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How Much Is Nature Worth? For You, \$33 Trillion

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HOW much is nature worth?

Some say the question is unanswerable, that it is impossible to calculate a dollar value for the natural world. Others say the question should not even be asked: that nature, like human life, is priceless and should not be devalued as if it were a mere commodity.

But economists and ecologists are searching for the answer anyway. Nature performs valuable, practical, measurable functions, they say: without them the human economy could not exist, and in many cases people could not duplicate them as cheaply — or at all. And they say it is time that the value of these functions is

considered when economic decisions are made.

One notable example of nature's economic value that they cite is the purification of New York City's water supply by microorganisms as the water percolates through the soil of the Catskills. The city plans to spend \$60 million to preserve that watershed in good health; the alternative, a water treatment plant, would have cost \$4 billion to build.

Nature performs a long list of other economic services as well. Flood control, soil formation, pollination, food and timber production, provision of the raw material for new medicines, recreational opportunities and the maintenance of a favorable climate are among them.

But like a well that is taken for granted until it runs dry, these ecosystem services, as ecologists call them,

Purifying drinking water costs billions; watersheds can do it for nothing.

have long been overlooked until they either no longer work or are gone — as, for instance, when the widespread destruction of Midwestern wetlands meant they could no longer perform their natural function of sponging up water from disastrous floods like those of recent years.

And to the extent ecosystem services are noticed at

all, people have tended to regard them as free.

Now, as human activity gradually uses up or destroys this natural capital and eats away at the natural systems that provide many of the services, many experts are insisting that the worth of ecosystem services must be calculated and heeded.

The results of the latest and in some ways the most ambitious effort to place a dollar value on natural capital and services were announced last week.

Thirteen ecologists, economists and geographers, in a report in the journal *Nature*, estimated the present global value of 17 ecosystem services at \$16 trillion to \$54 trillion a year, with a likely figure of at least \$33 trillion. Most of this, they said, lies outside formal markets and is therefore not reflected in market prices.

the customary gauge of economic value. Their estimate, they said, compares with \$18 trillion for the gross national product of the world, which is all the goods and services produced by people each year.

The researchers, who based their conclusion on other published studies and their own calculations, freely point out that their estimate is a rough approximation, a first step that is mainly intended to determine whether ecosystem services amount to "big potatoes or small potatoes," in the words of Dr. Robert Costanza, an ecological economist at the University of Maryland who headed the study. "We come away from this thinking this is a minimum estimate," Dr. Costanza said.

Virtually everyone agrees that without the natural world, the human economy and indeed human life could not exist. In this sense, the value of nature is infinite, immeasurable. To some conservationists, this is all that needs to be said. "Common sense and what little we have left of the wisdom of our ancestors tells us that if we ruin the earth, we will suffer grievously," said Dr. David Ehrenfeld, a conservation biologist at Rutgers University. He said he accepted the results of the Costanza study, which he regards as conservative, but added: "I am afraid that I don't see much hope for a civilization so stupid that it demands a quantitative estimate of the value of its own umbilical cord."

Dr. Ehrenfeld and some other conservationists believe that moral arguments for saving nature are more persuasive than economic ones. But in the view of Dr. Costanza and others, moral and economic arguments should be pursued in parallel.

People make economic choices involving nature all the time, according to this view, but they do so without taking all the costs into account. For example, the dollar value of a wetland's flood-protection and water cleansing abilities has not traditionally been considered when it is lost to a shopping center. The result is a creeping depletion of natural wealth.

If such costs were reflected in day-to-day transactions, these theorists say, society would pay more attention to what is lost when land is "developed."

"We can't wait until we've disrupted the planet's life-support system beyond repair," said Dr. Gretchen C. Daily, a conservation biologist at Stanford University. She is the editor of a recent collection of papers on the subject, "Nature's Services: Societal Dependence on Natural Ecosystems," published as a book by Island Press. Once gone, she noted, many of these ecological assets would be difficult, if not impossible, to replace; it can take thousands of years to recharge depleted aquifers or replenish topsoil.

Until now, fledgling efforts at what is called "green accounting" have been pursued largely at the national level. In a widely applauded attempt of this kind, Dr. Robert Repetto, senior economist at the World Re-

A price on nature puts a dollar cost on a lost wetland.

sources Institute, a Washington-based research organization, has analyzed the economies of Indonesia and Costa Rica. In Indonesia, he and colleagues calculated that losses from soil erosion reduced the net value of crops by about 40 percent and that the loss of value from deforestation was four times as high as the value of the timber extracted. They also concluded that depletion of Costa Rica's soils, forests and fisheries resulted in a 25 percent to 30 percent reduction in potential economic growth.

A nascent effort to introduce a measure of natural-resource accounting into the United States' official calculation of economic worth was made in 1993, but it is on hold pending a Congressionally ordered study of the soundness of the approach by the National Academy of Sciences. A report is due this year.

The new Costanza study is not really an exercise in green accounting, and some experts question its practical usefulness while others express skepticism about its basic findings.

"There's no way of knowing how good this number is," Dr. Repetto said of the study's estimate of \$33 trillion for the global value of ecosystem services. "They've made some heroic assumptions. I suppose it's useful for rhetorical purposes." But the number, he said, is less important than the fundamental point made by the study: "that ecosystem services are important; I don't think reasonable people would deny that."

Other experts see more utility in the analysis. The study has succeeded in providing "a conservative estimate of what the environment does for us," said Dr. Stuart Plimm, an ecologist at the University of Tennessee who wrote a commentary on the Costanza study in *Nature*. "So often," he said, "people concerned with protecting the environment go up against these very highly detailed economic analyses and feel they don't have anything in kind with which to respond." In the tables of specific ecosystem services that accompany the study, he said, "what Costanza et al. has done is provide a checklist" that national and local policy makers can use in attempting to take a rough gauge of the economic worth of their natural assets.

One table, for instance, lists specific ecosystem services, and their supposed value, for 11 biomes, or types of natural areas. These include the open ocean, estuaries, seagrass and algae beds, coral reefs, continental shelves, tropical forests, temperate forests, grasslands and rangelands, tidal marshes and mangroves, wetlands and flood plains and lakes and rivers.

The next step, Dr. Costanza says, is to delineate more clearly the explicit linkages between particular local ecosystems and local economies. For example, how much of the value of the Louisiana shrimp catch is at-

Some say nature's value is incalculable.

tributable to the wetlands in which the shrimp reproduce and grow? But since wetlands perform other services as well, the wetlands' value as a shrimp nursery would be only a minimum indication of their overall value.

The same applies, for example, to the Catskill watershed, which serves other economic functions besides providing and cleaning New York City's water — attracting tourists, for instance. "Nobody thinks" the Catskills are worth only \$4 billion," Dr. Daily said, referring to the cost of replacing the Catskills' water-cleansing function.

Assuming the value of ecosystem services could eventually be established, how might economic policies

be changed? For openers, Dr. Daily and others say, government subsidies that distort the value of natural resources — in fisheries and logging, for example — should be abolished. Also, tax incentives might be given to landowners to protect the long-term assets represented by natural capital rather than using them for short-term gain.

Some experts advocate applying traditional economic arrangements to ecosystem services. For instance, Dr. Graciela Chichilnisky and Dr. Geoffrey Heal, economists at Columbia University, have proposed selling investment shares in a given ecosystem. Using the Catskill watershed as an illustration, they say that the capital thus raised would pay for preserving the watershed. Returns to investors would come either from a share of the costs saved by not having to build a treatment plant or, if the investment were private, by actually selling ecosystem services. In the case of a watershed, clean water would be sold.

But, says Dr. Daily, "the first thing is getting the prices right."

The Value of the Natural World

A new attempt by 13 scientists to assign dollar values to essential services performed for the human economy by the natural world divides the services into the following 17 categories, with examples.

GAS REGULATION Carbon dioxide/oxygen balance, ozone for ultraviolet protection

CLIMATE REGULATION Greenhouse gas regulation

DISTURBANCE REGULATION Storm protection, flood control, drought recovery

WATER REGULATION Provision of water for irrigation, mills or transportation

WATER SUPPLY Provision of water by watersheds, reservoirs and aquifers

EROSION CONTROL AND SEDIMENT RETENTION Prevention of soil loss by wind, runoff, etc.; storage of silt in lakes and wetlands

SOIL FORMATION Weathering of rock and accumulation of organic material

NUTRIENT CYCLING Nitrogen fixation

WASTE TREATMENT Pollution control, detoxification

POLLINATION Pollinators for plant reproduction

BIOLOGICAL CONTROL Predator control of prey species

REFUGES Nurseries, habitat for migratory species

FOOD PRODUCTION Production of fish, game, crops, nuts and fruits by hunting, fishing, gathering or subsistence farming

RAW MATERIALS Production of lumber, fuel or fodder

GENETIC RESOURCES Medicines, resistance genes for crops, ornamental plant species, pets

RECREATION Ecotourism, sports fishing, other outdoor recreation

CULTURAL Esthetic, artistic, educational, spiritual and/or scientific values of ecosystems

Source: *Nature*