COSTING THE EARTH

The Challenge for Governments, the Opportunities for Business

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Costs and Benefits

Nothing so annoys environmentalists about economists as their attempt to put a price on nature's bounty. "What am I bid for one ozone layer in poor condition?" they tease. "How much is the spotted owl worth?" The idea seems ludicrous. Yet society puts prices on environmental assets all the time by deciding which policies to pursue. It is surely better to try to make sure that those prices reflect the value of the environment as accurately as possible than to pretend that they do not exist.

Most real-world decisions involve conflicts of interest. If a factory pollutes a beach, those who once swam there carry the cost. If a logging company chops down a forest, the creatures that lived in it suffer. If a view is blocked by a building, those who once enjoyed it lose, while those who rent out the building gain. In a world where money talks, the environment needs value to give it a voice.

Values are often placed on the environment almost by default. Governments implicitly judge the costs and benefits of environmental action, whether deciding to sign the Montreal Protocol on CFCs or passing laws about the permitted level of water pollution. They do implicit sums when deciding whether to run

a road through a beauty spot; so do companies when carrying out an assessment of environmental impact.

Of course, political pressures are often the way governments measure environmental benefit. Newspapers, whipped up by environmental lobbyists, clamor for action; governments publicly accept that a problem exists and announce that they will solve it, without first asking what the solution will cost, or what benefits it will bring. This may be a highly inefficient way to allocate scarce resources to protect the planet. Voters do not always get most excited about the things that do the most environmental damage.

Without putting a value on environmental gains, it is also impossible to know how far an environmental policy should go. Ought every scrap of pollution to be eliminated? Economists point out, incontrovertibly, that although the first steps in cleaning up are relatively cheap, each additional step produces smaller and smaller results. The costs of getting rid of a pollutant will rise steeply as it diminishes. Environmentalists, who tend to think in absolutes, often argue that no level of pollution is safe. Economists disagree. Some kinds of pollution, they admit, ought to be totally prevented: thus a nuclear power plant should never leave highly radioactive waste lying about, nor should factories dump cyanide in the local river. In general, though, economists think that it may be wiser to tolerate some pollution than to try to get rid of it all, whatever the cost.

Measuring the Threat

Economists use two basic approaches to set values on environmental assets. One is direct: they ask people questions. The other approach is indirect. Economists hunt for a real-world market in which to try to capture the value of environmental assets.

The questions asked in the direct approach are, at their simplest, along the lines of "What would you be willing to pay to stop the Grand Canyon from being shrouded in smog?" Some answers are shown in Table 2.1. Over time, such questions have become more and more refined in order, for instance, to try to

stop people from naming huge sums on the sensible assumption that others will share the bill through higher taxes. Some surveys ask a set of questions once, then give interviewees a pep talk on the environmental issue at stake, and ask the questions again. Not surprisingly, such experiments prove the importance of environmental education in raising people's willingness to pay to prevent environmental damage. People name even larger values if they are given a day or two to reflect after the pep talk.

Surveys have some advantages over the second method of establishing environmental values. The use of indirect valuation captures only the market value of some environmental assets. That may not be the whole story. For example, what people spend to travel to a park gives a guide to the value they put on the experience. But travel costs say nothing about the values of

Table 2.1 A Value on Nature: Non-Use Values for Unique Natural Assets ($, mid-1980s)

Asset	Value per adult
Animal species	
Whooping crane	1
Emerald shiner	4
Bottlenose dolphin	6
Bighorn sheep	7
California sea otter	7
Northern elephant seal	7
Blue whale	8
Bald eagle	11
Grizzly bear	15
Natural amenities	
Water quality (S. Platte river basin)	4
Visibility (Grand Canyon)	22

Source: K. Samples, M. Gowen, and J. Dixon, "The Validity of the Contingent Valuation Method for Estimating Non-Use Components of Preservation Values for Unique Natural Resources," paper presented to the American Agricultural Economics Association, Reno, Nevada, July 1986.

those who might like to travel to a park the next year and would pay to keep that option open. Surveys capture more of the picture: what people say they would pay reflects, at least in theory, not only the market value of some environmental assets, for instance the higher price their house commands because it fronts onto an unpolluted river, but also the priceless enjoyment a person might get from fishing on that river, and the value that might be derived by another person, far away, from the comforting thought that the river was clean. Only surveys can hope to capture the most metaphysical of all the values that economists attach to the environment: those that reflect the benefit people draw from simply knowing that species or habitats continue to exist.

This kind of psychic value is important. One of the advantages of using surveys is that they are the only way to discover values put on some environmental assets by people who do not actually make use of them. People in industrial countries especially may put a value on a species or a habitat they may never see, even if they know they will never see it. They may be pleased to know that the oceans still contain whales and the Himalayas snow leopards. They may even attach value, however hazily, to the notion that these creatures will continue to exist long after they do. An indication of this is the size of voluntary contributions people are prepared to make to conservation bodies that hope to save wild species and places. The World Wildlife Fund (WWF), largest of all, receives nearly $100 million a year. Another is the effort that people in rich countries particularly will put into conservation campaigns.

Surveys have drawbacks, too. One is the large differences that regularly appear between the answer to the question "What would you be willing to pay for a 50% improvement in air quality?" and the apparently similar question "What would you accept as compensation for a 50% worsening in air quality?" When these questions were put to 2,000 people in Haifa, Israel, the answer to the first question was about $12 per household per year (1987 prices).[1] But the compensation the households wanted if air quality were to worsen was roughly four times as much. Sometimes surveys find that people simply say that nothing would be enough to compensate them for an environmental loss,

implying that its value to them is infinite. Ask a "What would you pay" type question, and the numbers are always much more modest (see Table 2.2). One possible explanation is that people feel more strongly about losses imposed on them than about gains that they choose. The loss of something a person already "owns," like clean air, is valued more highly than the potential gain of something new, like even cleaner air. People feel that they are the owners of an endowment of environmental rights, which they are deeply unwilling to abandon.

This may be why companies trying to site a polluting plant seem to find it easier to give the local community a sense of control over the decision. But the differences between what economists dub "WTP" (willingness to pay) and "WTA" (willingness to accept) questions are interesting from another point of view. Normally, economists draw curves to show how people are

Table 2.2 Calculation Disparities of Models in Various Studies, Between WTP, "willingness to pay," and WTA, "willingness to accept" (year-of-study $)

Study	WTP	WTA
Hammack and Brown (1974)	247.00	1,044.00
Banford et al. (1977)	43.00	120.00
	22.00	93.00
Sinclair (1976)	35.00	100.00
Bishop and Heberlein (1979)	21.00	101.00
Brookshire et al. (1980)	43.64	68.52
	54.07	142.60
	32.00	207.07
Rowe et al. (1980)	4.75	24.47
	6.54	71.44
	3.53	46.63
	6.85	113.68
Hovis et al. (1983)	2.50	9.50
	2.75	4.50
Knetsch and Sinden (1983)	1.28	5.18

Source: Cummings et al. (1986), quoted in David Pearce and Kerry Turner, *Economics of Natural Resources and the Environment* (London: Harvester Wheatsheaf, 1990).

willing to trade, say, apples for oranges, or money for matches. They assume that people are willing to move smoothly—"indifferently"—along these curves, trading gradually increasing amounts of apples for rising numbers of oranges, or a few pennies less for a declining number of matchboxes. Some environmental economists argue that the answers to their valuation surveys suggest that this key assumption of conventional economics may be meaningless in the real world. Such curves may simply not exist. People's reactions may depend on whether they are paying to get more or being compensated to accept less.

Using the Market

The indirect approach to discovering environmental values involves trying to find a real market that offers some guidance. In developing countries, where the environment is literally what most people live off, such markets are often easy to find. In richer countries, the link between environmental damage and a real market may be more tenuous. Take the property market. If two identical houses on neighboring streets sell for widely differing amounts, and the less expensive one is on the street with the noisiest traffic, it is reasonable to assume that the price difference may at least partly reflect the value people put on quiet streets. In fact, it may be hard to disentangle environmental nuisance from many other factors. A study by economists at Salford University of 3,500 houses in Stockport, England, found that those in the areas most affected by noise from Manchester Airport were on average 6% less expensive than others; but most of this price difference could be explained by other characteristics of the neighborhood and the houses.[2] Even if they had not been under the flight path, the houses would still have been less expensive.

Sometimes environmental damage has measurable costs. When air pollution corrodes stone, the cost of repairs can be reckoned. That is one way to get at the value of cleaner air. When polluted water makes people ill, economists may try to put a value on the loss of health.

In third world countries, it is often much easier to use these indirect measurement techniques. Natural resources have values that can be readily estimated. The products of wild nature are

harvested commercially. Examples range from animal skins, ivory, fish, and timber to resins, rattans, mushrooms, and game. The cash value of wild products is often the only way in which biological resources appear in national income accounts. In some countries their impact on the economy may be considerable. This is especially true for countries with forests: timber from wild forests has been Indonesia's second largest source of foreign exchange, and teak is now providing Burma with hard currency. Other kinds of forest products may also be important exports: two-thirds of India's forestry exports in the early 1980s came from products other than timber. That might be true for other forested countries, if statistics were available, but figures on the value of forest products other than timber are rarely collated.

Local people may use wild nature as an important source of food that may well pass through no market and so not appear in national accounts.[3] Without wild protein, firewood, medicines, and building materials, though, people would be poorer; and it is possible to calculate with some precision just how much poorer they would be. For example, one study by the New York Botanical Gardens of the net present value of fruit, latex, and timber from a patch of Amazon rain forest looked at the price of these products in local markets.[4] Using those values, it reckoned that a hectare of forest was worth $9,000 (but only $3,000 if destroyed and used for cow pasture). The timber alone was worth only 10% of the total, and if cutting down a tree for timber killed latex or fruit trees, the gain from logging was wiped out.

Forests are a source of food, fuel, and furniture for the world's 500 million forest dwellers. In many African countries, wild food is an important part of diet, especially for the poor. In Ghana, for example, three-quarters of the population depends largely on wild foods such as fish, caterpillars, maggots, and snails. In Zaire, three-quarters of the animal protein that people eat comes from wild sources.

Amazonia is not the only place where the value of products harvested from the wild exceeds the value of the same land when used for unfamiliar domesticated animals. In developed countries the value of wild food may be tiny compared with the value of the industries that grow up around hunting and fishing. The market value of the hooked salmon or shot pheasant is a fraction of the amount human predators frequently pay to catch them

Robert Scott, a rancher from western Montana, dreams of turning the cattle off the Montana great plains, where they have grazed for not much more than a century, and replacing them with species that preceded them. He yearns to persuade the owners of 12 million acres, on which live 3,000 people and 350,000 cattle, to pool their land, which now brings in a net agricultural income of less than zero (offset by the government subsidies on which people live). Fences would fall, cattle would go, and in their place would be wandering bison, elk, antelope, bighorn sheep, and hunters. The revenue from hunting fees, guiding, accommodation, and butchering would bring in perhaps $60 million. Conservationists would have a wilderness, hunters a paradise, and landowners a genuine income.

Wildlife tourism is another way in which protected nature can earn a cash return. Tourism, mainly to see wild animals, is Kenya's biggest foreign-exchange earner. One estimate gives each lion in Amboseli National Park a value of $27,000 a year in visitor pulling-power. The park's net earnings, mainly from tourism, run at about $40 per hectare per year, a net profit 50 times as high as the most optimistic projection for agricultural use.

Some of the functions of wild nature have enormous value in making possible other kinds of economic activity, but are nonetheless hard to quantify. Wild trees may pollinate domestic ones; wild birds may keep down pests. If either go, the cost will be lost crops or money spent on developing man-made alternatives. One example is the brazil nut, which needs a particular species of bee to pollinate it, and a forest-dwelling rodent called the agouti to open its hard shell and allow the tree to seed itself. As the bee needs pollen from a forest orchid to mate, and the orchids need insects or hummingbirds to pollinate them in turn, the continued production of brazil nuts needs enough forest to accommodate bees, insects, hummingbirds, orchids, and agoutis. Other examples are marshes and wetlands, rich homes for wildlife, which often play an important role in purifying water supplies or preventing floods. One study estimated that retaining a swamp outside Boston, Massachusetts, saved $17 million in flood protection alone.[5] In other countries, coastal mangroves and coral reefs provide barriers against the fury of the sea and at the same time sustain valuable fisheries.

The functions performed by trees are even more profuse and valuable. Their roots stabilize soil and regulate the run-off of rainfall. Streams in forested areas continue to flow in dry weather and are less likely to flood when storms come. Their enormous value in preventing soil erosion has been recognized in Venezuela, where the government recently tripled the size of Canaima National Park, which safeguards a watershed that feeds some of the country's most important hydroelectric facilities. In Honduras the 7,500-hectare La Tigra National Park guards more than 40% of the water supply for Tegucigalpa, the country's capital. Rain forest has an even more important economic function, that of feeding rainfall as well as absorbing it. Cut down the trees and nearby regions suffer higher temperatures and more drought. The destruction of Africa's rain forests may well have caused the Sahara to advance, fatally impoverishing millions; destroy the Amazon, and large tracts of central and northern Brazil may suffer the same fate.

Most of the uses for wild nature accrue locally. A price can be put on them without too much ingenuity. But there are other, less quantifiable ways in which natural resources may have considerable value to the human race as a whole, but where it is difficult to turn that value into earnings for the country that has to preserve species.

Those would-be tourists who will never go to Amboseli reward television companies, not Kenyans, when they watch nature programs. Many medicines on the shelves of Western chemists have been developed from plants or (more rarely) animals and bugs. In the mid-1980s, the value of prescription and over-the-counter, plant-based drugs in OECD countries was put at about $43 billion. Tropical species are especially useful because they are often chock-a-block with poisons that scare off predators. Those poisons—like curare, used by Brazil's Yanomani Indians to tip their arrows, and by doctors as a muscle relaxant—may be the active ingredient in modern drugs. But drug companies have rarely put money into drug research in developing countries.

Wild species also play an essential role in restoring or replacing domesticated ones. The tiny group of domesticated species that account for most foods on supermarket shelves need to be

able to draw on the gene pool of their wild relatives to maintain or increase yields. Ever since 1845, when potato blight wiped out the Irish potato crop, people have been aware that the genetic uniformity of cultivated plants makes them highly susceptible to disease and pests. Stripe rust in American wheat was defeated in the 1960s with germ plasma from a wild wheat found in Turkey.

Russ Mittermeier, a former official of the World Wildlife Fund in Washington, DC, used to thrill American audiences by pointing out that "Democracy in Latin America may depend on conservation in Madagascar. If rust hits the coffee crop, the continent could lose its main source of income. There are 50 species of wild coffee, many of them caffeine-free, in the rain forests of eastern Madagascar." His audiences particularly liked the bit about "caffeine-free." Some primitive farmers recognize the importance of genetic diversity for agriculture by planting several varieties of a crop in the same field. Modern farming uses plant breeding for the same effect. Most domesticated plants and animals come from countries other than those in which they are most used. In America, for example, at least nine out of ten commercially grown species are not native. They rely on wild relatives growing in other countries for periodic reinforcement. Only a small proportion of the wild relatives of many commercial crops have been collected and stored in seed banks (see Table 2.3).

Little-known plants, fish, and animals sometimes turn out to be valuable foods. In Panama and Costa Rica attempts are being made to domesticate the endangered but edible green iguana. Quinua, once a staple grain of the Incas, turns out to be one of the world's most productive sources of plant protein. Teosinte nearly became extinct. That is the name local people gave to a species of maize found in 1979 on a small hillside in Mexico that was being cleared. Unlike other known species of maize, it was a perennial, and is now being used to develop a perennial hybrid for commercial cultivation.

But however valuable teosinte may turn out to be for commercial agriculture (and one study hazarded a figure of nearly $7 billion), not a penny is likely to go back to the owner of the Mexican hillside. A recurrent problem with all these returns on biological diversity is the virtual impossibility of turning them into cash for the people who might see it as an incentive to continue conserving. In the past the royalties on medicines made from useful medicinal plants have accrued to drug companies, not the Yanomani. Several Western schools of botany—including the New York Botanical Gardens and the Royal Botanic Gardens at Kew—now insist, before they will undertake a research contract on medical applications of tropical plants, that the commissioning companies agree to pay a share of any royalties to support research by local scientists. That is a big advance. But

Table 2.3 Wild Species in the Bank

Crop	Wild species held in all seed banks as % total holdings	Estimated % wild species still to be collected
Cereals		
Rice	2	70
Wheat	10	20–25
Sorghum	0.5	9
Pearl millet	10	50
Barley	5	0–10
Corn (maize)	5	50
Minor millets	0.5	90
Root crops		
Potato	40	30
Cassava	2	80
Sweet potato	10	40
Legumes		
Beans	1.2	50
Chickpea	0.5	50
Cowpea	0.5	70
Groundnut	6.0	30
Pigeonpea	0.5	40

Source: International Board for Plant Genetic Resources, 1988 estimates.

drug companies are not likely to use for long a plant that must be collected from the wild. Supplies are likely to be too erratic. Instead, they usually either cultivate the plant nearer home (which means in the developed world) or synthesize it. Either way, the plant's native country loses income.

Of all the ways in which nature makes possible those economic activities that are more readily measurable, none is more important than its role in regulating the planet's life support system. Plants and plankton help recycle oxygen, absorb carbon dioxide, and regulate rainfall. Individual countries may make this possible by the way they preserve their natural resources; all humanity gains.

However refined the methods by which economists value the environment, politicians and businesses may take more notice of cash payments than the value people say they derive from this or that aspect of environmentalism. One of the great dilemmas of the coming years will be to find ways of rewarding poor countries for their contribution to the public good. There may be no mechanism that enables those who want to protect a resource to compensate those who want to destroy it.

A Premium for Insurance

One complication in setting environmental benefit against the costs of taking action is the difficulty of proving what will happen if nothing is done. Because environmental science is an uncertain art, most policy decisions involve a weighting for risk. If sulphur dioxide from coal-burning power stations were undoubtedly the cause of acid rain, then the decision to install scrubbers would be a (relatively) simple matter of balancing their cost against the value people place on forests. But there are probably several causes, including nitrogen oxides from car exhausts, and disentangling the main culprit will take time. In the meantime, governments have to decide whether to compel power stations to cut sulphur-dioxide output now or to wait for harder proof. If power stations are indeed the problem, then the sooner governments take action, the less it will