Section 6. Possibilities for Monetary Evaluation of Restoration Outputs

In Section 5 it was asserted that the concept of economic (or NED) value is applicable to the broad suite of services affected by Civil Works projects, including those that are most closely aligned with natural ecosystem parts and processes. This suggests that, to the extent that acceptable monetary estimates of restoration outputs could be practically generated for project evaluation, the monetary standard used for evaluating and justifying traditional Civil Works projects could also be applied to ecosystem restoration projects (National Research Council, 1999a). This section briefly explores technical and conceptual issues relating to the possibility for using a monetary evaluation standard for restoration project planning.

6.1 Definition of Economic Value

The concept of economic value, as defined by neoclassical welfare economics, follows from the premise that each person is the relevant judge of what is "good" for that individual based on the degree to which his or her preferences are satisfied. The theory assumes that each person has well-defined and stable preferences for alternative bundles of goods and services that include goods that are exchanged in the marketplace (market goods) and goods that are not (non-market goods). And importantly, it is assumed that there is broad scope for substitution among goods in the pursuit of preference satisfaction. This implies that the effect of a decrease (increase) in the consumption of some good on an individual's level of preference satisfaction can be offset through an increase (decrease) in the consumption of other goods (Freeman, 1993).

The concept of economic value rests squarely on this "utilitarian" premise that human welfare derives from preference satisfaction. Acceptance of that premise implies that the tradeoffs that a person makes as he or she chooses less of one good in favor of more of another good reveals something about the value of this tradeoff to the individual. Formally, the economic value of some change (tradeoff) to an affected individual is defined as the amount of monetary compensation (positive or negative) that the individual would need in order to maintain the same level of individual preference satisfaction with the change as without the change. This measure of compensation is specific to each affected individual and is entirely dependent on the circumstances of the specific change context (Bockstael, et al., 1998).

For example, consider a policy proposal to newly allow hunting in some public wildlife area. An affected individual who is a hunting enthusiast might be expected to realize an increase in preference satisfaction if the policy were implemented (although this result would depend on the supply and quality of other hunting sites in the same general vicinity as well as other circumstances specific to the change context and the individual). If the policy were implemented to this person's benefit, he or she would require negative compensation, as represented by the individual's maximum willingness to pay for the opportunity to hunt in the wildlife area, in order to maintain the same level of individual welfare experienced in the absence of that opportunity. This "willingness to pay" (WTP) measure of compensation reflects the measurement standard defined by the P&G for

evaluating the NED benefits of water resource projects; total project benefits are defined as the sum of WTP for each individual who stands to gain from the project.

Now consider another affected individual who is not a hunter but who enjoys bird watching in the wildlife area being considered for hunting use. This person might be expected to experience a decreased level of preference satisfaction if the area were opened to hunting. In that event, this person would require positive compensation, as represented by the minimum amount of money the individual would willingly accept to bear costs resulting from the hunting policy, in order to maintain the same level of individual welfare with the policy in place as without the policy. This "willingness-to-accept" (WTA) measure of compensation reflects the measurement standard defined by the P&G for the evaluation of the NED costs of water resource projects; total project costs are defined as the sum of WTA for each individual who stands to lose from the project.

6.2 Measurement of Economic Value

The marketplace provides the context for inferring economic values since the market price for some good provides a dollar measure of the amount of other goods that would need to be reduced in order to purchase it. Thus, for a marketed good, observed variations between market price and quantity consumed provide the basis for estimating the demand function (marginal WTP function) for that good. This demand function provides the information needed to estimate the economic value of structural changes in the supply and/or quality of the good.

For a variety of reasons, most ecosystem services are not traded in competitive markets, so there are no associated price data providing a basis for valuation. To address this problem, economic methods have been developed to estimate "shadow prices" for non-market goods that, in theory, represent the market prices that would emerge if these goods were traded in competitive markets. One class of methods, referred to as "revealed preferences" approaches, attempt to reveal shadow prices by examining market data on marketed goods that are linked in some way to the non-market good. Another class of valuation methods, referred to as "stated preferences" approaches, have been developed and applied to situations in which the market choices of people provide insufficient clues about their preferences for non-market goods.

6.3 Monetary Evaluation of Traditional Outputs

The Corps has long faced the need to use non-market valuation tools since traditional Civil Works outputs generally are not traded in competitive markets (Table 6.1 provides an overview of valuation techniques specified in the P&G). However, most traditional outputs have close market counterparts that facilitate valuation based on *change in net income* or *cost of most likely alternative.* So, for example, the benefits from enhancing waterway transportation links are assessed in terms of costs savings to commercial navigation shippers, and the benefits from enhancing flood regulation services are assessed in terms of property damages avoided. Similarly, the benefits of introducing new

sources of water supply and hydropower are estimated based on the cost of providing equivalent outputs using the least-cost alternative source. This valuation approach follows from the recognition that the affected population would be forced to obtain alternative sources of these outputs if the project source was not forthcoming.

In general, the valuation of traditional Civil Works outputs such as commercial navigation, flood damage reduction, hydropower and water supply has been readily possible for two main reasons. First, project-induced alterations in the underlying ecosystem service flows (e.g., waterway transportation capacity, flood storage and diversion capacity) are intensive and largely involve physical relationships that are well understood and predictable. Thus, for these traditional outputs, the types of non-economic information on service flows needed for valuation is readily obtained. Second, as outlined above, these outputs generally have close market counterparts that provide market evidence for benefits assessment.

Table 6.1. Broad Approaches and Specific Techniques for Economic Valuation Specified by the Principles & Guidelines (P&G)

P&G Approaches for NED Estimation	Specific Non-Market Valuation Techniques	Applicable Benefit Categories
Change in Net Income	• Factor Income/Avoided Costs • Property Damages Avoided	Market productivity of ecological systems in production/consumption (e.g., inland navigation, flood hazard reduction)
Cost of Most Likely Alternative	• Replacement Cost	Service replacement (e.g., electricity, water supply)
Simulated Market Price	• Travel Cost • Hedonic Property Value • Contingent Valuation	Utility derived from direct use of ecological amenities (e.g., recreation)
Administratively Established Values	• Unit Day Values	Utility derived from certain recreational uses (e.g., hunting and fishing)

Recreation, on the other hand, represents a traditional Civil Works output that generally has no close market counterpart providing direct evidence for benefits assessment. Corps guidance sets out a set of techniques for estimating *simulated market price* (i.e., shadow prices) as the basis for assessing recreation benefits. These include, for example, the Travel Cost methods that looks to indirect evidence of shadow prices based on the time and money people spend to visit a recreation site. Perhaps in recognition that these methods can be difficult and costly to implement, however, Corps guidance also allows project recreation benefits to evaluated using *administratively established values* that represent average unit values for a day of fishing or hunting derived from previous studies.

6.4 Monetary Evaluation of Restoration Outputs

6.4.1 Technical Issues

In general, the specific techniques recommended by the P&G for valuing traditional outputs are also applicable to the types of "natural" ecosystem service outputs likely to be associated with ecosystem restoration. (Table 6.2 summarizes the general applications, evaluation basis, and strength and limits of these techniques in the restoration context.) This does not mean that valuation prospects for project-induced changes in natural services are generally favorable, however. One reason is that the non-economic relationships between management action and natural service outputs often represent complex hydrological and biological relationships that are not well understood and readily predictable (especially in situations requiring long periods of restoration time in environments susceptible to many future uncontrollable human impacts). A second reason is that natural services often directly affect the quality of human life in ways that have no close connection to the use of market goods. As discussed below for different types of natural service benefits, these factors pose significant technical limitations for the economic valuation of restoration outputs.

Economic valuation based on replacement cost may be appropriate when restoration efforts affect traditional outputs such as water supply and hydropower. However, attempts to estimate values for changes in natural ecosystem service outputs (e.g., waste treatment) based on the cost of replacing the service with a human-engineered alternative often founder because they fail to provide evidence that the alternative cost would actually be incurred if the natural service were not available. [See, for example, attempts by Costanza, et al. (1997) to use replacement cost as a measure of benefit for oceanic nutrient storage].

Ecosystem restoration might sometimes positively or negatively affect ecosystem services that serve as inputs into the production of marketed goods. When these effects involve traditional Civil Works outputs such as agricultural water supply, for example, they generally could be quantified and valued using P&G methods. However, valuation is much more difficult and limited by current knowledge and data when service outputs are farther removed from the end product of market value. Consider, for example, the contribution of estuarine wetlands to marine fisheries as a provider of food and nursery habitat. In this case the valuation of changes in the habitat service requires tracing through complex and uncertain bio-economic relationships among management action, wetland habitat, fish stocks, and fishery productivity.

Restoration might be expected to often affect recreation uses of ecosystems, for which various revealed preference techniques have been specifically developed and refined over the last several decades. Recreation benefits are the one class of restoration outputs that might be most readily valued in dollar terms, although even this case poses significant technical challenges for specifying and estimating the linkages among restoration actions and recreation behavior. Moreover, region-wide modeling would generally be needed

Table 6.2 Overview of Non-market Techniques for Valuing Restoration Outputs

Technique	General Applications	Measurement Basis	Major Strengths and Limits
Factor Income/ Avoided Costs	Use values for ecosystem services that serve as factors of production for market goods	Relies on estimating and using production relationships for the marketed good to infer how changes in ecosystem services will affect the profits or costs of producers	Main strength is that it avoids the need to estimate demand for the market good. However, the supply side focus is reasonable only if the production unit in question is small relative to the overall production of the market good, or if the improvement is ecosystem service input represents only a marginal change.
Property Damages Avoided	Use values for flood risk reduction & other ecosystem services that prevent property damage	Relies on estimating repair costs to specific properties with and without flood risk reduction services	Main strength is that value estimates are relatively easily, consistently and inexpensively made. Main limitation is that value estimates are hypothetical, since no post-damage repair choices are observed. Also, value estimates reflect only one potential dimension of willingness to pay.
Travel Cost	Use values for recreational uses of ecosystems	Investigates changes in the quantities consumed of a complementary market good, travel to the site, to estimate demand for site recreational uses	Main strength is that value estimates are based on the actual choices of people. One limitation is that region-wide modeling would generally be needed to estimate the implications for benefits of changes in site quality
Hedonic Property Value	Use values for location-specific ecosystem amenities and services that prevent property damage	Investigates prices of a complementary market good, residential property, to reveal implicit prices for location-specific ecosystem amenities or damage prevention services	Main strength is that value estimates are based on the actual choices of people. One limitation is that the scope of ecosystem values that can be estimated is limited to the set of ecosystem services that can be captured by people through their choice of residential location
Contingent Valuation	Use and passive use values for ecosystem services that affect human welfare in ways other than through market production	Relies on the use of sophisticated surveys to elicit information from respondents on their preferences for ecosystem services	Main strength is its flexibility that allows it to be used to estimate passive use benefits as well as use benefits associated with ecosystem services individually and in combination. Main limitation is that responses to hypothetical questions may not reflect what people would actually pay for ecosystem services in a real economic or policy choice setting.
Benefits Transfer	Use values for recreational uses of ecosystems	Relies on valuation results for some site(s) derived in previous studies (e.g., unit day values) to develop value estimates for the project site	Main strength is that it can be applied quickly and inexpensively. Main limitation is that it can provide only a gross approximation of benefits at project sites since recreational values are context (e.g., site, user) specific. Also not well suited to assessing benefits from changes in site quality.
Replacement Cost	Use values for ecosystem services that can be provided through alternative means	Relies on estimates of the cost of most economical alternative means for providing equivalent services	Its main strength, that it avoids estimation of the links between ecosystem services and human welfare, is also its major limitation. Can approximate service value only if 1) the replacement provides the same function at the same level as the ecosystem service, and 2) evidence suggests that people would be willing to incur this cost if the service were not available.

to estimate site-specific recreation benefits in order to account for available substitute sites.

Valuation prospects are much more limited for changes in natural ecosystem services that may contribute to human welfare independent of human use. Service outputs relating to the restoration of natural biological diversity for the sustenance of endangered species, for example, might give rise to such "passive use" benefits (as well as possible use values). The only available valuation techniques for estimating passive use benefits are stated preference methods. For example, the most common such technique, the Contingent Valuation Method (CVM), relies on the use of sophisticated surveys to get individuals to express their preferences for non-market services through money bids in simulated markets, policy referenda, or other hypothetical choice settings. Typically, a referendum format is used to elicit preferences for environmental protection or restoration programs. For example, respondents are asked if they would vote for an environmental management regime at a cost of $X to the respondent. In the survey, the amount of $X varies across respondents, enabling researchers to trace out a demand function from which willingness to pay can be derived.

The great advantage of CVM is its flexibility that facilitates its use to elicit use and passive use values associated with the improvement of many types of ecosystem services, individually and collectively. However, such valuation depends on the ability to forecast how projects might affect ecosystem attributes and convey this information to survey respondents in terms that are meaningful to them. Moreover, use of CVM for estimating environmental benefits remains controversial and not universally accepted within the economics profession since it produces value estimates that are not based on the actual choices of people. Its use for estimating passive use values is particularly controversial since there is no way to verify valuation results. Further, the number of people that may hold passive use values for natural resources with public goods characteristics is not known, and relatively small estimated values for a representative individual, when applied to large populations, can result in very high estimates of resource value. Such high valuation results feed the skepticism of those in the economics community and others who question the adequacy of hypothetical choice methods for valuing ecosystem services.

The above review suggests that, in general, the monetary valuation of non-market ecosystem service outcomes that are far removed from the end product of market value, or that directly affect the quality of human life, is severely limited by technical hurdles. Professor A. Myrick Freeman, in the concluding chapter to his 1993 book on the state-of-the art in measuring environmental and resource values, writes:

> The economic framework, with its focus on the welfare of humans, is inadequate to the task of valuing such things as biodiversity, the reduction of ecological risks, and the protection of basic ecosystem functions. When policies to protect biodiversity or ecosystems are proposed, economists may be able to say something sensible about the costs of those policies, but except where nonuse

> values are involved or where people use ecosystems (for example, for commercial harvesting of fish or for recreation), economists will not be able to contribute comparable welfare measures on the benefit side of the equation. (Freeman, 1993, p.485)

Professor Freeman's pessimism regarding prospects for valuing changes in certain types of ecosystem services may spring at least in part from doubt on his part that the obstacles to establishing the non-economic foundations of valuation can be overcome. After all, neither the actions of individuals in the marketplace or their responses to WTP surveys can reveal meaningful values for changes in ecosystem services if these individuals do not understand how these services contribute to preference satisfaction (Bockstael, et al, 1998).

But Freeman's remarks also seem to cast doubt on the validity of the economic concept of value as it relates to certain types of natural ecosystem services--indeed, the very types that may often be the focus of efforts to restore natural ecosystem parts and processes. Conceptual controversies surrounding the economic basis for measuring and using ecosystem service values for guiding public decision making are outlined briefly below.

6.4.2 Conceptual Issues

Critics of using valuation to guide environmental policy making can be found within the economics profession as well as among philosophers, psychologists and political scientists. These critics question whether the choices that people make in markets or hypothetical choice contexts can be interpreted as a reflection of well-defined and stable human preferences, or whether any such interpretations provide an appropriate basis for guiding environmental investments or regulations.

Professor Leonard Shabman and colleagues have summarized controversies surrounding these propositions from within the economics profession (Shabman and Stephenson, 2000; Shabman, 1993). They outline two main strains of economic thought challenge the notion that the economic concept of value is relevant or appropriate for guiding environmental decision making.

One comes from the Austrian school of economic thought that advances an interpretation of the role of market exchange as one of preference discovery and revision. According to the Austrian economists, the market choices of people are not dictated by a set of fixed preferences that are exogenously determined (i.e., determined independently of the choice context). Rather, the Austrian view is that an individual's preferences are endogenously determined by his or her knowledge of available choices at any given time, and these preferences are subject to continuous change as the individual gains more information about and experience with goods and their alternatives, and as personal circumstances change. Acceptance of the Austrian view that market exchange is a process by which individuals continually discover and revise preferences implies that market prices cannot be used as datum to reveal meaningful values for ecosystem services.

Research by behavioral psychologists on how people make decisions lends support to the view that people do not retrieve previously determined preferences when making complex choices. Psychologists have voiced the view that when people are faced with choices made under unfamiliar conditions and with limited information, the choices observed are not dictated by retrieved preferences, but rather preferences that are constructed at the time based on the choice context and circumstances (Schkade, 1994). This is a particularly important criticism for the use of CVM questions to elicit values for ecosystem services, one that has been made by psychologists as well as some economists.

The other major economic criticism for valuing ecosystem services as a guide to environmental policy comes from the so-called Institutional economists. The main focus of the Institutional economists critique is on the use of the positive net benefits criterion (i.e., national economic efficiency standard), based on the summation of individuals' economic gains and losses, for guiding policy making. Institutional economists note that observed market choices and prices reflect the distribution of income as much as individual preferences, and thus raise distributional concerns. In the words of Shabman and Stephenson (2000), "the institutional economists argue that non-market valuation inappropriately elevates the preferences of current individuals and those with the greatest income (ability to pay) to the touchstone of environmental decision making."

More generally, use of the efficiency standard for justifying public investments and regulations has long been a point of controversy within neoclassical welfare economics, although these concerns are now rarely voiced (Bockstael, et al, 1991; Just, et al. 1982). The efficiency standard is based on the premise that a public investment is in the national interest if those individuals who gain from the investment could fully compensate those individuals who lose, and still be better off. But since the efficiency of some investment is determined using benefit and cost measures that are conditioned upon the initial distribution of wealth, use of the efficiency standard for policy making implicitly assumes that the existing wealth distribution is desirable. This, of course, is debatable. That assumption, coupled with the fact that compensation is rarely paid to those who individuals who experience a loss from a public investment or regulation, raises serious concerns about the distributional effects over time of public decisions guided by the efficiency standard.

For the Institutional economist, such distributional concerns are particularly important in the case of environmental policy making since people often attach moral and social importance to environmental issues that they normally express through the political process, not through market choices. Given this, institutional economists argue that it is inappropriate to base environmental investment and regulatory decisions on preferences revealed from market exchange (Bromley, 1997).

Political scientists and philosophers have offered similar criticisms of the use of market prices for revealing human preferences for environmental and other investments that may involve a moral or community dimension. For example, Professor Arthur Maass in a

1966 paper on the relevance of benefit-cost analysis for guiding public investments decisions writes:

> "The second basic assumption of the new welfare economics and of benefit-cost analysis that needs to be challenged is consumers' sovereignty—reliance solely on market-exhibited preferences of individuals. This assumption…is not relevant to all public investment decisions, for an individual's market preference is a response in terms of what he believes to be good for his own economic interest, not for the community. Each individual plays a number of roles in his life…and each role can lead him to a unique response to a given situation. Thus, an individual has the capacity to respond to a given case, to formulate his preferences, in several ways, including these two: (1) what he believes to be good for himself—largely his economic self-interest, and (2) what he believes to be good for the political community. The difference between these two can be defined in terms of breadth of view. To the extent that an individual's response is community, rather than privately oriented, it places greater emphasis on the individual's estimate of the consequences of his choice on the larger community." (Maass, 1966)

Mark Sagoff, a professor of Philosophy, has advanced essentially the same argument about the different types of preferences that people hold, and he goes further to make judgments about the relevance of each for environmental policymaking. Professor Sagoff argues that people simultaneously hold "ideal-regarding preferences" that reflect community concerns and "self-regarding preferences" that reflect individual desires. In his view, the WTP concept of value is not relevant or appropriate for environmental policymaking since it is individuals' community-oriented preferences, not personal desires, that dominate the way in which people view environmental issues and judge protection policies (Sagoff, 1988).

6.5 Concluding Remarks on Monetary Evaluation of Restoration Outputs

The above review suggests that considerable technical obstacles, both non-economic and economic, stand in the way of comprehensive monetary accounting of restoration project benefits. Scientific obstacles relate to problems in tracing the links between restoration actions and service outcomes underlying all possible routes to human benefits. Economic obstacles relate to methodological limitations for measuring non-market benefits of service outcomes that affect the quality of human life in ways that have no close connection to marketed goods. Together, these obstacles to comprehensive valuation of restoration outputs impede use of a monetary standard for evaluating and justifying restoration projects.

In addition, some economists and other professionals have questioned the relevance of the economic concept of value as it relates to certain types of ecosystem services that might often be the focus of restoration projects. Challenges from these critics could hinder the political acceptability of using a monetary standard for evaluating and

justifying restoration project plans, even if the technical hurdles to ecosystem valuation are significantly lowered over time.

Nevertheless, in some cases it should be technically possible to estimate monetary values for restoration outputs that could be used to inform project decisions in ways that are politically acceptable. For example, when restoration plans affect traditional Civil Works outputs such as hydroelectric generation and recreation, these effects could and should be estimated. If project plans involve a reduction in existing levels of traditional outputs, these opportunity costs could be included directly in the cost measure used to evaluate and compare plan alternatives against non-monetary measures of restoration outputs within a cost-effectiveness framework (Moser, 1990; Shabman, 1993). Similarly, in the multipurpose NED/NER context, estimated benefits for traditional outputs for which plans are formulated could be estimated and netted from the measure of plan implementation costs used for cost-effectiveness and incremental cost analyses.

When restoration project plans affect traditional or other service benefits that are unrelated to the specific outputs for which plans are formulated and that can be readily assessed in dollar terms, these "incidental benefits" should be estimated even though Corps policy may prevent their use for plan comparison directly within the CE/ICA framework. But such estimates could still serve a useful function as a sidebar to incremental cost analysis by helping to answer the "is it worth it" question for the set of plans identified as non-dominated based on the comparison of non-monetary measures of ecosystem outputs and monetary opportunity costs. In essence, such value estimates would provide one direct indication of the "significance" of restoration outputs.