POLICY TOOLBOX

CHAPTER 18

Ecosystem Services for Sustainable Prosperity

Ida Kubiszewski and Robert Costanza

We live in an age of globalization. An age where information travels instantly around the world. Where humans and their built infrastructure have reached every part of the globe, striving for unending material growth and prosperity. These goals would only be possible, however, within a system unconstrained by any biophysical limits. On Earth, we must live within the planetary boundaries set by the functioning of our ecological life-support system.[1]

In pursuit of unending material growth, western society has increasingly favored institutions that promote the private sector over the public and commons sectors, capital accumulation by the few over asset building by the many, and finance over the production of real goods and services. Steady decline in median income and marginal tax rates have reduced the funds available to spend on public goods while simultaneously contributing to rising income disparity and ecosystem degradation. At the same time, many developing countries are on a path to replicate this system, creating a more extreme version of this disparity within their own boundaries.[2]

This view of what "prosperity" means emerged when the world was still relatively empty of humans and their built infrastructure. Natural resources were abundant, social settlements were sparser, and inadequate access to infrastructure represented the main limit on improvements to human well-being. Much has changed in the last century, however. The human footprint has grown so large that in many cases real progress is constrained more by limits on the availability of natural resources and ecosystem services than by limits on built capital infrastructure.[3]

In a full world, we can no longer focus on valuing certain aspects of society while ignoring others. We need to redefine prosperity to ensure that we are moving in the appropriate direction. We first have to remember that the end goal of an economy is to improve human well-being and the quality of life sustainably. Material consumption and gross domestic product (GDP) are merely means to that end, not ends in themselves. We have to recognize, as both ancient wisdom and new psychological research tell us, that material consumption beyond real need can actually reduce overall well-being. We have to be able to distinguish real poverty in terms of

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low quality of life versus merely low monetary income.[4]

But most important, we have to identify what really does contribute to human well-being—namely the ecological systems that provide us with fresh water, soil, clean air, a stable climate, waste treatment, pollination, and dozens of other essential ecosystem services. Ecosystem services can be defined as the ecological characteristics, functions, or processes that directly or indirectly contribute to human well-being—the benefits people derive from functioning ecosystems.[5]

Importance of Natural Capital and Ecosystem Services

The ecosystems that provide these various services are sometimes referred to as "natural capital," using the general definition of capital as a stock that yields a flow of services over time. In order for these benefits to be realized, natural capital must be combined with other forms of capital that require human actions to build and maintain. These include built or manufactured capital, human capital, and social or cultural capital.[6]

So how do we identify and determine the importance of the contributions of natural capital to human well-being in a way that will help society use this knowledge to make decisions? One way is to identify the services that ecosystems provide to humans. Even without any subsequent valuation, just knowing about the existence and benefit to humans of the services derived from an ecosystem can help ensure appropriate recognition of the full range of potential impacts of a given policy option. This can make the analysis of ecological systems more transparent and can help inform decisionmakers about the relative merits of different options before them.

Recognition of their existence is nevertheless not enough if the value of those services is not used in decisionmaking by policymakers or consumers. By not having a number attached to the contributions of these services in terms comparable with economic services and manufactured capital, the value of ecosystem services is often perceived to be zero. Hence, they are often given too little weight in policy decisions and usually a lower priority than economic goods and services.

Valuing Ecosystem Services

Why is it so important to value these services in a comparable way? When it comes to decisionmaking, ecological conflicts arise from two sources: scarcity and restrictions in the amount of ecosystem services that can be provided and distribution of the costs and benefits of the provisioning of the ecosystem services. Ecosystem services science makes trade-offs explicit and thus facilitates management and planning discourse. It helps stakeholders make sound value judgments. Ecosystem services science thus generates relevant socioecological knowledge for stakeholders and decisionmakers along with sets of planning options that can help resolve sociopolitical conflicts.[7]

Accurately valuing ecosystem services is one challenge. Another is that many ecosystem services are public goods. This means that they are non-excludable and that multiple users can simultaneously benefit from using them. Such a characteristic poses a problem, as society does not have the institutions and policies to deal with this type of resource. This creates circumstances where individual choices are not the most appropriate approach to valuation. Instead, some form of community or group choice process is needed.

In recent years, scientists and economists have tried to develop techniques for estimating the benefits from ecosystems. Valuation can be expressed in multiple ways, including monetary units, physical units, or indices. Economists have developed a number of valuation methods that typically use metrics expressed in

Hannu

Human footprint: clearcut for an artillery range in Estonia

monetary units, while ecologists and others have developed measures or indices expressed in a variety of nonmonetary units, such as biophysical trade-offs.[8]

One of the first studies to estimate the value of ecosystem services globally was published in the journal *Nature* in 1997, entitled "The Value of the World's Ecosystem Services and Natural Capital." The authors estimated the value of 17 ecosystem services for 16 biomes to be in the range of $16–54 trillion per year, with an average of $33 trillion per year—a figure larger than annual global GDP at the time.[9]

More recently the concept of ecosystem services gained attention with a broader academic audience and the public when the Millennium Ecosystem Assessment (MA) was published in 2005. The MA was a four-year study that involved 1,360 scientists and that was commissioned by the United Nations. The report analyzed the state of the world's ecosystems and provided recommendations for policymakers. It determined that human actions have depleted the world's natural capital to the point that the ability of a majority of the "planet's ecosystems to sustain future generations can no longer be taken for granted."[10]

In 2008, a second international study was published on The Economics of Ecosystems and Biodiversity (TEEB), hosted by United Nations Environment Programme. TEEB's primary purpose was to draw attention to the global economic benefits of biodiversity, to highlight the growing costs of biodiversity loss and ecosystem degradation, and to draw together expertise from the fields of science, economics, and policy to enable practical actions moving forward. The TEEB report was picked up extensively by the mass media, bringing ecosystem services to a broad audience.[11]

Even though much new research and reporting is being done around the topic of ecosystem services, uncertainty always exists in measurement, monitoring, modeling, valuation, and management. To reduce this, constant evaluation is necessary to determine the impacts of existing systems and to design new systems with stakeholder participation as experiments from which we can more effectively quantify performance and learn ways to manage such complex systems.

A key challenge in any valuation is imperfect information. Individuals might, for example, place no value on an ecosystem service if they do not know the role that the service plays in their well-being. Here is an analogy. If a tree falls in the forest and there is no one around to hear it, does it make a sound? The answer to this age-old question obviously depends on how "sound" is defined. If sound is the perception of sound waves by people, then the answer is no. If sound is defined as the pattern of physical energy in the air, the answer is yes. In the case of ecosystem services, individuals' actions and stated preferences would not reflect the true benefit of ecosystem services as they do not realize the existence of the benefits being provided. Another important challenge is accurately measuring the functioning of a system to correctly quantify the amount of a given service derived from that system.[12]

Leaflet

Ecosystem service: drawing water from the Ogallala aquifer, Buffalo Lake National Wildlife Refuge, Texas

But recognizing the importance of ecosystem services does not eliminate the limitations that human perception-centered valuation creates. As the tree analogy demonstrates, perceived value can be a quite limiting valuation criterion, because natural capital can provide positive contributions to human well-being that are either never (or only vaguely) perceived or may only manifest themselves in the future. A broader notion of value allows a more comprehensive view of value and benefits, including, for example, valuation relative to alternative goals/ends, such as fairness and sustainability, within the broader goal of human well-being. Whether these values are perceived or not and how well or accurately they can be measured are separate and important questions.[13]

The incorporation of the value of ecosystem services into the definition of sustainable prosperity is critical to ensuring that a "real" and sustainable prosperity can be estimated and pursued. It goes beyond that, however: ecosystem services are essential to the existence of human society, as they are the life support system of the planet. Often the connection between ecosystem services and human health, and hence prosperity, is difficult to make, since it is often indirect, displaced in space and time, and dependent on many forces.[14]

Institutions around Ecosystem Services

Recognizing that we are in a biophysical crisis because of our overconsumption and lack of protection of ecosystem services, we must invest in institutions and technologies to reduce the impact of the market economy and to preserve and protect public goods. New types of institutions are needed to do this, using a sophisticated suite of property rights regimes. We need institutions that use an appropriate combination of private, state, and common property rights systems to establish clear property rights over ecosystems without privatizing them.

One such category of institution is the commons sector, which would be responsible for

managing existing common assets and for creating new ones. Some assets should be held in common because it is more just; these include resources created by nature or by society as a whole—for example, a freshwater environment created by nature or common knowledge created by society. Others should be held in common because it is more efficient; these include nonrival resources for which price rationing creates artificial shortages (information) or rival resources (goods that are used up through consumption) that generate nonrival benefits, such as trees filtering water to make it drinkable. Others should be held in common because it is more sustainable; these include essential common pool resources and public goods such as clean air.[15]

An example of such an institution for managing the commons sector is a "common asset trust" at various scales. Trusts can "propertize" the commons without privatizing them, as do many land trusts currently in existence. Common asset trusts could protect and restore critical natural capital—the resources provided by nature that are in some way essential to human well-being. They can also promote information and technologies that can protect or enhance public goods. Examples of this include low pollution energy sources, non-ozone-depleting refrigerants, organic agriculture, erosion- and drought-resistant agriculture (such as perennial grains), alternatives to trawl fishing, devices that reduce bycatch in fisheries, and so on. All such information should be freely available for whoever chooses to use it.[16]

Another such institution that has provided a model of this type of institution is "payment for ecosystem services." This sets up a system in which landowners or farmers are paid to maintain the ecosystems that provide services to the rest of the population in a region. Those using the services provide the money for the payment. Probably the best known such system was implemented in Costa Rica over a decade ago: landowners are paid to plant or preserve forested areas on their land. A workshop was held in Costa Rica around this issue and proved to be very successful.[17]

Ideas about ecosystem services and their valuation have begun to appear not only in public media outlets in the form of high-profile reports but also in the business community. Dow Chemical recently established a $10-million collaboration with The Nature Conservancy to tally up the ecosystem costs and benefits of every business decision. Such collaboration will provide a significant addition to ecosystem services valuation knowledge and techniques. But significant research and new institutional design are still required.[18]

Hundreds of projects and groups are currently working toward better understanding, modeling, valuation, and management of ecosystem services and natural capital. It would be impossible to list all of them here, but a few key ones are a new international Ecosystem Services Partnership that is a global network helping to coordinate activities and build consensus; a World Bank initiative called Wealth Accounting and Valuation of Ecosystem Services, with the goal of improving information available to decisionmakers in Ministries of Finance and Planning or in central banks so that development can proceed in a more sustainable fashion; and a new United Nations effort called the Intergovernmental Platform on Biodiversity and Ecosystem Services that will be an interface between the scientific community and policymakers and that aims to build capacity for and strengthen the use of science in policymaking.[19]

Priorities on Ecosystem Services

Given that significant levels of uncertainty exist in ecosystem service measurement, monitoring, modeling, valuation, and management, we should continuously gather and integrate appropriate information, with the

goal of learning and adaptive improvement. To do this we should constantly evaluate the impacts of existing institutions and design new ones with stakeholder participation as experiments from which we can more effectively quantify performance and learn.

We need institutions that can effectively deal with the public goods nature of most ecosystem services, using a more sophisticated suite of property rights regimes. We need institutions that use a balanced combination of existing private property rights systems and new systems that can propertize ecosystems and their services without privatizing them. Systems of payment for ecosystem services and common asset trusts can be effective elements in these institutions.

The spatial and temporal scale of the institutions to manage ecosystem services must be matched with the scales of the services themselves. Mutually reinforcing institutions at local, regional, and global scales over short, medium, and long time scales will be required. Institutions should be designed to ensure the flow of information between scales, to take ownership regimes, cultures, and actors into account, and to fully internalize costs and benefits.

Distribution systems should be designed to ensure inclusion of the poor, since they depend more on common property assets like ecosystem services. Free-riding should be prevented, and beneficiaries should pay for the services they receive from biodiverse and productive ecosystems.

One key limiting factor in sustaining natural capital is shared knowledge of how ecosystems function and how they support human well-being. This can be overcome with targeted educational campaigns, clear dissemination of success and failures directed at both the general public and elected officials, and true collaboration among public, private, and government entities.

Relevant stakeholders—local, regional, national, and global—should be engaged in the formulation and implementation of management decisions. Full stakeholder awareness and participation contributes to credible, accepted rules that identify and assign the corresponding responsibilities appropriately and that can be effectively enforced.

Ecosystem concepts can be an effective link between science and policy by making the trade-offs in today's world more transparent. An ecosystem framework can therefore be a beneficial addition to policymaking institutions and frameworks and can help to integrate science and policy.

These are just first steps. But in order to establish sustainable prosperity for all, the value of ecosystems services will need to be understood and factored into all policy and business decisions in the future.

Chapter 18. Ecosystem Services for Sustainable Prosperity

1. Lack of biophysical limits from R. Beddoe et al., "Overcoming Systemic Roadblocks to Sustainability: The Evolutionary Redesign of Worldviews, Institutions, and Technologies," *Proceedings of the National Academy of Sciences*, 24 February 2009, pp. 2483–89; planetary boundaries from J. Rockström et al., "A Safe Operating Space for Humanity," *Nature*, 23 September 2009, pp. 472–75, and from W. Steffen, J. Rockström, and R. Costanza, "How Defining Planetary Boundaries Can Transform Our Approach to Growth," *Solutions*, May 2011, pp. 59–65.

2. Capital accumulation by the few over asset building by the many from Bureau of National Economic Accounts, "Current Dollar and 'Real' GDP," U.S. Department of Commerce, Washington, DC, 2007, and from J. E. Stiglitz, *Globalization and Its Discontents* (New York: W. W. Norton & Company, 2002); rising income disparity and ecosystem degradation from J. G. Hollender et al., "Creating a Game Plan for the Transition to a Sustainable U.S. Economy," *Solutions*, June 2010, pp. 36–41.

3. Constrain real progress from H. E. Daly, "From a Failed-Growth Economy to a Steady-State Economy," *Solutions*, February 2010, pp. 37–43.

4. Material consumption beyond real need reducing overall well-being from R. A. Easterlin, "Explaining Happiness," *Proceedings of the National Academy of Sciences*, 16 September 2003, pp. 11176–83.

5. Definition of ecosystem services from R. Costanza et al., "The Value of the World's Ecosystem Services and Natural Capital," *Nature*, 15 May 1997, pp. 253–60, and from Millennium Ecosystem Assessment (MA), *Ecosystems and Human Well-being: Synthesis* (Washington, DC: Island Press, 2005). Ecosystem processes and functions may contribute to ecosystem services but they are not synonymous. Ecosystem processes and functions describe biophysical relationships and exist regardless of whether or not humans benefit. Ecosystem services, on the other hand, only exist if they contribute to human well-being and cannot be defined independently. See E. F. Granek et al., "Ecosystem Services as a Common Language for Coastal Ecosystem-based Management," *Conservation Biology*, vol. 24, no. 1 (2010), pp. 207–16.

6. Definition of natural capital from R. Costanza and H. E. Daly, "Natural Capital and Sustainable Development," *Conservation Biology*, March 1992, pp. 37–46; combining the different forms of capital from R. Costanza et al., "Valuing Ecological Systems and Services," *F1000 Biology Reports*, July 2011, p. 14.

7. Source of ecological conflict from Costanza et al., op. cit. note 6.

8. Economist valuation methods from A. M. Freeman, *The Measurement of Environmental and Resource Values: Theories and Methods*, 2nd ed. (Washington, DC: RFF Press, 2003); ecologist valuation methods from R. Costanza, "Value Theory and Energy," in C. Cleveland (ed.), *Encyclopedia of Energy, Vol. 6* (Amsterdam: Elsevier, 2004), pp. 337–46.

9. Costanza et al., op. cit. note 5.

10. MA, op. cit. note 5, p. 14; MA, *Living Beyond Our Means: Natural Assets and Human Well-Being: Statement from the Board* (Washington, DC: World Resources Institute, 2005), p. 2.

11. P. Sukhdev and P. Kumar, *The Economics of Ecosystems and Biodiversity (TEEB)* (Brussels: European Communities, 2008).

12. Imperfect information from B. Norton, R. Costanza, and R. Bishop, "The Evolution of Preferences: Why 'Sovereign' Preferences May Not Lead to Sustainable Policies and What to Do About It," *Ecological Economics*, February 1998, pp. 193–211; quantify the amount of a given service derived from that system from E. B. Barbier et al., "Coastal Ecosystem-based Management with Nonlinear Ecological Functions and Values," *Science*, 18 January 2008, pp. 321–23, and from E. W. Koch et al., "Non-linearity in Ecosystem Services: Temporal and Spatial Variability in Coastal Protection," *Frontiers in Ecology and the Environment*, February 2009, pp. 29–37.

13. Broader notion of value from R. Costanza, "Social Goals and the Valuation of Ecosystem Services," *Ecosystems*, January-February 2000, pp. 4–10.

14. Ecosystem services essential to the existence of human society from G. C. Daily et al., *Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems* (Washington, DC: Ecological Society of America, 1997); connection to human health from MA, op. cit. note 5.

15. Assets that should be held in common from Beddoe et al., op. cit. note 1, and from I. Kubiszewski, J. Farley, and R. Costanza, "The Production and Allocation of Information as a Good That Is Enhanced with Increased Use," *Ecological Economics*, vol. 69 (2010), pp. 1344–54.

16. Common asset trust from P. Barnes, *Capitalism 3.0* (San Francisco: Berrett-Koehler, 2006), and from P. Barnes et al., "Creating an Earth Atmospheric Trust" (letter), *Science*, 8 February 2008, p. 724; freely available information from Kubiszewski, Farley, and Costanza, op. cit. note 15.

17. Payment for ecosystem services from J. Farley and R. Costanza. "Payments for Ecosystem Services: From Local to Global," *Ecological Economics*, vol. 69 (2010), pp. 2060–68.

18. Ecosystem services in public media from J. D. Schwartz, "Should We Put a Dollar Value on Nature?" *Time*, 6 March 2010; C. Asquith, "Dow Chemical and The Nature Conservancy Team Up to Ask, What Is Nature Worth? Interview with Mark Weick and Michelle Lapinski," *Solutions*, vol. 2, no. 6 (2011).

19. Ecosystem Services Partnership, at www.espartnership.org; Wealth Accounting and Valuation of Ecosystem Services, at go.worldbank.org/PL08P9FTN0; Intergovernmental Platform on Biodiversity and Ecosystem Services at ipbes.net.