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ECOSYSTEMS


# Valuation of Ecosystem Services in Institutional Context

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## Introduction

As long as we are forced to make choices, we are doing valuation. But different approaches to valuation are based on qualitatively different assumptions. For example, the economics approach to valuation is based on the ethical principle of consumer sovereignty, and it privileges the kinds of decisions individuals make in the marketplace. We accept the economics approach as a useful partial approach to decision making in relation to ecosystem services if one is interested in what people think about and want from services; if one believes that human preferences are the basis for the value of services; if one accepts the assumption that adding individual preferences reflects humanity's collective valuation of ecosystem services and life support; and if one assumes that marginal changes will only cause marginal consequences.

The thesis of this article is that currently used modes of valuing ecosystem services do not take into account the inherent complexities and resulting uncertainties associated with dynamics of these coupled systems of people and nature. Ecosystem services are not a smooth, controllable function of human controls; rather, the nonlinearities and shifting relationships of these systems create changes that are inherently unpredictable. Human values and preferences are not static and pre-existent; rather, they are formed in interaction with nature and with society. Those types of uncertainties are difficult to capture with current modes of valuation. We end with some modest suggestions of institutional solutions to deal with those uncertainties. We begin with a weak typology of various goals of ecosystem valuation.

## What is valuation "for"?

Economic valuation of natural systems and their services is undertaken for at least three reasons. First, a study may attempt to show that natural systems are indisputably linked to human welfare, even when they are priced at zero. This is the sense in which we understand recent efforts to value the whole earth (for example, Costanza and others 1997)—the lesson learned is that the significance of natural systems for economic well-being is real and large and that it therefore must be taken into account. The focus is not on a single number that describes the worth of an ecosystem but on the myriad ways in which human systems and natural systems influence and undergird one another. The goal is to make sure that "nature" is represented in decision-making processes and to note that its role in the economy is not merely aesthetic.

Second, economic valuation may be undertaken to describe the relative importance of various ecosystem types. For example, the special significance of wetlands for the economy has been a major result of ecological and economic valuation studies (for example, Odum 1984; Farber and Costanza 1987; Turner and others 1995). The lesson that wetlands are especially valuable has been embedded in legal and institutional systems, leading to their relative protection from development and agricultural impacts and direct modifications. In this case, economic valuation results were adduced as evidence supporting an already well-established ecological intuition about the importance of wetland function for society.

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Third, economic valuation of an ecosystem or its services may be undertaken to justify or critique a particular decision in a particular place, for example, in a cost–benefit framework, where tradeoffs in relation to a set of decision-making alternatives are to be made. Relevant decisions may involve regulating development impacts, assessing damages, determining access levels, setting user fees, and determining optimum taxation levels. Particular use of economic valuation, in other words, is not an abstract or theoretical exercise—it affects the allocation and distribution of resources in real ways. Moreover, the battlegrounds over these valuation studies are not only in academic venues but courtrooms, adversarial environments where the admission of uncertainty is damning (Binger and others 1995).

We are clearly sympathetic with the first two uses of ecosystem valuation, where the goal is not to summarize ecosystem services with a single "bottom-line" number, but to better understand the significant connections between nature and society. We outline a number of caveats with respect to ecosystem complexity and the construction of human values, leading us to conclude that the third use of ecosystem valuation is less useful in ecosystem management.

## Existing forms of valuation

Many natural scientists, who view human society as a "subsystem" of the natural world, would argue that ecosystem services and life support are essential for society irrespective of their recognition by humans. These services form the biogeophysical precondition for social and economic development. There are many ecosystem services that meet the criteria of having economic value (they contribute to well-being and are scarce) but for which humans have not yet developed preferences. The decoupling of preferences from the biophysical preconditions results from simple ignorance and from a deeper, modern "mental alienation" from nature. The outcome of economic valuation studies is therefore only as good as the values of the people being assessed. Basing management of ecosystem services solely on marginal economic values of individuals in a cost–benefit framework therefore may be an unreliable guide to sustainable use of ecosystems.

Ecologists have sometimes used energy flow analysis as an alternative to economic valuation, with the view that energy flow analysis reflects the biophysical preconditions for social and economic development. Some studies focus on energy flow within a sector or in the economy as a whole, whereas others address solar energy–driven flows all the way to the global level as a basis for value. The debate between economists and ecologists on those issues sometimes has been quite heated. We argue that both economic and ecological approaches are trapped by a hegemony of cost–benefit analyses (whether monetary or energy flow based) and implicit assumptions of a global and stable equilibrium.

Several assumptions behind cost–benefit analysis underlie both economic and ecological approaches to valuation. First, they share a myth of objectivity. For many economists and ecologists, it is assumed that the correct values to use in decision making are "out there": pre-existent, natural, discoverable, and (in some sense) good. For economists, the assumption is that people have measurable but unexpressed preferences over states of nature. For biophysical analysts, the assumption is that states of the world can be judged according to objective measures of ecosystem function.

Second, both kinds of valuation share a belief in deep commensurability that relates to the way systems are believed to operate. Because neoclassical economists find it useful to assume people are rational, calculating, optimizing consumers who constantly trade-off benefits and costs at the margin, their values can be measured in the currency of their comparisons—utility—or in the currency of the market—money. Biophysical economists (typically ecologists) view ecosystems in much the same way: at the systems level there is a process of self-organization driven by optimization through selection. The currency of this optimization most often suggested is energy. In both cases, however, comparisons made by analysts have salience because they are using the very currency they believe is used by the optimizing, self-organizing agents that populate the system in question. And if values are commensurable, then the analyst can use some variant of cost–benefit analysis to make decisions objectively, by applying the appropriate weights to the goods and services being compared.

Third, both traditional economic and biophysical valuation typically are undertaken with a normative premise—that ecosystem services *should* be valued in the prescribed way. For economic valuation, this is valuation by individuals according to their own preferences, through something that at least resembles a marketplace (although it may be rather artificial). For energy analysts, valuation is done (by an expert on behalf of "the system") according to principles of ecosystem self-organization, so that the resulting energy stocks and flows or other biophysical indicators are considered right. In either case, changes away from the optimum (the market equilibrium or a natural steady state) come at a cost—a loss of economic efficiency or a deviation from nature's potential. Put another way, measurable gains can be made by "getting the values right."

There are problems with each of the assumptions above. We believe that values—in whatever units—emerge from the interaction of systems, both people with nature and people with people, and that this is an ongoing process. This runs counter to the view that values and preferences are static, and it challenges the belief in commensurability. Ecologists above all should be leery of methods that purport to describe simple mechanisms of trade-offs between complementary goods. If ecology is the study of connectedness, it should rise above the science of anonymity, alienability, and fungibility. The interaction of people with nature can be informed by ecological science that recognizes the possibility of multiple stable states, thresholds, and self-organization. The interaction of people is enhanced by institutions (for example, North 1990; Hanna and others 1996) that do not simply reduce them to individual, independently optimizing units but provide a framework for collective decision making (Ostrom 1990). In this article, we suggest a synthesis that is based on nonlinearities and dynamic behavior of ecosystems and ecosystem services stressing the role of adaptive institutions. But we begin with a short discussion of how scales of space and time in coupled ecological and social systems create inherent complexities and uncertainty.

## Complexity and Resilience of Ecosystems

In a world of human dominance, complex systems, and true uncertainty, it becomes increasingly difficult to assume that there will be only negligible feedbacks of marginal change. Ecological, economic, and social systems are so interwoven that local and incremental actions may accumulate and multiply into regional and global surprises. The tyranny of small decisions may become instead the rule, that is, that many locally rational choices will create synergistic impacts that may spill over into other areas, a phenomenon increasingly observed in many countries. The presence of threshold effects and irreversibilities in life-support systems is a warning against relying solely on consumer preferences as the basis for value. In situations where ecosystems are losing ecological resilience (the amount of disturbance that a system can absorb without changing stability domains, sensu Holling 1973), it may even be irrational in decision making to use cost–benefit analysis based on ecologically uninformed preferences.

The above-mentioned approaches to valuation are based on assumptions about stability and near-equilibrium dynamics of ecosystems. Yet a growing body of literature has documented a pattern of ecological surprise and policy response in managed resource systems. Walters (1986) first described a rhythm of crisis and opportunities in resource systems. The six ecological histories of regional scale systems in Gunderson and others (1995) all follow the model of a resource crisis, followed by policy reformation, and renewal. Similar patterns are described in local, small-scale resource systems by Berkes and Folke (1998) and in large, North American bureaucratic management systems by Johnson and others (1999).

One of the problems with cost–benefit approaches is that by applying these techniques (focused as they are on a single desirable equilibrium) to set policy, an inevitable "surprise" or policy crisis occurs. This has been described as a pathology of resource management (Holling and Meffe 1996), where management actions initially are successful, leading to a myopia of research and management and eventual reduction in the resilience of the ecosystem.

Ecological resilience is overwhelmed by a number of pathways. One is through extractive activities, such as soil removal, that reduce key sources of capital within a system. Other activities change the nutrient status of ecosystems—nutrient additions can lead to change in the domains of trophic status in lakes (Carpenter and Cottingham 1997) or in wetlands (Gunderson 1999). Human activities, such as agricultural irrigation, lead to broad-scale changes in land-use patterns that lead to broad-scale collapses due to salinization or sequestration of heavy metals. Harvesting can lead to shifts in ecosystem structures through switches in trophic relationships in freshwater lakes (Carpenter and Kitchell 1993) or coral reefs (McClanahan and others 1996).

Many resource crises occur at tractable (that is, local) spatial scales and hence allow for linkages across scales for recovery and renewal. Another way of saying this is that technology increases the scale at which key processes affect the system and overwhelms the resilience of ecosystems at local scales. As the degree of human impact continues to increase in extent, a key unanswered question is whether the adaptive capacity of both ecological and social systems can keep pace with this expanding human footprint.

## ADAPTIVE INSTITUTIONS

Economic valuation methods, based as they are on the concept of self-organizing markets, borrow strongly from pluralist ideas about decision making—that the public interest is found in a competition among economic interests, where each individual valuation is accorded equal weight. Energy evaluation methods borrow most strongly from the idea that the public interest is unitary and discoverable by experts. Adaptive approaches admit that the public interest emerges through social interactions, the interrogation of nature, and political discourse. It could be said that the public interest, because it is "public," does not exist prior to these interactions.

The mythology that derives from methodological individualism is that the relevant preferences over environmental goods and services are more or less static and predetermined and can be revealed at the individual level. Reflection suggests that individuals hold preferences on several scales—Sagoff (1981) has called these consumer preferences versus citizen preferences. Individuals may provide different values for an environmental commodity in the context of the core family, a scientist, or a representative of the government.

Institutions, operating at appropriate scales, provide the framework—the norms and rules—for the generation of preferences. Preferences and values (even entitlements) are not fixed. They evolve as part of a social process, part deliberative, part historical (Sunstein 1988). People not only have preferences over states of nature but over the processes that lead from state to state. We believe adaptive and flexible institutions that reassess valuation in the context of resilience in coupled social–ecological–economic systems are critical for sustainable use of ecosystem services. By nurturing institutional learning, we discover how to interpret and respond to ecological, social, and political dynamics. From a sustainable use perspective, the challenge is to develop flexible and adaptable institutions in tune with ecosystem dynamics and ecosystem services (Folke and others 1998).

Trying to fit the process of institutional learning into a cost–benefit framework reduces the complexity of preference formation and social interactions to merely a commodity-calculus. The commodification of nature, and of political space, are found not to be as inevitable as previously thought by economists, evidenced by work on common property and communal management regimes (Berkes and Folke 1998; Ostrom 1990). That is, community institutions that are organized around notions of the collective good, and that resist the parcelization and reductive view of nature implicit in most valuation exercises, have proved to be not just idealistic theorizing but real forms of social organization. The tragedy of the commons, and the difficulties of managing complex systems, are found sometimes to be overcome through community social organization (at least on local scales).

Perhaps it is time to rethink the paradigms or foundations of resource management institutions and place more emphasis on development of sustaining foundations for dealing with complex resource issues. Learning is a long-term proposition that requires balance against short-term objectives. Another necessary shift is from management by objectives and determination of optimum policies, towards new ways to understand and manage ecological systems in an ever-changing world. The revised focus should not be solely on variables of the moment (water levels, population numbers) and their correlative rates, but rather on more enduring system properties, such as resilience, adaptive capacity, and renewal capability. This framework involves both the human and biophysical components of the landscape and its ecosystems.

## CONCLUSION

Existing methods of valuation accept and validate the current alienation of people from ecosystems and from each other. Accepting economic preferences "as is" does not include the opportunity for individuals to learn about their environment and to pool their information for beneficial collective decisions, nor does it provide a framework for active social deliberation over desired states of nature.

Environmental valuation in its usual form borrows more from the metaphors of engineering and accountancy than of science. The economist/ecologist is a disinterested technician, adding energy flows or money flows to assess values that are "out there;" the analyst is neutral, the parameters are static, and the bottom line is the truth. The danger of applying environmental valuation based on the cost–benefit ideology comes from decision makers who mistakenly think that the result that a cost–benefit analysis generates is objective. This sidesteps processes of dialogue and deliberation, creating a spurious sense of objectivity about that which is certainly contested and politically messy but which also can create the opportunity to transcend individual valuation in the pursuit of the public good. Both economic- and energy-based valuation approaches have their role as an input to this process but not as ultimate decision-making tools.

Scientific inquiry, at least in its ideal form, comes from a community of scholars interacting with their best arguments and evidence. Scientific consensus is achieved not through an expression of willingness to pay, but by an advancement of credible reasons for changing beliefs. No one would argue that science does this perfectly, or even uniformly well. Science is prone to overconservatism and even to fads and bandwagons. But likewise, no one argues that science should retreat to a system of markets or voting; rather, it is clear that more-or-less enlightened deliberation of a community of participant-scholars is the best hope for scientific advances (Williams and Matheny 1995). Why should it be less so in the case of environmental valuation?

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