Untangling the Environmentalist's Paradox: Better Data, Better Accounting, and Better Technology will Help

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Untangling the Environmentalist's Paradox: Better Data, Better Accounting, and Better Technology Will Help

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The recent article in *BioScience* by Ciara Raudsepp-Hearne and colleagues, "Untangling the Environmentalist's Paradox: Why Is Human Well-being Increasing as Ecosystem Services Degrade?" (Raudsepp-Hearne et al. 2010) sheds light on a conundrum facing classical ecologists. As the authors explain, "The environmentalist's expectation could be articulated as 'ecological degradation and simplification will be followed by a decline in the provision of ecosystem services, leading to a decline in human well-being.'" But, they note, human well-being in fact appears to be increasing in the face of degraded ecosystem services.

I agree with this description of the environmentalist's expectation with a slight but significant word change: Ecological degradation and simplification will *eventually* be followed by a decline in the provision of ecosystem services, leading to a decline in human well-being. The addition of "eventually" makes explicit the time dimension in the "paradox," which is otherwise potentially lost. It also allows me to recast some of the issues in the article using two concepts from the economist's toolbox.

The first is the distinction between "stocks," a resource pool that doesn't have a time dimension, and "flows," an input or output that is measured per unit of time. An ecosystem service is a flow; it has a time dimension and a quantity associated with it (e.g., metric tons of wheat produced per hectare per year). Potentially, stocks of resources (e.g., nutrients in the soil in which the wheat is grown, the groundwater pool or precipitation from which the plants draw moisture) can combine to yield a variety of ecosystem services (e.g., liters of water and kilograms of plant nutrient over the cropping period). This distinction between stock and flow helps to untangle the paradox highlighted in the title chosen by Raudsepp-Hearne and colleagues. Drawing down stocks makes it possible to provide ecosystem services for extended periods. Eventually, however, the decline of stocks makes it impossible to continue providing the same level of services and human well-being will be reduced, and the paradox is eventually resolved. The authors allude to this possibility in their fourth hypothesis for the paradox—the idea that there are time lags between ecosystem degradation and effects on well-being—specifically citing research by Wackernagel, Vitousek, Worm, and others that have explored this theme.

It is notable, however, how many times Raudsepp-Hearne and colleagues use such expressions as "might be," "it is possible that," and "it could be." Their uncertainty highlights a central concern I have with the empirical analysis Raudsepp-Hearne and colleagues have undertaken and their proposal for additional research topics: the reliance on existing data and the expectation that new data will be available for new research.

Data scarcity is one of two key challenges to assessing whether the environmentalist's expectation has been or will be fulfilled. The first is the sorry state of available data on ecosystem services and the stocks of resources that provide them. It is a sad fact that I can get higher-resolution elevation data for Mars than for Earth, and the elevation data set for our planet is one of the few good global data sets! We desperately need to collect time-series data on the state of the planet's ecosystems at high spatial resolution. The technological cost of collecting these data has declined substantially in the past few years, but we are still missing the global will, and perhaps the institutions, to do it.

To illustrate the second key challenge to untangling the paradox I need to return to the economist's toolbox and bring out the concept of externalities. An externality exists when a resource that provides a useful and thus valuable service is not effectively controlled by anyone (an open-access resource), and when the use of it by one person affects the value of the service to others. Initially, using the service does not damage the resource (one fisherman with a pole harvesting fish in a large lake cannot deplete the stock of fish significantly), but the more the resource is used (say, multiple fishermen with large nets), the more damage eventually occurs, and the quantity of the service that the resource can provide therefore declines.

Can human behavior be altered to use resources sustainably? In a series of publications, Ester Boserup argued that human development is essentially a sequence of repeated steps of developing institutions to convert open-access resources into private property—a once freely available resource becomes overused, and a set of rules, regulations, and new technologies is created to manage the resource sustainably (see, e.g., Boserup 1965). Private property rights give the resource-owner exclusive use and presumably an incentive to use it sustainably.

Discrete resources such as land or small bodies of water are relatively easy

to privatize, through either individual or group ownership. But complex ecosystems with multiple ecosystem services that can extend over large areas of space (e.g., river systems) or time (e.g., long-maturing plant species) make the assignment of property rights challenging. When little data exist on how the services are generated, the challenge is even greater. And resources that cross national boundaries further exacerbate the difficulty.

The debate over how to reduce greenhouse gas emissions (GHGs) is a classic example. Humans have been treating the atmosphere as an open-access resource, releasing an ever-growing quantity of GHGs without constraint. Limited emissions initially had little effect on the services provided by the atmosphere. But a by-product of today's levels of energy use and agricultural production is the release of a sufficient quantity to raise average temperatures enough to cause significant disruptions. The United Nations Framework Convention on Climate Change negotiations are, at their core, about allocating property rights to the atmosphere for GHG emissions. Any conversion of an open-access resource to private property can engender conflict among existing users (think land and water wars). In the case of a global resource such as the atmosphere, unprecedented cooperation among all the world's inhabitants is required.

A few other observations about the relationships between human well-being and ecosystem services seem relevant, given the apparent meaning that Raudsepp-Hearne and colleagues attach to the term "welfare." The Human Development Index tends to be a measure of physical well-being, not psychological well-being. I think this is perfectly reasonable. If basic physical needs are not met, then psychological well-being is also likely to suffer. But implicitly, and to some extent, explicitly, the authors fall back on an argument that psychological well-being has suffered. Economists tend to be leery of trying to measure whether people are psychologically better off (although some economists have been part of the recent spate of publications on happiness measures). Early attempts to find quantitative measures of utility, with units of utils, proved ineffective, and the profession decided to assume that if a person chose one consumption pattern rather than another, then that person must have preferred the chosen pattern and was therefore better off with it. Acting as an amateur psychologist, I would argue that psychological well-being is mutable, changing with age, the happenstances of living a life, and the culture in which one is reared. I would get claustrophobic living in Hong Kong for an extended period of time, but I can imagine that someone from Hong Kong might find the wide open spaces of Wyoming, which I love, frightening. And if a child of mine were reared in Hong Kong, she might well find the bustle exhilarating.

Raudsepp-Hearne and colleagues suggest a linear relationship between food availability and human well-being. This is a reasonable simplification at low levels of consumption, but as consumption increases, it doesn't hold. Rates of obesity are high in the United States, growing in Europe, and beginning to increase in far too many developing countries. The "Environmentalist's Paradox" authors report that they "did not address aspects of well-being that have not been measured globally, such as psychological health, social solidarity, or cultural change." As physical well-being becomes less of an issue, these components of well-being become increasingly important research topics. Raudsepp-Hearne and colleagues also confuse an important change in public policy with a technological innovation, describing the growth of biofuels as a technological innovation—in fact it is driven almost entirely by political decisionmaking.

However, improvements in technology will be essential. The only way to avoid the reality of the environmentalist's nightmares is to aggressively develop and exploit new technologies, such as cell phones that can help a Kenyan farmer tap into the latest information on prices, weather forecasts, and potential new crop varieties that more efficiently use nutrients while being tolerant of droughts and floods. Fortunately, the interaction of the green, gene, and information technology revolutions provides a huge new set of tools to deal with the coming challenges.

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