Accounting for Environmental Assets

A country can cut down its forests, erode its soils, pollute its aquifers and hunt its wildlife and fisheries to extinction, but its measured income is not affected as these assets disappear. Impoverishment is taken for progress

by Robert Repetto

Natural scientists frequently seem baffled and dismayed when economists display little appreciation of the gravity of environmental degradation. One reason for this seeming indifference is that economists' accounting framework, and the models built on it, assigns no economic value to changes in natural resource stocks. This basic measuring instrument must be recalibrated if policymakers are to recognize and be held accountable for the wholesale disruption of natural systems now under way.

The 50-year-old framework, standardized in the United Nations System of National Accounts (SNA), completely ignores the crucial environmental changes of our times: the marked degradation of natural resources in much of the developing world and the growing pressures on global life-support systems such as climate and biological diversity. These changes may shape the future development of the world economy. But by failing to recognize the asset value of natural resources, the accounting framework that underlies the principal tools of economic analysis misrepresents the policy choices nations face.

Fortunately, at a time when more and more countries are adopting the policies and institutions of the market economy, this methodological model is under revision, for the first time in 20 years. The situation presents an opportunity, not to be missed, to correct a fundamental flaw.

Whatever their shortcomings and however little their construction is understood by the general public, the national income accounts are undoubtedly one of the most significant social inventions of the 20th century. It is no coincidence that since these measures have become available governments in all major countries have taken responsibility for the growth and stability of their economies, and enormous investments of talent and energy have been made to understand how economies can be better managed. Their political and economic impact can scarcely be overestimated. In the U.S., should quarterly gross domestic product (GDP, the sum of all goods and services produced in the country) be even marginally lower than in the preceding three months, a recession is declared, the administration's competence is impugned and public debate ensues. Throughout the world the rate of GDP growth is the primary measure of economic progress.

The current system of national accounts reflects the Keynesian macroeconomic model that was dominant when the system was developed. The great aggregates of Keynesian analysis—consumption, savings and investment—are carefully defined and measured. But Keynes and his contemporaries were preoccupied with the Great Depression and the business cycle. Because commodity prices were at an all-time low, natural resource scarcity was the least of their worries. Unfortunately, as Keynesian analysis for the most part ignored the productive role of natural resources, so does the current system of national accounts.

In fact, scarcity of natural resources was of little concern to 19th-century neoclassical economics, from which most contemporary economic theories are derived. In 19th-century Europe, food grains and raw materials were flooding in from America, Australia, Russia and the colonies, while steamships and railroads were lowering transport costs. Forgotten were the dismal predictions of Ricardo, Malthus, Marx and other earlier classical economists that industrial economies would stagnate or collapse because of rising land rents and subsistence wages. What mattered to England and other industrializing nations was the pace of investment and technological change.

The classical economists had regarded income as the return on three kinds of assets: natural resources, human resources and invested capital. Neoclassical economists virtually dropped natural resources from their model and concentrated on labor and invested capital. When these theories were applied after World War II to problems of economic development in the Third World, human resources were also left out on the grounds that labor was always "surplus," and development was seen almost entirely as a matter of savings and investment in physical capital.

As a result, there is a dangerous asymmetry in the way economists measure, and hence the way they think about, the value of natural resources.

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TERRACED ORCHARD in Costa Rica still shows the stumps of forest trees that were cut down to clear the land. Agricultural use of steeply sloping hillsides is often unsustainable because the soil quickly erodes.

DEFORESTATION has destroyed more than a quarter of Costa Rica's remaining forest since 1970. The loss of this asset has damaged the nation's earning potential, especially as the value of some tree species has quadrupled in recent decades.

Buildings, equipment and other manufactured assets are valued as income-producing capital, and their depreciation is written off as a charge against the value of production. This practice recognizes that consumption cannot be maintained indefinitely simply by drawing down the stock of capital without replenishing it. Natural resource assets, however, are not so valued. Their loss, even though it may lead to a significant decrease in future production, entails no charge against current income.

Although the model balance sheet in the U.N. SNA (which few countries actually compile) recognizes land, minerals and timber as economic assets to be included in a nation's capital stock, the SNA income and product accounts do not. This approach is fundamentally inconsistent. Logically, if a country's balance sheets at two different times indicate that an asset—say, a forest—has been depleted, then the income and product accounts for the intervening years should show a charge for the depreciation. This follows from perhaps the most fundamental identity of accounting: the difference in stocks between two temporal points equals the net flow in the intervening period. For example, the difference between a person's net worth at the start and end of a year equals his or her net savings (or dissavings) during the year.

The U.N. System of National Accounts violates this basic identity with respect to natural resource assets. Ironically, low-income countries, which are typically most dependent on natural resources for employment, revenues and foreign-exchange earnings, are instructed to use a national accounting system that almost completely ignores their principal assets.

Behind this anomaly is the mistaken assumption that natural resources are so abundant that they have no marginal value. In fact, whether they enter the marketplace directly or not, natural resources make important contributions to long-term economic productivity. Another misunderstanding is that natural resources are "free gifts of nature," so that there are no investment costs to be written off per se. The value of an asset, however, is not its investment cost but the present value of its income potential. Common formulas for calculating depreciation by writing off investment costs are just convenient rules of thumb. The true measure of depreciation is the capitalized present value of the reduction in future income from an asset because of its decay or obsolescence. In the same way that a machine depreciates as it wears out, soils depreciate as their fertility is diminished, since they can produce the same crop yield only at higher cost.

Codified in the U.N. SNA, the bias against natural resource assets gives false signals to policymakers. It reinforces the illusion that a dichotomy exists between the economy and the environment and so leads policymakers to ignore or destroy the latter in the name of economic growth. It confuses the depletion of valuable assets with the generation of income. The result can be illusory gains in income and permanent losses in wealth.

There is nothing wrong with drawing on natural resources to finance economic growth, especially in resource-dependent countries. The revenues derived from resource extraction can finance productive investments in industrial capacity, infrastructure and education. A reasonable accounting representation of the process, however, should recognize that one kind of asset has been exchanged for another. Should a farmer cut and sell the timber in his woods to raise money for a new barn, his private accounts would reflect the acquisition of a new income-producing asset, the barn, and the loss of an old one, the woodlot. He thinks himself better off because the barn is worth more to him than the timber. In the national accounts, however, income and investment rise as the barn is built, and income also rises as the wood is cut. Nowhere is the loss of a valuable asset reflected. Even worse, if the farmer used the proceeds from his timber sale to finance a winter vacation, he would be poorer on his return and unable to afford the barn. But national income would still register a gain.

The true definition of income encompasses the notion of sustainability. It is similar to the definition of sustainable development given by the World Commission on Environment and Development (the Brundtland Commission): that which meets the needs of the present generation without sacrificing the welfare of the future. This income concept encompasses not only current earnings but also changes in asset positions: capital gains are equivalent to an increase in income, and capital losses are a reduction in income.

The experience of Costa Rica shows how failure to account for natural resource assets can lead to economic disaster. To many naturalists, the country is renowned as the Western Hemisphere's conservation leader. It has set aside a fifth of its land for national parks and is the site of pioneering programs in nature tourism and restoration ecology. Yet during the past 20 years, Costa Rica has suffered devastating deterioration of its natural resources.

One of the hemisphere's highest rates of deforestation has led to the loss of 30 percent of the country's forests. Furthermore, most of the forest was simply burned to clear land for relatively unproductive pastures and hill

farms, sacrificing both valuable tropical timber and myriad plant, animal and insect species. Because most of the area converted from forest was unsuitable for agriculture, its soil eroded in torrents. Losses averaged more than 300 tons per hectare from land used to grow annual crops and nearly 50 tons per hectare from pastures. Between 1970 and 1989 an estimated 2.2 billion tons of soil washed away, enough to bury the capital city of San Jose to a depth of 12 meters. Meanwhile water pollution and overexploitation devastated coral reefs and coastal fisheries.

Because forests, fisheries, farming and mining directly account for 17 percent of Costa Rica's national income, 25 percent of its employment and 55 percent of export earnings, this destruction caused severe economic losses. The year 1989 saw the destruction of 3.2 million cubic meters of commercial timber worth more than $400 million. This amount, $69 for each person in Costa Rica, exceeded payments on the foreign debt by 36 percent. Erosion from farmland and pastures washed away nutrients worth 17 percent of the value of the annual crops and 14 percent of the value of livestock products. The deterioration of stocks in the main fishing ground was so severe that fishermen's earnings fell beneath the level of welfare payments to the destitute. Yet nothing in Costa Rica's national economic accounts records these asset losses.

When Costa Rica ran into economic difficulties in the early 1980s, economists diagnosed the problem as a debt crisis. Foreign liabilities had increased, and servicing that debt became ever more burdensome. The International Monetary Fund rushed south with programs to stabilize the monetary base. No one spoke of stabilizing the natural resource base, even though the loss in domestic assets—forests, soils and fisheries—had been much greater than the increase in external liabilities and had deprived the country of export income from which debt-servicing payments could have been made. The difference is that the buildup in foreign liabilities had been recorded and scrutinized; the depreciation in natural resource assets had been obscured and ignored.

To derive an accurate picture of what had happened, the Tropical Sciences Center in Costa Rica and the World Resources Institute collaborated to compile natural resource accounts for the country's soils, forests and fisheries for the period from 1970 to 1989. Estimates of changes in forest cover, mangrove area and other land uses were based on periodic surveys using remote sensing and satellite imaging. Data on forest type, volume, growth and composition were derived from detailed field studies, and estimates of soil erosion were generated using maps of topography, rainfall, soil types and land uses. The fishery accounts were based on sampling studies of fish populations.

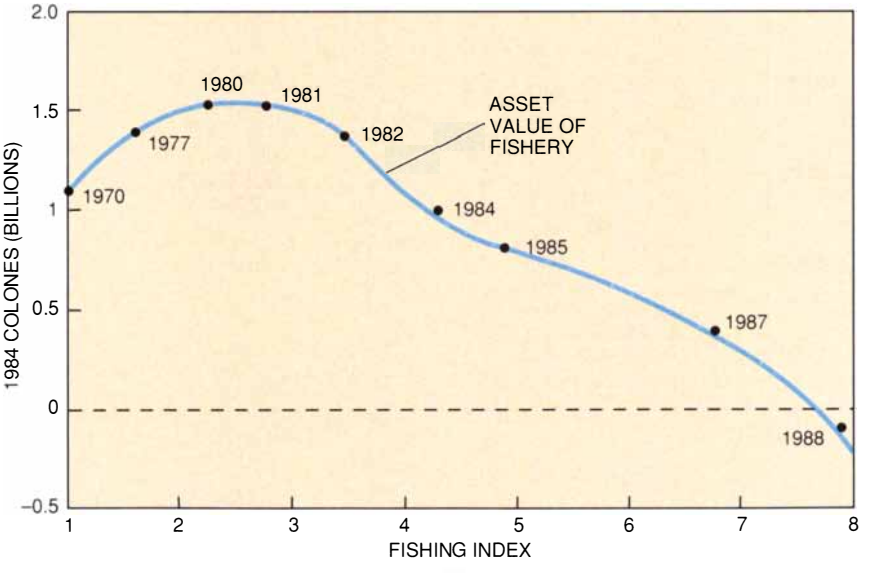
The most visible loss of natural resource assets in Costa Rica has been the destruction of its forests. Researchers constructed forestry accounts based on detailed maps of bioclimate, soil type, geology and topography, which were overlaid with land-use maps spanning the period under study. They estimated the proportions of various tree species in each forested area, along with age distributions, timber volumes and growth rates. The results are considerably more detailed and accurate than conventional forest inventories carried out for purposes of commercial logging.

The analysts then examined changes in land use to estimate the extent of deforestation. Between 1966 (the year closest to 1970 for which land-use data are available) and 1989, 847,000 hectares (2.1 million acres), or 28 percent of Costa Rica's forests, were lost. The largest losses were suffered in upland and tropical wet forests and tropical moist forests, precisely those sheltering the highest biological diversity. Two thirds of the deforestation affected ecological zones in which forest uses represented the most intensive sustainable use of the land. Despite the dominant role of the livestock industry in deforestation, only 14 percent of the area cleared was suitable for pasture.

The complete physical accounts related changes in standing volumes to annual harvesting and deforestation, as well as to growth and regeneration on remaining forest areas. The value accounts were derived from estimates of stumpage value (the market value of standing trees), which varied by species, maturity and distance from sawmills. Over time, the fraction of the forest stock that could be marketed increased substantially. Stumpage values in constant prices have risen between fourfold and 10-fold since 1970, depending on the timber variety, demonstrating how shortsighted the wanton destruction of forests has been.

Indeed, despite a declining rate of deforestation in recent years, asset depreciation has increased dramatically because the hardwoods being destroyed have become more valuable. The forestry sector generated substantially negative levels of net national income throughout the 1980s: the value of forest capital destroyed greatly outweighed the value of forest products generated.

Much of Costa Rica's terrain is steeply sloping and subject to heavy rainfall; the loss of forest cover leads to rapid erosion. Estimates of soil erosion rates were based on much the same empirical base as the forestry accounts: detailed mappings of topography, geology and soil type, rainfall and land use. From these figures, analysts subtracted estimates of the erosion rates that would occur under the highest sustainable land use for each land unit. Total erosion averaged 92 tons per hectare across all land uses, and nonsustainable erosion



TRAJECTORY OF EXPLOITATION shows how the effort expended on fishing in Costa Rica increased (as measured by an index developed at the Tropical Sciences Center), but the industry's profits decreased and eventually disappeared.

averaged nearly 300 tons per hectare on land under annual crops. Because of the decline in the area under forest cover, total erosion increased from 122 million tons per year to 189 million tons between 1970 and 1984.

The resulting monetary loss comprises both declines in farm productivity and off-site damage caused by the runoff of such enormous quantities of soil. Only partial estimates—based on sedimentation effects on hydroelectric systems—could be made of off-site damage. The overall estimate of the cost of soil erosion to agricultural productivity was based on the cost of replacing principal plant nutrients lost from the vanished topsoil. This approach is only a first approximation, since erosion also harms soil structure and biological activity and removes micronutrients.

The resulting accounts show losses increasing roughly in proportion to the acreage under agricultural uses. Annual cropping, especially on sloping land subject to heavy rainfall, contributes the largest amount to estimated depreciation, but pastures, because of their predominance among land uses, also contribute about a third of the total. Soil depreciation charges an average 13 percent of the value added for livestock production, 17 percent for annual crops, and between 8 and 9 percent for all agricultural production.

During the same period that forest and soil assets suffered serious damage, the value of the nation's principal fishery has essentially been wiped out. The Costa Rican fishing industry is mostly artisanal; it is unregulated and also subsidized through diesel fuel prices and tax benefits. The influx of small boats accelerated sharply in the 1980s as alternative employment opportunities in rural and urban areas stagnated. Meanwhile evidence of overexploitation has multiplied: fewer fish of highly valued species are caught, and the ratio of catch to fishing effort has declined steadily. Because fish stocks cannot be measured directly, changes in the value of the principal fishery in the Gulf of Nicoya were estimated by constructing a bioeconomic model relating sustainable yield to fishing effort. Researchers created an index of fishing activity by boats of differing power classes and capacities, reflecting the relative daily harvests by each type of boat.

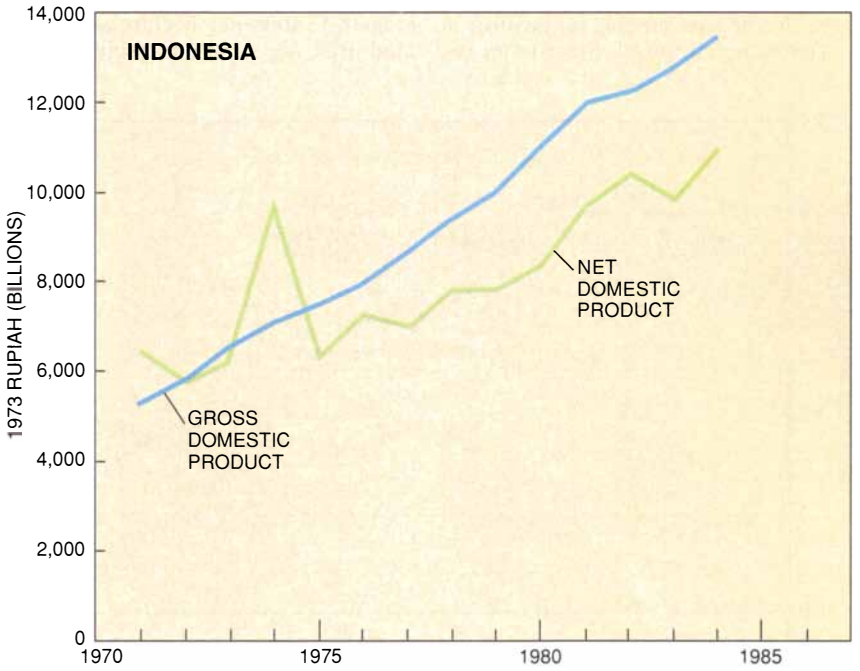
In this framework the value of the fishery can be estimated as the capitalized value of the annual sustainable profit that it can generate. As fishing effort increased throughout the 1980s, profits declined. By 1988 fishermen were scarcely recovering their direct costs, even assuming that their time was worth no more than the subsistence allowance provided to the unemployed, only a fraction of the agricultural wage. In other words, the asset value of the fishery was zero.

These three sets of accounts demonstrate that Costa Rica has been using up its natural capital at a rapid rate. From 1970 to 1989, the accumulated depreciation in the value of its forests, soils and fisheries exceeded $4.1 billion in 1984 prices—more than the average value of one year's GDP. Relative to the size of the economy, the annual loss is huge. It is as if in the U.S. the entire defense budget disappeared every year without a trace.

Yet this is only part of the loss that actually occurred. For forests, the numbers include only the loss of immediate and future timber value. Costa Rican forests provide other important services—as wildlife habitat, tourist attraction, ecosystem regulator and supplier of nontimber commodities—but their value has yet to be estimated. For soils, depreciation counted only the loss of principal nutrients for plant growth because of erosion. Other deleterious changes caused by erosion, such as the loss of micronutrients, microbiological activity and desirable soil structure, which also reduce soil fertility, were not captured. And for fisheries, only the value of the principal species in one important fishing area lost through overfishing enters the accounts.

Even the conservative methods used here show that the performance and prospects of the Costa Rican economy have been substantially overstated. The rate of net capital formation, a critical variable in economic growth, was much less than estimated. Natural resource depreciation rose from 26 percent of gross capital formation in 1970 to 37 percent in 1989. The conventional accounting framework overstated actual net capital formation (which subtracts depreciation of man-made and natural capital from gross capital formation) by more than 70 percent in 1989. An accounting system so misleading about an economic process as important as capital formation can be of no use for economic analysis, planning or evaluation.

The experience of other developing countries for which natural resource accounts have been compiled parallels that of Costa Rica. In the Philippines, for example, annual losses resulting from deforestation averaged 3.3 percent of GDP between 1970 and 1987. In 1988 dryland farming losses attributable to erosion totaled roughly 2.5 percent of GDP. More important, the lost topsoil degraded the nation's watersheds, reducing the output of hydroelectric projects and interrupting the irrigation of lowland rice paddies. These identifiable effects totaled nearly 5 percent of GDP. Once washed out to sea, topsoil damaged the coral reefs that support the small-scale fisheries. This pollution, together with overfishing, wiped out all profits by 1984. Although the na-



ECONOMIC GROWTH is overstated by measures that ignore the value of natural resource assets. Adjusting for depreciation of those assets (*green line*) presents a different picture in Indonesia and other nations.

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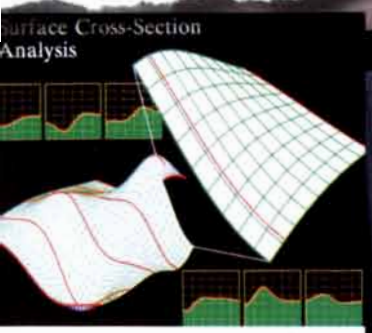

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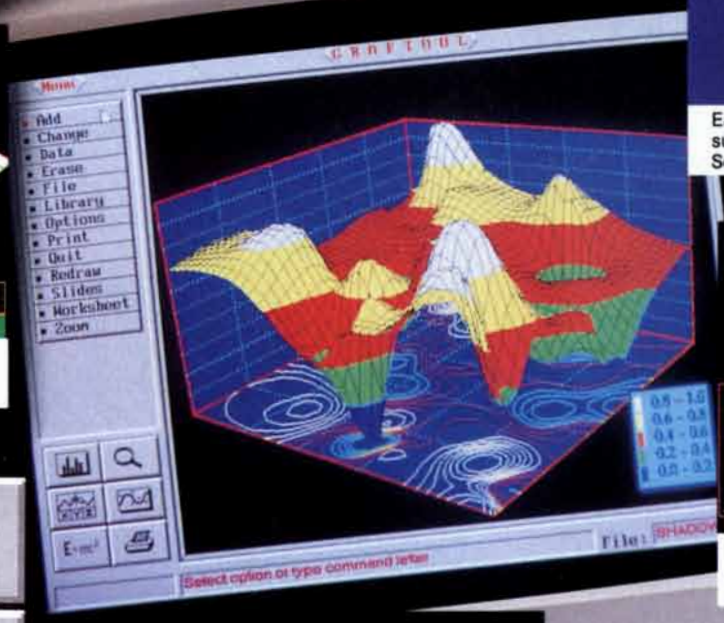

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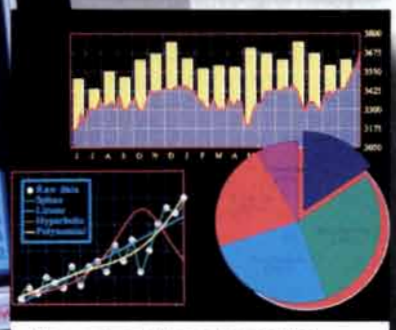

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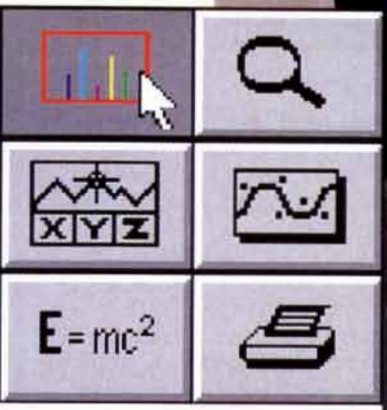

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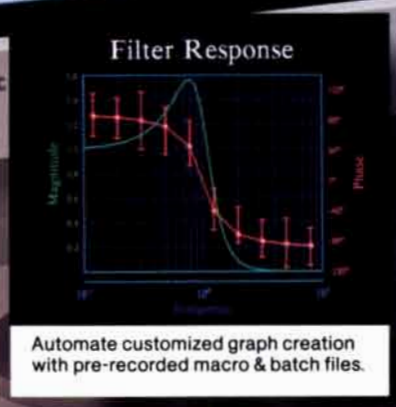

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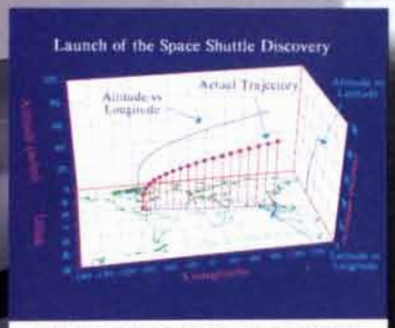

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tion's accounts showed a mounting external debt, they gave no sign of the destruction in productive capacity that made paying back that debt more and more unlikely.

Indonesia's natural resource accounts show that between 1977 and 1984 the depletion of natural resources totaled 19 percent of GDP. The 4 percent annual depreciation of soil fertility, for example, is roughly the same as the annual increase in farm production, suggesting that current increases in the yield of the nation's upland farms are being achieved almost entirely at the cost of future production. Once again, conventional accounting methods show no sign of this impending danger.

A growing number of resource-dependent countries are coming to realize the inadequacy of the current system of national accounts. Analysts have begun compiling natural resource accounts along the same lines as Costa Rica's in Mexico, El Salvador, Bolivia, Brazil, Chile, the Philippines, Indonesia, China, Malaysia, India and possibly other developing countries. In some countries the official statistical or environmental agencies are closely involved in these efforts. Economists are also constructing such accounts in Norway, Canada, Australia, France, Germany, the Netherlands and the U.S.

The importance of providing an accounting system that accurately and effectively integrates economic and environmental values has been repeatedly emphasized by world leaders. In addition, the U.S. Congress has instructed U.S. representatives to the United Nations and the multilateral development banks to urge that such changes be made in the standard system of national accounts and instructed the U.S. Agency for International Development to support the efforts of countries to compile natural resource accounts.

At the focal point of these efforts are the U.N. Statistical Commission and the U.N. Statistical Office, which are in the process of revising the standard U.N. System of National Accounts. In addition, formerly socialist countries and others, including the U.S., are now reconciling their national accounting systems with the SNA.

At present, however, the U.N. statistical authorities are adopting an equivocal stance toward the problem of natural resource accounting. They have refused to correct the basic inconsistency in the SNA's treatment of natural resources. Instead they are merely developing guidelines that countries may use to compile natural resource accounts as an adjunct to the official definitions.

NATURAL RESOURCE ASSETS are capable of generating considerable income if properly managed. Their loss (as seen in the now destroyed section of the Brazilian rain forest above) must be recognized on national balance sheets.

This straddle is unlikely to be helpful. Such adjunct accounts, even if compiled, will not command the attention of the public and policymakers as do the well-known measures of GDP, national income and investment. These, with all their distortions and inconsistencies, will continue to be the main yardsticks by which economic performance is evaluated and analyzed. Moreover, since statistical offices around the world are chronically underfunded, they are not likely to take on the task of constructing natural resource accounts on a regular basis until they are made part of the core system.

The U.N. statistical authorities should not lose the opportunity now at hand to make changes that are already long overdue. Indeed, the U.N. Conference on Environment and Development (UNCED) which will take place in Rio de Janeiro this month, would be the ideal occasion for announcing a definite timetable for change. The work done in Costa Rica and other nations has shown that realistic accounts covering a country's principal resources can be constructed at modest cost, using only data already available. These countries have also demonstrated that such accounts drastically alter the evaluation of economic performance in resource-dependent countries, providing a direly needed early warning of ecological as well as economic losses.

Three years would seem to be ample time to complete the change. It is hard to believe that countries that have labored under Marxist-Leninist economic systems for 50 years or more can convert their economies to capitalism in less time than the U.N. can change the definition of capital depreciation. The UNCED conference faces a serious challenge in achieving tangible results that will benefit the global environment. The correction of the system of national accounts is one that is within reach and that in the long run will have enormous significance.

FURTHER READING

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