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ACCOUNTING FOR ENVIRONMENTAL SERVICES: CONTRASTING THE SEEA AND THE ENRAP APPROACHES

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Both the System of Integrated Environment and Economic Accounting (SEEA) and the Environmental and Natural Resources Accounting Project (ENRAP) are efforts to expand conventional national economic accounts in order to better reflect interactions between the market economy and the natural environment. In order to maintain a close relationship to the System of National Accounts (SNA) accounting standards, SEEA adopts conventional definitions of productive sectors. However, SEEA fails to account for many valuable services of the natural environment and encourages the use of techniques that provide misleading and poor estimates of depreciation and damage to the environment. ENRAP addresses these deficiencies by explicitly recognizing that the natural environment is a productive economic sector. ENRAP encourages the use of imputation approaches that draw on techniques common in the environmental economics literature. These approaches are consistent with definitions of depreciation and environmental damage widely accepted in economic theory. The principles that underlie the ENRAP approach provide a basis for contrasting ENRAP and SEEA empirically. Using Philippine data, SEEA-type estimates are compared with those of ENRAP.

1. WHAT DO WE MEAN BY "ENVIRONMENTAL ACCOUNTING?"

The term "environmental accounting" can have two distinct interpretations. For, perhaps, a majority of economists who have thought about the subject, environmental accounting refers to adjustments in the conventional measures of economic performance, such as the GDP, NDP, GNP or NNP, in order to make these measures more sensitive to changes in the natural environment. This view of accounting focuses on its "scorekeeping" role: accounting as a tool for measuring performance—the performance of a business or an entire economy (Peskin, 1996; NAS, 1999). The theoretical approach often used to develop alternative measures of economic performance is to examine the implications of maximizing a social welfare function expanded to include the services of natural capital. Along with the goods and services generated by marketed capital, the arguments of this function include both the marketed and non-marketed goods and services generated

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by the natural environment. These goods and services include the consumption benefits of amenities provided by the natural environment, waste disposal services, and the detrimental effects of pollution (treated as a negative service). The ability of both marketed and environmental capital to generate these goods and services at any point in time depends on the depreciation of marketed capital, the depreciation of natural resources, and the deterioration of the natural environment. Depending on the specific arguments and form of the social welfare function and the assumed technical constraints that limit its maximization, the theoretical analysis leads to a Hamiltonian that is equivalent to a modified net national product measure (see Weitzman, 1976; Hamilton, 1996; Mäler, 1996; Chu, 2000).

While consistent with this line of theoretical development, an alternative focus of accounting is not on the scorekeeping function, but rather on its "management" role. This involves the use of accounting as a means to assemble information in a logical manner in order to support the operations of a business or an entire economy. For management purposes, the structure of the accounts is more important than the implications of this structure on performance indexes.

Of course, accounting structures need not rely totally on economic theory. Structures can be justified on grounds of convenience, convention, tradition or even arbitrary decisions of the moment. However, the advantage of a theoretical justification is that it helps assure that the structure is complete and logically consistent and that any *imputations* are credible. By "imputation" we mean the *interpretation* of data. While the mere collection and manipulation of accounting data do not involve imputation, any further interpretation of either the data or their transformation necessarily means that imputation is taking place.[1] A statement, for example, that "... this number equals environmentally adjusted GDP ... " is an example of an imputation. For this statement or any other imputation to have credibility, one cannot rely on the data alone: one must appeal to *a priori* theory.

As we shall see below, one problem with the UN SEEA system is its overreliance on considerations of convention and convenience. This has led to a system that not only is too incomplete to address important environmental management questions but also lacks credibility in the interpretation (or imputation) of its assembled data.

2. The ENRAP Approach[2]

The ENRAP accounting structure is based on the premise that economic accounts should attempt to cover all the economic inputs and outputs that,

[1]Is is misleading, therefore, to compare alternative accounting systems regarding the degree of imputation involved. The issue is not whether System A has more or less imputation than System B but whether the imputations in either system make economic sense.

[2]The Philippine Environmental and Natural Resources Accounting Project (ENRAP) was a ten-year effort to develop data and accounting systems to assist the Philippine government in its management of environmental and natural resource policy. Funded by the US Agency for International Development, it has recently been turned over to the Philippine Department of the Environment and Natural Resources (DENR).

together, comprise an economic system.[3] For inputs and outputs to be "economic," they need not have market prices. Rather, they must be scarce enough that if marketed, they would attract a non-zero price.[4] The natural environment is one major source of non-marketed but economically scarce inputs and outputs. ENRAP essentially "expands" conventional economic accounting structures to cover the input and output services of non-marketed (essentially environmental) capital.[5]

The reason for ENRAP's emphasis on a complete accounting of all economic inputs and outputs is that ENRAP is primarily a tool of policy. By "policy," we mean those governmental actions that are intended to alter the amount, composition, and distribution of system outputs. The ultimate object of *economic* policy is to find the level, the composition, and the distribution of *economic* outputs that attain agreed upon social objectives in an efficient and fair manner. Even though ENRAP is popularly viewed as a system of environmental accounts, because it attempts to cover *all* economic inputs and outputs, whether environmental or non-environmental, it is more than a tool of *environmental* policy. It is, also, a tool of a more general *economic* policy. Those who have expressed concerns about environmental–economic interactions—the effect of the environment on the economy or the effect of economic activity on the environment—are really expressing a need for this more general economic policy.

Although the principal motivation for ENRAP has been on its policy or "management" role—in particular, its support of environmental management—its coverage of the services of both conventionally marketed capital and environmental capital makes ENRAP consistent with the theoretically "correct" performance or "scorekeeping" measures put forth in the economic literature.

Most business accounts include both a "current" account, describing the flow of inputs and outputs during an accounting period, and a "capital" account (or balance sheet), describing net wealth at the end (and/or beginning) of the accounting period. A few national accounting systems have both a current and capital account as well. At the moment, however, ENRAP has not yet attempted to develop a complete set of capital accounts. The following discussion, therefore, will only cover the theoretical development of ENRAP's current account.

The starting point for ENRAP is the conventional national economic accounts. As suggested above, one way of viewing the conventional accounting entries is to note that they all represent flows of goods or services generated by marketed capital. These goods and services are generated by plant and equipment, by human capital (labor), and by Nature (raw materials). Although the conventional accounts do cover some of the outputs generated by the natural environment, these are limited to outputs with market prices. Those natural goods and services that are not marketed, even though they are "economic," are not

[3]"System" is being used in an engineering sense: a process whereby inputs get transformed into outputs.

[4]While this definition of "economic" is conventional among economists, others (for example, the authors of the UN SEEA system) use the term "economic" to mean goods and services that trade in markets.

[5]Perhaps even a more important source of non-marketed, economic goods and services is the household. ENRAP does not cover household production except for the non-marketed production of firewood in upland, rural areas.

included. These excluded goods and services fall into one of three categories: input services (the more important being waste disposal services); output or environmental quality services (such as recreation and esthetic services); and negative outputs (e.g. pollution). The basic ENRAP strategy is to append these non-marketed services to the marketed services already accounted for in the conventional accounts. The monetary value of these services is obtained by using estimated shadow prices set to an approximate value that would be expected were these goods and services marketed.

Note that the philosophy behind this strategy is in sharp contrast to philosophies underlying other environmental accounting systems—especially physical accounting systems. The obvious difference is the attempt to measure all the new environmental entries in monetary terms. However, this attempt is not always successful. Thus, there is a set of ENRAP data that are only in physical terms. Yet, even the ENRAP physical accounts differ from other physical environmental accounting systems. ENRAP coverage is confined only to entities that, in principle, would command positive prices were they marketed. For example, the life-sustaining energy generation services of the sun are not covered since they are not valuable in an economic sense. While of critical value in a non-economic sense, these services are in excess supply.[6] Of course, the energy service of the sun could be a crucial component of physical accounting systems that are not grounded in economic theory. An energy accounting system would be a good example.

Table 1 illustrates the ENRAP accounts. Shown is the consolidated account summarizing all economic activity. As is the case with conventional accounting, these consolidated accounts are built from many detailed sub-accounts and data sets. Entries in all capital letters represent the sum of all entries above them. Thus, CHARGES AGAINST GROSS DOMESTIC PRODUCT is the sum of Compensation of Employees, Proprietor's Income, Indirect Taxes and Gross Returns to Capital. GROSS DOMESTIC PRODUCT is the sum of Personal Consumption, Investment, Inventory Change, Exports less Imports and Government Expenditures. Note that these two sums are also in the conventional accounts. Thus, the ENRAP framework preserves all the elements of conventional income accounting.

The three most significant new entries are Environmental Waste Disposal Services (entered negatively), Environmental Damages (also entered negatively) and Direct Consumption of Environmental Quality Services (entered positively). As the waste disposal services are free inputs to those establishments needing to dispose of wastes, they are analogous to a subsidy. Thus, they are treated like input subsidies in conventional accounting—that is, as negative inputs. Environmental damages are treated as negative output. This treatment follows the practice of other environmental accounting systems, such as SEEA. These damages include all opportunity costs associated with the consumption of environmental services—waste disposal services as well as environmental quality services.[7]

[6]While the life-sustaining services of the sun are in excess supply to human populations that consume these services, not all other services of the sun are necessarily in excess supply. The esthetic services provided by a beautiful sunset may be an example of a solar service that can obtain a positive market price.

[7]An example of these latter opportunity costs are congestion damages associated with the consumption of crowded, nature-based recreational facilities.

The entry Net Environmental Benefit (Disbenefit) serves three purposes. First, it is a balancing entry, defined as the difference between the absolute value of all environmental services (waste disposal and environmental quality services) and damages. It thus assures that the input side and the output side of the modified accounts will have the same total. Second, it can be used as a crude measure of the efficiency of environmental management. It can be shown (Peskin, 1989) that if environmental services and damages are valued at the margin (that is, at the shadow price of the marginal unit), a Net Environmental Benefit (NEB) equal to zero implies a Pareto optimal allocation of environmental services.[8] If NEB is negative, then the level of services is too high (i.e. too much pollution or over use of the environment); if NEB is positive, then waste disposal and environmental quality services are too low. (Any losses in well-being due to more pollution would be more than offset by freeing up resources that could serve other beneficial purposes.)[9] Thirdly, since NEB measures the net current account value of the environment, the accumulated, discounted NEB provides a measure of the asset value of Nature.

The modified accounts are completed with two other entries. The first, Non-marketed Household Production, covers in the ENRAP accounts only the non-marketed household production represented by firewood collection and upland cultivation by informal users of steeply-sloped land (e.g. slash-and-burn farming). These entries were included because of the potential importance of such activities on deforestation and the tendency of formal data gathering institutions to exclude them.

The final entry is Natural Resource Depreciation, included along with conventionally measured Capital Depreciation. Both entries are included to provide a measure of MODIFIED NET NATIONAL PRODUCT, modified to include the depreciation of natural assets as well as marketed assets. Net National Product is actually a measure of income. It measures income after offsetting, through investment, the loss in capital services measured by depreciation. As first defined by Prof. Hicks, it is a measure of income intended to "... give people an indication of the amount, which they can consume without impoverishing themselves."[10] In principle, since the loss in capital is being offset, any lost income generated by this capital is being offset as well. As a result of the offset, the level of income could be maintained indefinitely (although not necessarily in per capita terms). Net income, so defined, provides a measure of *sustainable* income.

As the net income measure in the ENRAP accounts focuses on sustainable income (as intended by Prof. Hicks) and not sustainable product, "depreciation" must necessarily refer to true *economic* depreciation, meaning the decline in the value of assets over time—not necessarily the decline in their physical condition.

[8]If the current allocation of environmental services is *not* Pareto optimal, it would then be possible to find another allocation that would at least make one person better off without making anyone else worse off.

[9]The discussion in Peskin (1989) is graphical and thus requires expressing the argument in only two dimensions. This is done by aggregating all positive services of the environment (e.g. waste disposal and environmental quality services) into one group and all negative services (e.g. pollution and congestion) into another. A more general mathematical optimization model, such as found in Baumol and Oates (1988), would permit a multidimensional explanation.

[10]Hicks, 1946, p. 172. See also Hicks, 1940, pp. 105–24 and 1942, pp. 174–9.

TABLE 1

ENRAP Accounting Framework
(Consolidated Account)

Input	Output
Compensation of Employees	Personal Consumption
Proprietor's Income	Investment
Indirect Taxes	Inventory Change
Gross Return to Capital	Exports
	–Imports
	Government Goods and Services
CHARGES AGAINST GROSS DOMESTIC PRODUCT	GROSS DOMESTIC PRODUCT
Capital depreciation (–)	Capital depreciation (–)
CHARGES AGAINST NET DOMESTIC PRODUCT	NET DOMESTIC PRODUCT
Capital depreciation (+)	Capital depreciation (+)
Non-marketed Household Production	Non-marketed Household Production
a. Firewood	a. Firewood
b. Domestic water	b. Domestic water
c. Other items	c. Other items
Environmental Waste Disposal Services (–)	Environmental Damages (–)
a. Air	a. Air
b. Water	b. Water
c. Land	c. Land
	Direct Consumption of Environmental Quality Services
	Recreational
	Esthetic
	Ecological
Net Environmental Benefit (Disbenefit)	
CHARGES AGAINST MODIFIED GROSS DOMESTIC PRODUCT	MODIFIED GROSS DOMESTIC PRODUCT
Capital Depreciation (–)	Capital Depreciation (–)
Natural Resource Depreciation (–)	Natural Resource Depreciation (–)
a. Forests	a. Forests
b. Fisheries	b. Fisheries
c. Minerals	c. Minerals
d. Soils	d. Soils
CHARGES AGAINST MODIFIED NET DOMESTIC PRODUCT	MODIFIED NET DOMESTIC PRODUCT

Even if an asset never declines physically, its value and, hence, its ability to sustain income, can decline if the services generated decrease in value. While physical depletion is usually associated with true economic depreciation, the association can be complex. Simple estimates of depreciation, such as using the replacement value of the "lost" capital, can be very misleading. Often replacement value provides far too high an estimate, especially when the "lost" units of capital have little effect on the stream of generated services.[11]

[11]Consider the value of "lost" soil to a farm due to erosion. If topsoil is very deep, there can be substantial erosion losses without major effects on farm product. Yet, the replacement costs of such erosion can be very high. Would it pay for the farmer to incur these costs, perhaps to forestall the day when the soil is fully depleted? Not necessarily: the money saved might be better spent in developing some other source of wealth.

The link between an asset's physical condition and its value can be especially weak with natural resource and environmental assets. Part of the problem is that most environmental assets generate more than one type of service. The value of some of these can depend on both physical condition and demand. Consider, for example, a lake. The lake can be a source of recreation, drinking water, waste disposal, and surface transportation. Its recreation value depends not only on its physical condition—for example, its level of pollution—but also on the demand for water-based recreation. The recreation demand, in turn, depends on such factors as income and population. Certainly, the value of the drinking water service also is pollution and population related. On the other hand, the level of pollution could have little effect on the lake's ability to generate waste disposal and surface transportation services.

ENRAP's desire to measure true economic depreciation forces one to deal with these complexities. Easier but misleading estimates based, say, on replacement costs, can be very different and, therefore, can have very different implications for policy.

3. SEEA

SEEA generally follows the rules formulated for national economic accounting as defined by the United Nations System of National Accounts (SNA). Thus, SEEA generally adheres to the production definitions of the SNA, its accounting identities, and its reliance on observed data. The SEEA advocates a flexible approach involving four stages of implementation (United Nations, 1993). The first stage starts with the revised SNA (Version I of the SEEA); the second involves SNA reformatting and dis-aggregation in order to identify environmental protection activities (Version II)[12]; the third, physical accounting (Version III); and the fourth, the addition of imputed environmental costs through alternative valuation methods (Versions IV.1–3). A fifth stage (Versions V.1–6), which would allow expansion of the SNA production boundary to include household activities and the environmental services produced by nature (hence the ENRAP approach), has not been recommended for adoption by the SEEA proponents. The following discussion refers to SEEA Version IV.

As with ENRAP, the SEEA framework is intended to support environmental management decisions and policies affecting environmental–economic interactions. However, there is also a strong concern for scorekeeping. As a result, much of the SEEA literature focuses on appropriate adjustments to conventional measures of economic performance.

However, the SEEA adjustments to conventional GDP are limited to deductions for natural resource depletion and environmental degradation. While consistent with the economic literature on appropriate environmental and resource

[12]An underlying assumption is that these environmental protection activities can be separately identified. While many environmental industrial and governmental activities are identified in the Standard Industrial Classification, a large number of other environmental activities are mixed with non-environmental activities and are not separately identified. The production of valves, pipe, and meters is an example. Some of these products may serve environmental protection functions; others may not. Similarly, protection activities resulting from process changes and changes in product mix may also be hard to identify as "environmental."

adjustments to GDP, theory suggests that limiting the adjustments to natural resource depletion and environmental degradation does not go far enough. In particular, the system neglects to account for non-marketed, environmental inputs and outputs. As a result, SEEA cannot support more general economic policies that focus on the complete spectrum of economic variables, both environmental and non-environmental.

TABLE 2

SEEA ACCOUNTING FRAMEWORK

Input	Output
Compensation of Employees Proprietor's Income Indirect Taxes	Personal Consumption Investment Inventory Change Exports –Imports
Gross Return to Capital	Government Goods and Services
CHARGES AGAINST GROSS DOMESTIC PRODUCT	GROSS DOMESTIC PRODUCT
Capital depreciation (–)	Capital depreciation (–)
CHARGES AGAINST NET DOMESTIC PRODUCT	NET DOMESTIC PRODUCT
Capital depreciation (+)	Capital depreciation (+)
Environmental "Damages" [measured by control costs] (–) a. Air b. Water c. Land	Environmental "Damages" [measured by control costs] (–) a. Air b. Water c. Land
CHARGES AGAINST MODIFIED GROSS DOMESTIC PRODUCT	MODIFIED GROSS DOMESTIC PRODUCT
Capital Depreciation (–)	Capital Depreciation (–)
Natural Resource Depreciation [net price method] (–) CHARGES AGAINST MODIFIED NET DOMESTIC PRODUCT	Natural Resource Depreciation [net price method] (–) MODIFIED NET DOMESTIC PRODUCT

The SEEA adjustments are illustrated in Table 2. The layout for the consolidated version of the SEEA structure is altered from that found in the United Nations SEEA Handbook in order to provide easier comparison with ENRAP. As with ENRAP, the account shown represents a consolidation of the individual production sectors of the Standard Industrial Classification. Note the "missing" ENRAP entries: SEEA does not cover any household production activities; there are no waste disposal services; there are no environmental quality services; and there is no net environmental benefit entry.

4. COMPARING ENRAP AND SEEA

4.1. *Non-market, Environmental Services*

In terms of the accounting structure, the biggest difference between SEEA and ENRAP is that SEEA accounts for environmental services only if they are marketed. Thus, for example, SEEA accounts for marketed forest products, but not for any environmental quality services provided by forests such as recreation. In addition, if the forests provide waste disposal services, such as land disposal of sewage wastes, these would be neglected as well. It is not that the authors of SEEA fail to recognize that such services exist. It is only that they feel that their inclusion is inappropriate in their formal accounting system.

While the SEEA does not cover the non-marketed services of the natural environment, the system does recognize that many of these services do have social importance. For this reason, SEEA attempts to measure the depletion of natural resources and the negative effects of pollution (environmental degradation). As indicated in Table 2, these estimates are used to adjust conventional net national product measures to obtain a more environmentally relevant measure. This procedure (in effect, measuring the depreciation of an asset but neglecting to measure the outputs generated by the asset) does not have a parallel in conventional accounting. It would be as if the conventional accounts recognized the importance of the steel industry by measuring the depreciation of steel-making capital while, at the same time, ignoring steel production.

4.2. *Pollution-control Costs*

A second difference between SEEA and ENRAP is that SEEA attempts to distinguish between pollution-control costs and all other costs in the conventional economic accounts. To do this, SEEA assumes that it is possible to identify production sectors that exclusively provide pollution-control services. The objective of identifying environmental control costs is a worthy one. Such information can be used for retrospective investigations of the costs and benefits of environmental regulation. Cost information has also been used to determine whether environmental regulations have had a detrimental effect on economic productivity. ENRAP, however, has not attempted to go this route, believing that jointness problems create insurmountable data difficulties. The ENRAP developers feel that it was just too difficult to determine how much of a particular expenditure, such as for pumps or instrumentation, or a particular action, such as a change in product mix, was for environmental purposes or for other purposes.

4.3. *Measuring Pollution Damage*

A third difference between ENRAP and SEEA concerns the method of estimating pollution (or environmental degradation) value and environmental depreciation. ENRAP attempts to follow the principles of neo-classical economics in that environmental services are measured in terms of what society would be willing to pay for these services. Pollution damages are estimated by how much society would be willing to pay to avoid these damages. ENRAP relies heavily on methods and studies drawn from the environmental benefit-estimation literature. In contrast, SEEA estimates damages based on costs. In particular, pollution damage is usually measured by the costs of pollution control—what SEEA refers to as a "costs-caused" measure. They recognize that a willingness-to-pay measure—which they refer to as a "costs-borne" measure—would, theoretically, be more correct. But SEEA developers prefer not to use the imputation techniques often employed in the environmental benefits literature to develop willingness-to-pay estimates.[13]

4.4. *Measuring Environmental Waste Disposal Services*

It should be noted that ENRAP also relies on cost estimates—not to estimate damages but, rather, to estimate environmental waste disposal services. For example, waste disposal services are proxied by the costs facing polluters were they not to use the environment for disposal purposes. These estimates often rely on engineering pollution-control costs for high levels of control (e.g. 95 percent pollution reduction). Such estimates often assume fixed levels of production, unaffected by the pollution-control activity. As a result, they are very short run and probably too high. ENRAP would prefer to use longer-run, willingness-to-pay estimates on the part of those using the environment for waste disposal purposes. Unfortunately, studies of the willingness-to-pay for waste disposal on the part of industrial and household polluters seem non-existent. However, the engineering cost estimates are probably good enough for policy assessment purposes. They allow, for example, a rough comparison of the benefits and costs of proposed regulations. In fact, engineering costs are the basis of most currently available benefit-cost assessments of regulation.

4.5. *Natural Resource Depletion*

The newly revised draft of the United Nations SEEA Handbook describes three approaches to measuring natural resource depletion: the net price approach, the El Serafy approach, and the present value approach.[14] However, in their estimates of the value of natural resource depletion, SEEA practitioners appear to prefer the so-called "net-price" or net-rent approach.[15] These measures are cost-based—in particular, the "cost" of replacing any lost resource rent associated with the loss of the natural asset.[16] The approach approximates true economic depreciation—defined as the change in the value of an asset over time—only under very special circumstances. Specifically, the net-rent approach measures true economic depreciation only if rents increase precisely at a rate that equals the overall social discount rate. In fact, were economies and their markets for capital perfectly competitive, this condition would be expected to hold. That is, if a particular resource generated rents that grew faster than other rents, the value

[13]For an overview of these techniques, see Freeman (1993).

[14]United Nations (1998).

[15]There is a problem in terminology. "Net price" is defined as sales price minus unit costs including a normal profit. However, this is equivalent to economic rent. Thus, the method could be termed, just as well, as the "net rent" approach. Unfortunately, in the new SEEA manual, the term "net rent" method is used to refer to a calculation where total rent is divided by total quantity. Total rent, in turn, is defined as total revenue less total cost, where total cost apparently does not include normal profit. Were total cost to include normal profit, there would be no arithmetical difference between "net price" and "net rent." Since the term "net rent" is more accurate, it will be used in this paper.

[16]A variation of this approach has been used to estimate the negative value of soil erosion. Specifically, the fertilizer-equivalent of eroded soil is measured and depreciation is estimated to be equal to the cost of fertilizer replacement. When the topsoil layer is reasonably thick, the average soil fertilizer content exceeds the marginal fertilizer value of the eroded top layer. In such cases, the value of the "lost" soil can be minimal. The fertilizer-replacement method will clearly overestimate the true loss of soil productivity and associated depreciation.

of the superior resource would be bid up through the competitive process until rates of return were equalized over all capital alternatives. Unfortunately, these conditions hardly hold in real economies—especially developing ones.

In applying the net rent approach, the newly revised SEEA handbook makes a distinction between non-renewable assets (such as minerals) and renewable assets such as forests or fisheries. With the non-renewable assets, unit rent is multiplied by the amount extracted. With renewable assets, unit rent is multiplied by the difference between actual yields and (the assumed) smaller "sustainable" yields. Depletion, so measured, is equivalent to the "cost" of attaining sustainability. Again there is no reason why depletion, so defined, should approximate true economic depreciation.

In contrast to the net rent approach, ENRAP prefers to measure natural resource depreciation (or appreciation) by estimating changes in the natural asset's value. This approach requires detailed accounting of the factors that affect the value of the natural asset, whether negatively or positively, intentional or not. The empirical differences between ENRAP and SEEA accounts are quite significant, largely due to the use of the net-rent depreciation estimates. In addition, the two approaches greatly differ on how to treat factors that may make a positive change in the value of capital stock. Two of the most important positive influences are the discovery of minerals and forest growth. With respect to both of these factors, ENRAP views them as offsets to depletion while SEEA treats them as "other accumulation or volume changes." As such, while mineral discoveries and natural growth enter the measure of capital stock, they do not affect SEEA's revised GDP calculation. This treatment leads to an asymmetry in the calculation of revised Net Domestic Product and in the relation between capital stock and income. In the United States, for example, mineral discoveries have served to offset mineral extractions. As a result, the stock of minerals has remained fairly constant. Under the SEEA approach, however, the ability of this constant stock to maintain income would be ignored.

The depreciation accounting used by SEEA serves to "penalize" countries relying on extractive industries regardless of their efforts to maintain the stock of economically available minerals. Thus, suppose two countries extracted minerals at exactly the same rate. Suppose further that one country used some of the proceeds to explore successfully for new mineral sources but the other did not. The country that maintained its mineral stock would be, according to SEEA, no better off than the county that did not maintain its stock.

As suggested in the revised SEEA Handbook, there are no technical reasons why the SEEA accounting format requires one particular depreciation calculation rather than another. Also, SEEA could have chosen to treat mineral discoveries and natural forest growth differently—as (income-affecting) offsets to extractions. Indeed, the US Bureau of Economic Analysis version of SEEA does just that. Empirically, decisions on the method of depreciation calculation and the treatment of discoveries and natural growth are important. For example, net rent estimates of the value of depletion can be orders of magnitude larger than estimates that come closer to measuring true economic depreciation. For example, depreciation of Philippine dipterocarps forests for the year 1989 was ₱14,451 million using the net rent estimate. It was only ₱823 million using an estimate based on changes in the present value of generated forest product—an estimate that more closely approximates true economic depreciation in the Philippines non-competitive forest markets. Similarly, a net rent estimate of copper and gold depletion for the same year was 3,376 million pesos while the El Serafy ("user cost") estimate was only 311 million pesos. Again, a net rent estimate of soil loss (using fertilizer replacement costs) was 4,546 million pesos, while the El Serafy estimate was only 334 million pesos. The only case where Philippine net rent and present-value estimates were of the same order of magnitude was for fisheries. For this asset, the net rent estimate was 111 million pesos while the present-value estimate was 737 million pesos.[17] However, the net rent approach for this asset is very questionable. Because of free entry into fishing, observed net rents are often near zero and even negative, especially for near-shore species.

4.6. *Environmental Services*

The difference in estimation method and treatment of growth and discoveries can account for large differences in the estimates of net income (NDP) between SEEA and ENRAP. In addition, by not counting the environmental quality services generated by the natural environment, SEEA overlooks a positive contribution to the gross product measure as well. This positive factor can offset some or all of the negative contribution of pollution.[18] As a result of this exclusion, not only the NDP but also the environmentally adjusted GDP estimates are expected to be both quantitatively and qualitatively different between the two systems.

5. Overall Results

Tables 3 and 4 present the estimates generated by the two approaches. It should be noted that the Philippine SEEA project, housed at the National Statistical Coordination Board, has not yet generated a full set of SEEA accounts along the lines indicated in Table 2. Therefore, Table 4 was generated by the authors using data from ENRAP files and published NSCB data.[19] In particular, pollution damage, in the spirit of the SEEA handbook, was set equal to ENRAP estimates of the costs to reduce pollution to non-damaging levels. (In ENRAP accounting, these estimates are used to proxy the value of waste disposal services.) Natural resource depletion estimates are from Domingo (1998). There is no 1992 estimate for soils.[20]

Table 5 summarizes the differences between the SEEA and ENRAP estimates. The most striking empirical difference between the two accounting systems is that ENRAP's modifications to conventional income measures are quite minor,

[17]These depreciation estimates may be found in IRG (1991). All values are in constant 1985 prices.

[18]In a study of the Chesapeake Bay, using ENRAP-type accounting, the environmental quality services were far larger in absolute terms than were pollution damages. See Grambsch, Michaels, and Peskin (1993).

[19]See Domingo (1998) and Domingo and de Perio (1998).

[20]ENRAP estimates that if SEEA were to use "replacement" cost depreciation estimates for soils loss (based on the costs of the fertilizer equivalent), the SEEA depreciation estimate for soils would be in the neighborhood of 5,000 million pesos for 1992.

TABLE 3

ENRAP CONSOLIDATED ACCOUNTS
(1992 Data—Million Pesos)

Input		Output	
Compensation of Employees	349,534	Personal Consumption	1,019,209
Indirect Taxes (less Subsidies)	138,202	Investment and Inventory Change	288,401
Operating Surplus (Incl. Depreciation)	868,493	Exports	393,706
		–Imports	(459,911)
		Government Goods and Services	130,524
		Statistical Discrepancy	(15,700)
CHARGES AGAINST GROSS DOMESTIC PRODUCT	1,356,229	GROSS DOMESTIC PRODUCT	1,356,229
Capital depreciation (–)	(109,082)	Capital depreciation (–)	(109,082)
CHARGES AGAINST NET DOMESTIC PRODUCT	1,247,147	NET DOMESTIC PRODUCT	1,247,147
Capital depreciation (+)	109,082	Capital depreciation (+)	109,082
Non-marketed Household Production		Non-marketed Household Production	
a. Firewood	2,817	a. Firewood	2,817
		Environmental Damages (–)	
Environmental Waste Disposal Services (–)			
a. Air	(3,081)	a. Air	(1,173)
b. Water	(12,246)	b. Water	(87)
		Direct Consumption of Environmental Quality Services	2,859
Net Environmental Benefit (Disbenefit)	16,926		
CHARGES AGAINST MODIFIED GROSS DOMESTIC PRODUCT	1,360,645	MODIFIED GROSS DOMESTIC PRODUCT	1,360,645
Capital Depreciation (–)	(109,082)	Capital Depreciation (–)	(109,082)
Natural Resource Depreciation (–)		Natural Resource Depreciation (–)	
a. Forests	(304)	a. Forests	(304)
b. Fisheries	(3,961)	b. Fisheries	(3,961)
c. Minerals	(16)	c. Minerals	(16)
d. Soils	(356)	d. Soils	(356)
CHARGES AGAINST MODIFIED NET DOMESTIC PRODUCT	1,246,926	MODIFIED NET DOMESTIC PRODUCT	1,246,926

Note: The numbers in the conventional accounts are NSCB estimates as of 1998.

while SEEA's are more substantial. In fact, the difference in either ENRAP's modified GDP or NDP measure is much smaller than the entry for Statistical Discrepancy. The implication is that, statistically, there is no difference at all. The much larger SEEA difference reflects: (1) the much higher estimate of natural resource depreciation provided by the net rent approach; (2) the neglect of accounting for positive environmental asset services; and (3) the non-accounting for non-marketed household firewood production.

6. Policy Application Issues

These differences have important implications concerning the use of the two approaches for both environmental "scorekeeping" and management. Regarding

TABLE 4

SEEA Consolidated Accounts
(1992 Data—Million Pesos)

Input		Output	
Compensation of Employees	349,534	Personal Consumption	1,019,209
Indirect Taxes (less Subsidies)	138,202	Investment and Inventory Change	288,401
Operating Surplus (Incl. Depreciation)	868,493	Exports	393,706
		–Imports	(459,911)
		Government Goods and Services	130,524
		Statistical Discrepancy	(15,700)
CHARGES AGAINST GROSS DOMESTIC PRODUCT	1,356,229	GROSS DOMESTIC PRODUCT	1,356,229
Capital depreciation (–)	(109,082)	Capital depreciation (–)	(109,082)
CHARGES AGAINST NET DOMESTIC PRODUCT	1,247,147	NET DOMESTIC PRODUCT	1,247,147
Capital depreciation (+)	109,082	Capital depreciation (+)	109,082
Environmental Degradation (–)[a]		Environmental Degradation (–)	
a. Air	(3,081)	a. Air	(3,081)
b. Water	(12,246)	b. Water	(12,246)
CHARGES AGAINST MODIFIED GROSS DOMESTIC PRODUCT	1,340,902	MODIFIED GROSS DOMESTIC PRODUCT	1,340,902
Capital Depreciation (–)	(109,082)	Capital Depreciation (–)	(109,082)
Natural Resource Depreciation (–)[b]		Natural Resource Depreciation (–)	
a. Forests	(542)	a. Forests	(542)
b. Fisheries	(3,476)	b. Fisheries	(3,476)
c. Minerals	(477)	c. Minerals	(477)
d. Soils	(1,401)	d. Soils	(1,401)
CHARGES AGAINST MODIFIED NET DOMESTIC PRODUCT	1,225,924	MODIFIED NET DOMESTIC PRODUCT	1,225,924

Notes: The numbers in the conventional accounts are NSCB estimates as of 1998.
[a]From Table 3: Environmental Waste Disposal entries.
[b]From Domingo (1988) and communication with NSCB.

TABLE 5

Comparison of ENRAP and SEEA Estimates to Conventional GDP
(1992 Data—Million Pesos)

	Conventional	ENRAP	SEEA	D ENRAP	%D ENRAP	D SEEA	%D SEEA
GDP	1,356,229	1,360,645	1,340,902	4,416	0.3	–15,327	–1.1
NDP	1,247,147	1,246,926	1,225,924	–221	0.0	–21,223	–1.7

Note: D = difference above (+) or below (–) conventional GDP or NDP; %D = percentage difference with conventional GDP or NDP as base.

scorekeeping, the ENRAP data suggest that the familiar claim that conventional GDP or NDP overestimates "true" GDP may have little foundation in fact.[21] The contrary results, as expressed by SEEA, could merely reflect omissions in the non-marketed services provided by the natural environment and non-economic

[21]Of course, the conclusion may have to be modified as ENRAP estimates of environmental services become more refined and complete over time. However, the observation that "green" GDP (or NDP) differs little from conventional GDP (or NDP) has been the case with other applications of the ENRAP methodology and in most applications of SEEA-type accounting as well.

measures of natural resource depreciation. The ENRAP data lead to the conclusion that while there may be theoretical interest in modifying conventional GDP or NDP to reflect environmental conditions, such modifications may be of little practical interest. Such a conclusion would not be surprising in a developed, industrial country where output is dominated by market activity. It is somewhat unexpected to see a similar result in a developing country such as the Philippines.

On the other hand, while environmental and resource modifications to the accounts may have little consequence for scorekeeping, such modifications may be quite important for environmental policy management. Indeed, by not accounting for such non-marketed outputs as waste disposal services and environmental quality services, SEEA provides no information that could be used to determine a rational allocation of these services. For example, environmental management usually requires the policy maker to balance the marginal value of waste disposal services[22] against the marginal (negative) value of any associated pollution and environmental damage. Since SEEA measures environmental damage by restoration costs, relying on SEEA information for this analysis would, by definition, lead to benefit–cost ratios identically equal to unity. In addition, by not accounting for non-marketed services, the value of important natural assets, such as forests, is understated. Merely measuring natural resource depreciation arising from lost rents from diminished marketed product is misleading and not useful, especially if the asset in question, such as a forest, also generates valuable non-marketed goods and services.

If, as argued here, SEEA is of limited use for environmental management and policy, one might ask: just what are its benefits? After all, SEEA programs exist in many countries, while the ENRAP system is far less well known.

The principal claim for SEEA is that it provides a standard accounting framework, consistent with the UN System of National Accounts. If all nations would adopt this standard framework, it would facilitate international comparisons. Since one of the chief functions of the United Nations is the publication of statistics comparing economic and social performance of member countries, it is no surprise that they are the principal proponents of SEEA.

While international standardization can be useful, it does come at a price. In fact, an internationally standardized statistical system is inherently inefficient—it wastes resources, specifically resources needed for the development of information. The argument for the inefficiency is a simple consequence of the theory of benefit–cost optimization. Efficient data collection requires that the marginal benefit of the additional unit of collected information equal its marginal cost. Since it is likely that the costs of data development and the benefits of data collection will differ among nations, it is equally likely that the optimal amount of data collected as well as what is collected will differ as well. Efficient data collection will not suggest the same system for all.

For example, in the United States, there is a widely perceived need to base policy decisions on benefit–cost criteria. The common view is that the government makes mistakes and even stated objectives cannot be fully trusted. There is a fear that without the application of benefit–cost criteria, the government may act to

[22]Or, equivalently, the marginal opportunity cost due to denied access to these services.

serve special interests and not the general interest. Even though special interests have successfully fought the use of benefit–cost criteria, benefit–cost analysis nevertheless has survived many pieces of legislation and it is a central tool in the policy review and assessment process. In this policy environment, information, such as generated by ENRAP, is essential. In contrast, many smaller, democratic nations, such as Norway or The Netherlands, depend far less on the application of benefit–cost techniques. There appears to be a strong belief that the democratic process is sufficient to make the government function in the general interest. Government objectives are assumed valid. In such a policy environment, there is less need for data to aid in the selection of objectives as a need to view the costs of physical consequences of these objectives. Physical accounting systems such as the Dutch NAMEA and cost-based systems such as SEEA may be quite adequate. It would be inefficient to force an ENRAP system on such countries.

One irony, however, arises from the fact that SEEA data and physical data are easily generated from the ENRAP system. The reverse is not the case. Thus, given the strong desire for an international standard, it would make more sense to make the standard ENRAP instead of SEEA. One can generate a SEEA from an ENRAP but not an ENRAP from a SEEA.

Besides promoting standardization and international comparability, one other claim for SEEA is that it avoids the large number of imputations that are necessary to implement ENRAP. It should be remembered, however, that an ''imputation'' is merely the act of *attributing* meaning to a number. To the extent that the numbers in a SEEA account have some meaning, then at least some imputation has been done—either on the part of the creator of the number or on the part of the user. It is indeed true that many, if not most, of the imputation techniques ENRAP uses to measure the value of non-marketed environmental services are controversial and are still undergoing development in the economics profession.[23] One should keep in mind, however, that there are no imputed values in ENRAP that would not also be required for those benefit–cost assessments that underlie rational environmental policy. Moreover, the approximate data found in the ENRAP accounts have been proven to serve the needs of policy makers. ENRAP has already supported literally dozens of policy studies in the Philippines.[24] Finally, the theoretical arguments in this paper should suggest that the implicit imputations in the SEEA framework are also not without controversy.

If avoiding the use of those imputation techniques adopted by ENRAP means that the accounting system must avoid measurement of crucial, non-marketed services of the environment, it may be too high a price to pay—in terms of both a loss of consistency with economic principles and the ability to serve practical policy needs. Those who have concerns about ''imputations'' (more precisely, concerns about certain complex imputation procedures) remind one of the familiar choice between being approximately correct or precisely wrong. The authors of ENRAP have opted for the first alternative.

[23]Are they more controversial than the imputations in SEEA? This paper has argued that at least some of the SEEA imputations could be highly controversial—for example, imputing ''depreciation'' to the replacement cost of capital.

[24]Many of these are described in ENRAP reports. For example, see IRG (1994, 1996a, 1996b).

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