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ECOSYSTEMS

Social Goals and the Valuation of Ecosystem Services

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INTRODUCTION

Ecosystem services are obviously important in sustaining human life on earth (Daily 1997; Costanza and others 1997a). The big questions include: how important? Over what temporal and spatial scales? What are the limits of humanity's ability to substitute for them? At what levels of stress do they flip to some other (less desirable) state? All of these questions require the ability to understand and model the interconnected, coevolving system of humans and nature (Costanza and others 1993, 1997b). In addition, the answers to these questions are not purely academic. We humans have to make choices and trade-offs concerning ecosystem services, and this implies and requires "valuation," because any choice between competing alternatives implies that the one chosen was more highly "valued." That the alternatives are "competing" is important, because if we can find a "win–win" solution then no real choice is required, and we can avoid valuation. But most environmental decisions involve the problem of having to weigh and aggregate the myriad different kinds of "benefits" of a proposed action against its "costs." In most cases, these benefits and costs are both poorly understood and poorly quantified. In addition, the future vision and social goals that define the degree to which something is a benefit or a cost are themselves evolving and changing. In doing valuation of ecosystem services, we need to consider a broader set of goals that include ecological sustainability and social fairness, along with the traditional economic goal of efficiency.

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VISIONS OF THE ECONOMY AND ITS RELATIONSHIP TO THE ECOLOGICAL LIFE-SUPPORT SYSTEM

Joseph Schumpeter (1954) emphasized the importance of a "pre-analytic vision" of the world and its major problems. He noted that

> "vision of this kind not only must precede historically the emergence of analytic effort in any field, but also may reenter the history of every established science each time somebody teaches us to *see* things in a light of which the source is not to be found in the facts, methods, and results of the preexisting state of the science" Schumpeter (1954, p. 41).

Our preanalytic vision is changing in many important respects. The evolution of the human economy has passed from an era in which human-made capital was the limiting factor in economic development to the current era in which remaining natural capital has become the limiting factor. Basic economic logic tells us that we should maximize the productivity of the scarcest (limiting) factor, as well as try to increase its supply. This means that economic policy should be designed to increase the productivity of natural capital and its total amount, rather than to increase the productivity of human-made capital and its accumulation, as was appropriate in the past when it was limiting. This implies a very different vision of the economy and its place in the overall system.

Figure 1a shows the conventional economic preanalytic vision. The primary factors of production (land, labor, and capital) combine in the economic process to produce goods and services (usually measured as gross national product or GNP). GNP is

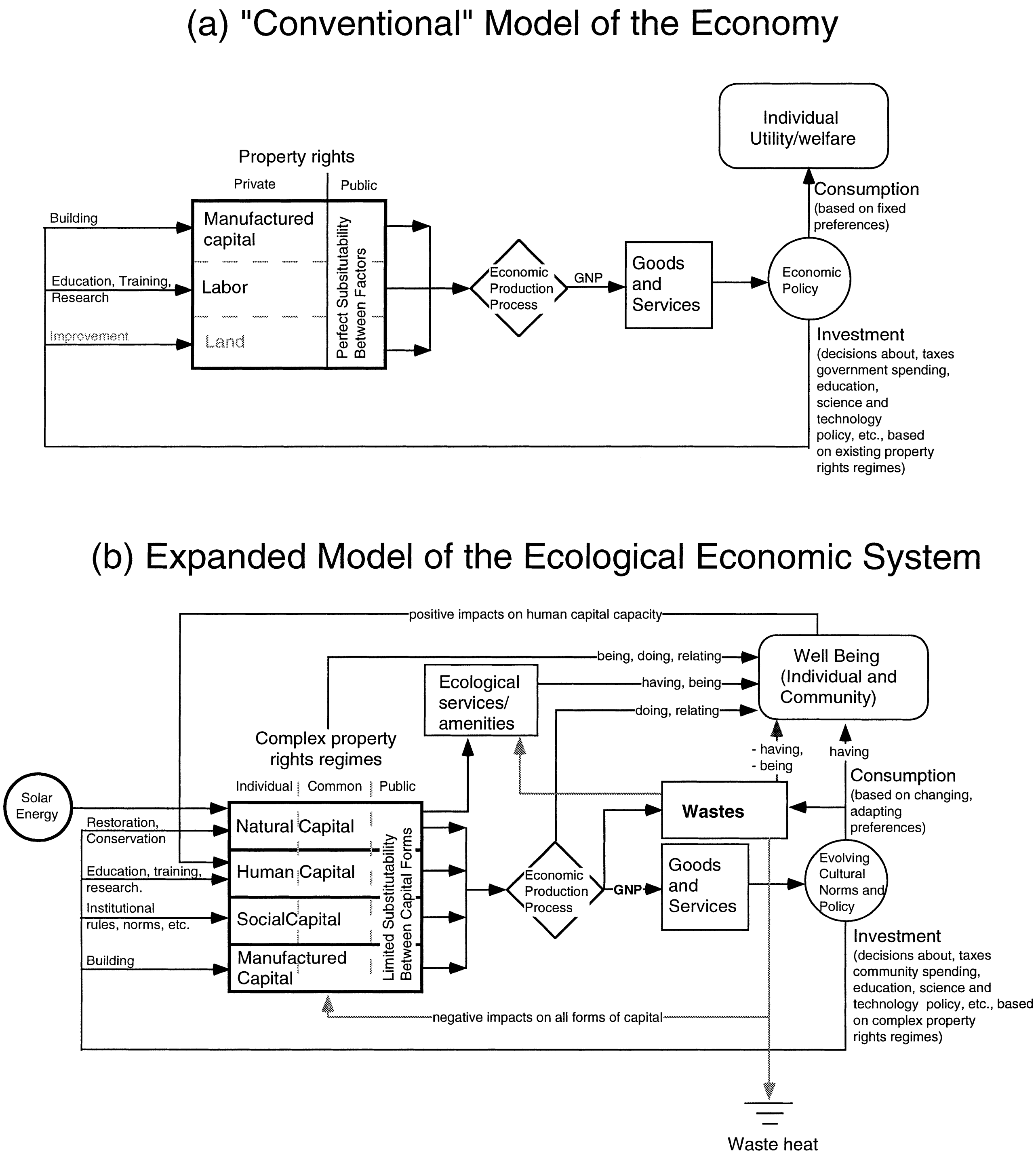

Figure 1. Coventional economics model (a) and expanded "ecological economic" model (b).

divided into consumption (which is the sole contributor to individual utility and welfare) and investment (which goes into maintaining and increasing the capital stocks). Preferences are fixed. In this model, the primary factors are perfect substitutes for each other, so "land" (including ecosystem services) can be almost ignored, and the lines between all the forms of capital are fuzzy. Property rights are usually simplified to either private or public, and their distribution is usually taken as fixed and given.

Figure 1b shows an alternative "ecological economics" view of the process (Ekins 1992; Costanza and others 1997b). Notice that the key elements of the conventional view are still present, but more has been added and some priorities have changed. There is limited substitutability between the basic forms of capital in this model, and their number has expanded to four. Their names also have changed to better reflect their roles: (a) natural capital (formerly land) includes ecological systems, mineral deposits, and other aspects of the natural world; (b) human capital (formerly labor) includes both the physical labor of humans and the know-how stored in their brains; (c) manufactured capital includes all the machines and other infrastructure of the human economy; and (d) social (or cultural) capital. Social capital is a recent concept that includes the web of interpersonal connections, institutional arrangements, rules, and norms that allow individual human interactions to occur (Berkes and Folke 1994). Property rights regimes in this model are complex and flexible, spanning the range from individual to common to public property. Natural capital captures solar energy and behaves as an autonomous complex system, and the model conforms to the basic laws of thermodynamics. Natural capital contributes to the production of marketed economic goods and services, which affect human welfare. It also produces ecological services and amenities that directly contribute to human welfare without ever passing through markets. There is also waste production by the economic process, which contributes negatively to human welfare and has a negative impact on capital and ecological services. Preferences are adapting and changing, but basic human needs are constant. Human welfare is a function of much more than the consumption of economic goods and services.

These two visions of the world are significantly different. As Ekins (1992) points out:

> "It must be stressed that that the complexities and feedbacks of model 2 are not simply glosses on model 1's simpler portrayal of reality. They fundamentally alter the perceived nature of that reality and in ignoring them conventional analysis produces serious errors . . ." (p. 151).

Valuation, Choice, and Uncertainty

The conventional vision or paradigm also assumes that tastes and preferences are fixed and given and that the economic problem consists of optimally satisfying those preferences. Tastes and preferences usually do not change rapidly and, in the short run (that is, 1–4 years), this assumption makes sense. But preferences do change over longer time frames, and in fact there is an entire industry (advertising) devoted to changing them. Sustainability is an inherently long-run problem, and in the long-run it does *not* make sense to assume tastes and preferences are fixed. This is a very disturbing prospect for economists because it takes away the easy definition of what is "optimal." If tastes and preferences are fixed and given, then we can adopt a stance of "consumer sovereignty" and just give the people what they want. We do not have to know or care why they want what they want, we just have to satisfy their preferences as efficiently as possible. But if preferences are expected to change over time and under the influence of education, advertising, changing cultural assumptions, and so on, we need a different criterion for what is "optimal" and we have to figure out how preferences change, how they relate to this new criterion, and how they can or should be changed to satisfy the new criterion.

One alternative for this new criterion is sustainability itself, or more completely sustainable scale (or size of the economic subsystem), fair distribution, and efficient allocation (Daly 1992). This criterion implies a two-tiered decision process (Page 1977; Daly and Cobb 1989; Norton and others 1998) of first coming to a social consensus on a sustainable scale and fair distribution and, second, using both the market and other institutions like education and advertising to implement these social decisions. This might be called "community sovereignty" as opposed to "consumer sovereignty." It makes most conventional economists very uncomfortable to stray from consumer sovereignty because it eliminates the tidy view of economics as simply optimally satisfying a fixed set of preferences and it opens a Pandora's box of possibilities for manipulating preferences. If tastes and preferences can change, then who is going to decide how to change them? There is a real danger that a totalitarian government might be employed to manipulate preferences to conform to the desires of a select elite rather than the society as a whole.

Two points need to be kept in mind in this regard: (a) preferences are already being manipulated every day; and (b) we can just as easily apply open democratic principles to the problem as hidden or totalitarian principles in deciding how to manipulate preferences. So the question becomes: do we want preferences to be manipulated unconsciously, either by a dictatorial government or by big business acting through advertising? Or do we want to formulate preferences consciously based on social dialogue and consensus with a higher goal in mind? Ethics is the forging and revising of our existing preferences in the light of a higher goal. Taking preferences as given would mean that the ethical problem has been solved once and for all. Either way, this is an issue that can no longer be avoided, and one that can best be handled using open democratic principles and innovative thinking.

Valuation of Ecosystem Services and Preferences

The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. Some argue that valuation of ecosystems is either impossible or unwise. For example, some argue that we cannot place a value on such "intangibles" as human life, environmental aesthetics, or long-term ecological benefits. But, in fact, we do so every day. When we set construction standards for highways, bridges, and the like, we value human life—acknowledged or not—because spending more money on construction would save lives. Another often-made argument is that we should protect ecosystems for purely moral or aesthetic reasons, and we do not need valuations of ecosystems for this purpose. But there are equally compelling moral arguments that may be in direct conflict with the moral argument to protect ecosystems, such as the moral argument that no one should go hungry. All we have done is to translate the valuation and decision problem into a new set of dimensions and a new language of discourse, one that in some senses makes the valuation and choice problem more difficult and less explicit.

So, whereas ecosystem valuation is certainly difficult, one choice we do *not* have is whether or not to do it. Rather, the decisions we make, as a society, about ecosystems *imply* valuations. We can choose to make these valuations explicit or not; we can undertake them by using the best available ecological science and understanding or not; we can do them with an explicit acknowledgment of the huge uncertainties involved or not, but as long as we are forced to make choices we are doing valuation. The valuations are simply the relative weights we give to the various aspects of the decision problem.

Society can make better choices about ecosystems if the valuation issue is made as explicit as possible. This means taking advantage of the best information we can muster and making uncertainties about valuations explicit too. It also means developing new and better ways to make good decisions in the face of these uncertainties. Ultimately, it means being explicit about our goals as a society, both in the short term and in the long term, and understanding the complex relationships between current activities and policies and their ability to achieve these goals.

This leads back to the role of individual preferences in determining value. If individual preferences change (in response to education, advertising, peer pressure, etc.) then *value* cannot completely *originate* with preferences. Value ultimately originates in the set of individual and social goals to which a society aspires.

Valuation and Social Goals

Valuation ultimately refers to the contribution of an item to meeting a specific goal or objective. A baseball player is valuable to the extent he contributes to the goal of the team's winning. In ecology, a gene is valuable to the extent it contributes to the survival of the individuals possessing it and their progeny. In conventional economics, a commodity is valuable to the extent it contributes to the goal of individual welfare as assessed by willingness to pay. The point is that one cannot state a value without stating the goal being served. Conventional economic value is based on the goal of individual utility maximization. But other goals, and thus other values, are possible. For example, if the goal is sustainability, one should assess value based on the contribution to achieving that goal—in addition to value based on the goals of individual utility maximization, social equity, or other goals that may be deemed important. This broadening is particularly important if the goals are potentially in conflict.

As briefly mentioned above, there are at least three broad goals that have been identified as important to managing economic systems within the context of the planet's ecological life support system (Daly 1992):

1. assessing and insuring that the scale or magnitude of human activities within the biosphere are ecologically sustainable;

2. distributing resources and property rights fairly, both within the current generation of humans and between this and future generations, and also between humans and other species; and

3. efficiently allocating resources as constrained and defined by 1 and 2 above, and including both marketed and nonmarketed resources, especially ecosystem services.

Several authors have discussed valuation of ecosystem services with respect to goal 3 above—allocative efficiency based on individual utility maximization (for example, Farber and Costanza 1987; Costanza and others 1989; Mitchell and Carson 1989; Dixon and Hufschmidt 1990; Pearce 1993; Goulder and Kennedy 1997). We need to explore more fully the implications of extending these concepts to include valuation with respect to the other two goals of (a) ecological sustainability, and (b) distributional fair-

Table 1. Valuation of Ecosystem Services Based on the Three Primary Goals of Efficiency, Fairness, and Sustainability[a]

Goal or Value Basis	Who Votes	Preference Basis	Level of Discussion Required	Level of Scientific Input Required	Specific Methods
Efficiency	*Homo economius*	Current individual preferences	Low	Low	Willingness to pay
Fairness	*Homo communicus*	Community preferences	High	Medium	Veil of ignorance
Sustainability	*Homo naturalis*	Whole system preferences	Medium	High	Modeling with precaution

[a]*Costanza and Folke 1997.*

ness (Costanza and Folke 1997). Basing valuation on current individual preferences and utility maximization alone, as is done in conventional analysis, does not necessarily lead to ecological sustainability or social fairness (Bishop 1993).

A Kantian or intrinsic rights approach to valuation (compare Goulder and Kennedy 1997) is one approach to goal 2, but it is important to recognize that the three goals are not "either–or" alternatives. Whereas they are in some senses independent multiple criteria (Arrow and Raynaud 1986), they must all be satisfied in an integrated fashion to allow human life to continue in a desirable way. Similarly, the valuations that flow from these goals are not "either–or" alternatives. Rather than an "utilitarian or intrinsic rights" dichotomy, we must integrate the three goals listed above and their consequent valuations.

A two-tiered approach that combines public discussion and consensus building on sustainability and equity goals at the community level with methods for modifying both prices and preferences at the individual level to better reflect these community goals may be necessary (Rawls 1971; Norton 1995; Norton and others 1998). Estimation of ecosystem values based on sustainability and fairness goals requires treating preferences as endogenous and coevolving with other ecological, economic, and social variables.

Valuation with Sustainability, Fairness, and Efficiency as Goals

Thus, we can distinguish at least three types of value that are relevant to the problem of valuing ecosystem services. These are laid out in Table 1, according to their corresponding goal or value basis. Efficiency-based value (E-value) is based on a model of human behavior sometimes referred to as "*Homo economius*"—that humans act independently, rationally, and in their own self-interest. Value in this context (E-value) is based on current individual preferences, which are assumed to be fixed or given (Norton and others 1998). No additional discussion or scientific input is required to form these preferences (since they are assumed to already exist), and value is simply people's revealed willingness to pay for the good or service in question. The best estimate of what people are willing to pay is thought to be what they would actually pay in a well-functioning market. For resources or services for which there is no market (like many ecosystem services) a pseudo-market can sometimes be simulated with questionnaires that elicit individual's contingent valuation.

Fairness based value (F-value) would require that individuals vote their preferences as a member of the community, not as individuals. This different species (*Homo communicus*) would engage in much discussion with other members of the community and come to consensus on the values that would be fair to all members of the current and future community (including nonhuman species), incorporating scientific information about possible future consequences as necessary. One method to implement this might be Rawls' (1971) "veil of ignorance," where everyone votes as if they were operating with no knowledge of their own individual status in current or future society.

Sustainability based value (S-value) would require an assessment of the contribution to ecological sustainability of the item in question. The S-value of ecosystem services is connected to their physical, chemical, and biological role in the long-term functioning of the global system. Scientific information about the functioning of the global system thus is critical in assessing S-value, and some discussion and consensus building is also necessary. If it is accepted that all species, no matter how seemingly uninteresting or lacking in immediate utility, have a role to play in natural ecosystems (Naeem and others 1994; Tilman and Downing 1994; Holling and others 1995), estimates of ecosystem services may be derived from scientific studies of the role of ecosystems and their biota in the overall system, without direct reference to current human preferences. Humans operate as *Homo naturalis* in this context, expressing preferences as if they were representatives of the whole system. Instead of being merely an expression of current individual preferences, S-value becomes a system characteristic related to the item's evolutionary contribution to the survival of the linked ecological economic system. Using this perspective, we may be able to better estimate the values contributed by, say, maintenance of water and atmospheric quality to long-term human well-being, including protecting the opportunities of choice for future generations (Golley 1994; Perrings 1994). One way to get at these values would be to use systems simulation models that incorporated the major linkages in the system at the appropriate time and space scales (Costanza and others 1993; Bockstael and others 1995; Voinov and others 1999). To account for the large uncertainties involved, these models would have to be used in a precautionary way, looking for the range of possible values and erring on the side of caution (Costanza and Perrings 1990).

To fully integrate the three goals of ecological sustainability, social fairness, and economic efficiency, we also need a further step, which Sen (1995) has described as "value formation through public discussion." This can be seen as the essence of real democracy. As Buchanan (1954, p120) put it: "The definition of democracy as 'government by discussion' implies that individual values can and do change in the process of decision-making." Limiting our valuations and social decision making to the goal of economic efficiency based on fixed preferences prevents the needed democratic discussion of values and options and leaves us with only the "illusion of choice" (Schmookler 1993). So, rather than trying to avoid the difficult questions raised by the valuation of ecological systems and services, we need to acknowledge the broad range of goals being served as well as the technical difficulties involved. We must get on with the process of value formation and analysis in as participatory and democratic a way as possible, but one that also takes advantage of the full range and depth of scientific information we have accumulated on ecosystem functioning. This is not simply the application of the conventional preanalytic vision and analyses to a new problem, but it will require a new, more comprehensive, more integrated, preanalytic vision and new, yet to be developed, analyses that flow from it. This will be an enormously important challenge for the next generation of ecosystem scientists.

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