is to harmonize and combine, or link, the underlying statistical systems in a common framework. Such a fact-finding framework could go a long way in defusing some of the arguments for and against getting physical in measuring the sustainability of economic performance. Comparing the pros and cons of the different accounting methods points to the need for both, physical and monetary, accounting and analysis.

Figure 2 shows the relationships of different accounting and data collection/use approaches in a common framework whose modules are linked through data flows. The framework reflects the above-mentioned dichotomy by distinguishing physical from national accounts-based monetary accounting, including an attempt at mixing physical with monetary data.

Three main categories of *physical accounting* are shown in the figure. Natural resource accounts (NRA) describe the stocks of different resources and their use during the accounting period in a fairly aggregate fashion. NRA were pioneered by Norway and further developed in France as "natural patrimony accounts." They are typically measured in different units of weight, volume, energy equivalent, area etc.

Physical input-output tables (PIOT) can be extended to include material flows from and back into the environment, according to its source and sink functions. Providing a balance of total material inputs and outputs, these tabulations can also be interpreted as material/energy balances. Originally, however, such balances were developed for specific production and consumption processes rather than for sectoral activity.

In response to measuring the sustainability of economic activity in non-monetary terms, material flow accounts (MFA), including energy flows, attempt to measure the material throughput through the economy. For purposes of aggregation these accounts have to

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express the flow of materials in one physical unit (weight). MFA describe the extraction, production, transformation and consumption of chemical elements, raw materials or products. They can be seen as a more aggregate presentation—than by the PIOT—of withdrawals and imports of raw materials, their accumulation in the economy and discharge back into the environment or to the rest of the world. MFA, as advanced by the Wuppertal Institute, include ecological rucksacks. These hidden material flows are the sum of all materials that are not physically incorporated in a particular product, but are required for use, recycling and disposal.

The overarching physical module of regional accounting applies mostly to land use, typically expressed in units of area. In principle regional accounts could also apply to other accounting modules, though to date monetary environmental accounting has hardly been applied at the sub-national level. Many if not most of the more detailed environmental questions of land use are probably better addressed by systems of environment statistics.

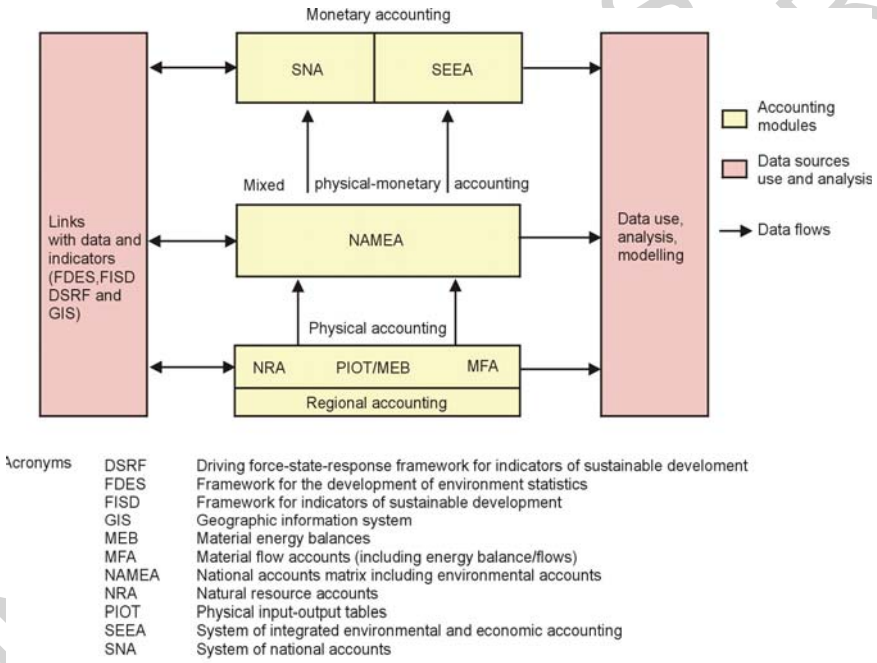

Figure 2. Framework for environmental and economic accounting

Mixing physical data and indicators with monetary ones are shown in Figure 2 as an intermediate step towards full monetary accounting. The prototype Dutch NAMEA links physical environmental indicators with monetary aggregates of production and consumption, considering that this is the farthest environmental accounting can go in terms of monetary valuation.

Once physical environmental impacts of natural resource depletion and environmental degradation (flows of pollutants and other impacts on natural systems) are valued in money terms, they can be incorporated in the *monetary national accounts*, notably the worldwide adopted System of National Accounts, the SNA. This is done in the SEEA

for both asset and flow accounts in several stages. Section 2, below, shows this approach as extensions of the asset and production boundaries of the national accounts.

Figure 2 also presents *indicators* as a data source for environmental accounting, i.e. flows into the accounting modules. The shaded module includes data systems that in turn obtain indicators from the accounts (flows from the accounting modules). This is in line with current approaches to indicator and data development such as the United Nations Frameworks for the development of environment statistics (FDES) or for indicators of sustainable development (DSRF, FISD). Indicators and accounting results are closer to analysis than basic—multipurpose—statistics since they are shaped to meet specific needs of policy makers, the research community and other groups of civil society.

Figure 2 also indicates the uses of physical and monetary accounts in policy analysis and modeling. It is important, however, to draw a clear line between descriptive data collection, estimation and presentation, for and in environmental accounts, and assumption-laden predictive or behavioral modeling. On the other hand, these links should be continuously examined as a feedback process between date users and producers.

The following sections focus on the concepts, methods and uses of *national* and *monetary* environmental accounting. This is not to deny the significance of physical accounts as a necessary step towards monetary accounting and for the management of particular natural assets. At the same time, the greatest integrative capacity is with the national accounts and their common numéraire of the market price. (Alternative numéraires such as emergy (energy) units or weight are also briefly discussed below.)

Another topic that is not elaborated here is the new and expanding field of corporate environmental accounting. There are, however, important connections between micro- and macro-level accounting. Corporate accounts should eventually become the main data source for national environmental accounts. To this end corporate accounting would have to be standardized and harmonized with the national environmental accounts concepts and definitions. The current efforts of the International Standards Organization (ISO) on environmental auditing, labeling, performance evaluation and life-cycle-assessment are steps in the right direction. Once such standardization is achieved an individual corporation would be in a better position to compare its environmental performance with that of its sector and the whole economy.

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2. Greening the National Accounts: Extending the System Boundaries

2.1. Replacing the Conventional Accounts?

Over the past three decades, there have been numerous proposals for modifying the national accounts for environmental concerns. In particular, critics have stressed three major drawbacks of conventional accounts:

- the neglect of new or newly observed scarcities of natural resources, which threaten the sustained productivity of the economy;

- the exclusion of environmental degradation as an "externality" of economic activity; and
- the accounting for expenditures of environmental protection as increases in national income and product though such outlays could be considered as a maintenance cost of society.

In response to this critique, the United Nations Statistics Division issued a handbook on integrated environmental and economic accounting, the SEEA. Conventional accounts have a large variety of micro- and macroeconomic uses, notably with regard to assessing short- and medium-term disequilibria in the market place. This suggests that integrated environmental and economic accounting should be developed as a *satellite* or parallel system of the SNA, rather than as a substitute for conventional accounts. The Rio Earth Summit confirmed this approach in its *Agenda 21* which also requested that it "be established in all member States at the earliest date."

On the other hand, selected elements of environmental accounting are already addressed in the SNA. They include the elaboration and classification of nonproduced tangible (natural) resources in asset accounts and a separate chapter on satellite accounts. Among other topics, this chapter deals with the links between the SNA and integrated economic-environmental accounting. Such linkage is a prerequisite for a meaningful comparison of conventional economic and environmentally-adjusted indicators.

The main objective of the SEEA satellite system is thus to respond to the above criticisms of the conventional national accounts; they include the

- segregation and elaboration of all environment-related flows and stocks of conventional accounts: including in particular environmental protection expenditures as part of a broader concept of "defensive expenditures" which represent the cost of compensation for the negative impacts of economic growth;
- linkage of physical with monetary environmental accounts and balance sheets: NRA and PIOT provide the physical counterpart of the monetary stock and flow accounts of the SEEA;
- assessment of environmental costs and benefits: expanding the SNA through costing (a) the use and depletion of natural resources in production and final demand and (b) the impacts on environmental quality, notably from pollution, by production, consumption and natural events, on the one hand, and environmental protection and enhancement, on the other hand;
- accounting for the maintenance of tangible wealth: extending the concept of capital to cover not only human-made but also natural capital. Capital formation is thus changed into a broader concept, allowing for the consumption/use of environmental assets;
- definition and measurement of indicators of environmentally-adjusted product and income: accounting for the costs of depletion and degradation permits the compilation of modified aggregates, notably an Environmentally-adjusted net Domestic Product (EDP), popularly (but wrongly, referring to a gross concept) known as a "green GDP."

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Various components of the SEEA were tested in case studies in developing and industrialized countries. 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.

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Biographical Sketch

Dr Peter Bartelmus is the Director at Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Germany. He is an economist and obtained his doctorate at the University of Heidelberg. He worked for several years as a statistical and economic advisor to the east African community in Nairobi, before joining the United Nations Environment Programme. In 1981 he moved to the Statistics Division of the United Nations in New York in order to develop an international program and systems of environmental statistics and accounting. He also participated in the preparations for the Rio Earth Summit

in 1992, to which he contributed the *Agenda 21* program on integrated environmental and economic accounting. He joined the Wuppertal Institute in 1999 and is currently also giving a course on ecological economics at the Bergische University, Wuppertal. His research and publications focus on the measurement and policy analysis of sustainable development, environmental economics, and environmental accounting.

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