

Economic returns from the biosphere

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Industrial companies and environmentalists are traditional opponents. But conflict may not be necessary: there is money to be made in projects that embrace environmental goals.

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Several large 'dirty' corporations, including British Petroleum, Monsanto, Dupont, Compaq, 3M, S. C. Johnson, Dow Chemical, Weyerhaeuser and Interface, are improving their financial performance by cleaning and 'greening' their operations¹. Last year, Costanza *et al.*² suggested that environmental services have great value, without indicating how this value can be realized. Here we propose various economic instruments that would allow investors to obtain economic returns from environmental assets, such as forests and landscapes, while ensuring their conservation. G. C.'s proposal³ for the creation of an international financial institution to promote this process was officially adopted by the group of 77 developing countries and by China at the Kyoto meeting last December.

The environment's services are, without doubt, valuable. The air we breathe, the water we drink and the food we eat are all available only because of services provided by the environment. How can we transform these values into income while conserving resources?

We have to 'securitize' (sell shares in the return from) 'natural capital' and environmental goods and services, and enrol market forces in their conservation. This means assigning to corporations — possibly by public-private corporate partnerships — the obligation to manage and conserve natural capital in exchange for the right to the benefits from selling the services provided. E. O. Wilson⁴ identifies "the need to draw more income from the wildlands without killing them, and so to give the invisible hand of free market economics a green thumb". Privatizing natural capital and ecosystem services is a vital step, as it enlists self-interest and the profit motive in the cause of the environment. Regulation can thus be confined to the more difficult cases.

Investing in the biosphere

In 1996, New York City invested between \$1 billion and \$1.5 billion in natural capital, in the expectation of producing cost savings of \$6 billion–\$8 billion over 10 years, giving an internal rate of return of 90–170% in a pay-back period of 4–7 years. This return is an order of magnitude higher than is usually available, particularly on relatively risk-free investments. How did this come about?

New York's water comes from a watershed in the Catskill mountains. Until recently, water purification processes by root systems and soil microorganisms, together with fil-



Attractive prospect: conservation of the environment can provide economic benefits for investors.

tration and sedimentation during its flow through the soil, were sufficient to cleanse the water to the standards required by the US Environmental Protection Agency (EPA). But sewage, fertilizer and pesticides in the soil reduced the efficacy of this process to the point where New York's water no longer met EPA standards. The city was faced with the choice of restoring the integrity of the Catskill ecosystems or of building a filtration plant at a capital cost of \$6 billion–\$8 billion, plus running costs of the order of \$300 million annually. In other words, New York had to invest in natural capital or in physical capital. Which was more attractive?

Investment in natural capital in this case meant buying land in and around the watershed so that its use could be restricted, and subsidizing the construction of better sewage treatment plants. The total cost of restoring the watershed is expected to be \$1 billion–\$1.5 billion. Hence an investment of \$1 billion–\$1.5 billion in natural capital could save an investment of \$6 billion–\$8 billion in physical capital. These calculations are conservative, as they consider only one watershed service, although watersheds (which are typically forests) often provide other important services, such as the support of biodiversity or carbon sequestration.

The commercial value of biodiversity can be partly captured by biological prospecting deals such as that between Merck and Costa Rica's InBio (see below). Joint implementation offers the possibility of commercializing

the carbon sequestration role, allowing carbon emitters in industrial countries to be credited with emission reductions that they support financially in developing countries. In other words, it allows them to buy abatement credits through bilateral trade. Several such deals have been brokered by the Global Environment Facility.

The implementation of a global multi-lateral carbon-emission market, as proposed by the United States in the context of the Kyoto negotiations, will provide a more robust way of selling sequestration services by allowing credits for carbon sequestration that can be cashed in the emissions market. In principle, then, a forest ecosystem can sell many different services. Recent provisions in Costa Rica recognize this: forested conservation areas are credited with income for the services that they provide both as watersheds and as carbon sinks, at a rate of \$50 per hectare for the former and \$10 per hectare for the latter. This is sufficient to tip the balance in favour of conserving land of marginal agricultural value.

Agriculture provides another example of the returns from investing in biodiversity to preserve genetic variation. In the early 1970s, the 'grassy stunt' virus posed a major threat to Asia's rice crop, but was defeated by the transfer of an immunity-conveying gene from wild rice to commercial varieties. In 1976, another threatening disease was defeated by transferring to commercial varieties the immunity carried by certain strains

of wild rice, preserved for just this reason by the International Rice Research Institute in the Philippines. The returns to this investment in conservation are incalculably large.

'Securitizing' the biosphere

To address its water problem (see above), New York City has floated an 'environmental bond issue', and will use the proceeds to restore the functioning of the watershed ecosystems responsible for water purification. The cost of the bond issue will be met by the savings produced: the avoidance of a capital investment of \$6 billion–\$8 billion, plus the \$300 million annual running costs of the plant. The money that would otherwise have paid for these costs will pay the interest on the bonds. New York City could have 'securitized' these savings by opening a 'watershed savings account' into which it paid a fraction of the costs avoided by not having to build and run a filtration plant. This account would then pay investors for the use of their capital.

This same financial structure is already used in securitizing the savings from increased energy efficiency in buildings. This process involves issuing contracts (securities) entitling their owners to a specified fraction of the savings. These contracts are often tradeable, issued to the providers of capital, and can be sold by them even before the savings are realized. This is a way of making investment in saving energy attractive, and does not imply any transfer of ownership of the underlying asset. The US Department of Energy has a standard protocol for estimating the savings from enhanced energy efficiency in buildings. Several financial agencies are willing to accept these estimates of energy savings as collateral for loans.

The introduction of market forces could be taken a step further. Imagine a corporation managing the restoration of New York's watershed, with the right to sell the services of the ecosystem. In this case, the service is the provision of water meeting EPA standards. Ownership of this right would enable the corporation to raise money from capital markets to meet the costs of conserving New York's watershed. If the issue was biodiversity, rather than a watershed, the corporation would own and sell (or license) the rights to intellectual property derived from the biodiversity. Such a framework would harness private capital and market forces in the service of environmental conservation.

Financing the biosphere

How significant a contribution could securitization and privatization make to conserving the biosphere? Many important watersheds are threatened by development: not only that of New York, but also the watersheds of Rio de Janeiro, the basin of the river Paraibo do Sul in the Mata Atlantica coastal forest in Brazil (a biotically unique region whose conservation would convey benefits

far in excess of the value of the water provided), and the watershed for parts of Buenos Aires. Arrangements of the type discussed here could be applied to the watersheds of some of the world's largest cities. In the United States, more than 140 cities are considering watershed conservation as an alternative to water purification. Not only could this be cost-effective, it could also stimulate conservation and a coming together of market forces with the environment.

The EPA recently estimated that ensuring safe and adequate drinking water for the United States will need infrastructure investment of \$138.4 billion over the next 20 years. The equivalent figure worldwide will be in the order of trillions of dollars. In the context of the other pressing infrastructure needs of developing countries, this amount is almost certainly not attainable by the public sector. Watershed conservation could substantially cut the investment needed, and securitization or privatization could ensure much of the balance is provided by the private sector.

What do privatization or securitization offer for other types of ecosystem? Daily⁵ identifies the following social and economic functions of ecosystem services: purification of air and water; mitigation of floods and droughts; detoxification and decomposition of wastes; generation and preservation of soils; control of most potential agricultural pests; pollination of crops and natural vegetation; dispersal of seeds; cycling of nutrients; maintenance of biodiversity; protection of coastal shores from erosion; protection from harmful ultraviolet; partial stabilization of the climate; and provision of aesthetic beauty and intellectual stimulation.

Which of these systems are amenable to the approach described here? One prerequisite is that the ecosystem must provide goods or services to which a commercial value can be attached. Watersheds satisfy this criterion: drinkable water is becoming increasingly scarce, and the availability of such water is one of the main constraints on health improvements in many poorer countries.

Commercial value of an ecosystem service is necessary but not sufficient for privatization, and some of that value has to be available for appropriation by the producer. An important issue in deciding whether ecosystem services can be privatized is the extent to which they are public goods. These are services which, if provided for one are provided for all, making it hard to exclude those who do not contribute to their costs from benefiting from their provision. So providers cannot appropriate all their returns, and for this reason we cannot be sure markets will allocate them efficiently. Water quality is a public good in the sense that if it is improved for one user it is improved for all. But water consumption is excludable, so the watershed case involves bundling a public with a private good. Knowledge, an intermediate category and one of the

services of biodiversity, has to be commercialized carefully, as shown by the need for protection such as patents and copyrights.

Ecotourism is an ecosystem service that could be treated by securitization or privatization. It is natural to expect that private investment will be forthcoming to finance the conservation of a region with significant ecotourism potential, in return for the right to some of the revenues. The growth of private game reserves is one obvious manifestation. There is a close economic resemblance to watersheds, in that the preservation of the ecosystems supporting ecotourism is a public good and benefits all. But the hotel rooms and guide services are private goods whose value is enhanced by the public good.

The commercial value of diversity is demonstrated by the International Rice Research Institute, which preserves genetic material for a range of strains (which is useful in providing immunity to new diseases, for example). Costa Rica and the pharmaceutical company Merck have made an innovative deal in which Costa Rica conserves an area of forest, supported by a payment from Merck; Merck has access to the results of biological prospecting in this forest; and Merck will pay Costa Rica a royalty on products developed from the prospecting. The deal represents a first step in providing a conservation agency in a developing country with a financial stake in the intellectual property of its biodiversity.

Can biodiversity be securitized to encourage private capital to conserve genetic variation and capture some of its commercial value? The only product of Incyte, a biotechnology company, is a database of information about genetic structures. This information has been heavily processed: biodiversity in its natural state represents unprocessed genetic information, which is less commercially usable. There may be a role for private capital in establishing a 'pre-processing' centre for genetic information from developing countries. Such a centre could conduct some preliminary analysis and sell the right to use it, with a royalty to the originating country.

For certain types of ecosystem service, privatization or securitization are real possibilities. They could be central in realizing the economic value of the underlying asset and so providing powerful economic incentives to conserve it for the future. □

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1. *Business Week* 10 November 1997, pp. 98–99.
2. Costanza, R. et al. *Nature* 387, 253–260 (1997).
3. Chichilnisky, G. *Development and Global Finance: The Case for an International Bank for Environmental Settlements* (UNDP-UNESCO Office of Development Studies, New York, 1996).
4. Daily, G. (ed). *Nature's Services: Societal Dependence on Natural Ecosystems* (Island, Washington DC, 1997).
5. Wilson, E. O. *The Diversity of Life* (Norton, 1993).

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