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# Economic Valuation of Environmental Benefits

by Allegra Cangelosi

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## Here are Some Questions:

Sediment rolls down the Maumee River to Maumee Bay every hour of every day. The material becomes contaminated as it passes leaking landfills. The sediment is expensive to dredge and store, and adds maintenance costs to water treatment. Upstream prevention measures could reduce significantly the sediment loads into the harbor, but such initiatives would cost money.

*Would the benefits of a program to prevent soil erosion into the Maumee justify the costs?*

A wetland area near the Saginaw Bay of Lake Huron is slated for development. But the State of Michigan could purchase the wetland for use by hunters and anglers if it could justify to voters the cost of the land.

*What are the economic benefits of conserving the wetland? What value would be lost in development?*

In the early part of this century, the city of Chicago reversed the flow of the Chicago River and developed canals to facilitate sanitation in the Chicago area. The Illinois River, as a result, now feeds Great Lakes water into the Mississippi, allowing aquatic organisms to pass relatively freely between the two systems. Exotic species invasions have caused permanent decline in Great Lakes species diversity, and they impose new maintenance costs on industrial users of the Great Lakes. Three plans for reducing organism transfers via the Chicago River have been proposed, one more effective -- and expensive -- than the rest. We know that a new invasion via the Chicago River is possible, but we don't know when it might occur or how bad the consequences might be.

*How much should we invest in prevention of inter-basin transfers of species at the Chicago River? When should the investment be made?*

Contaminated harbor sediments release significant new loads of Polychlorinated biphenols (PCBs) into the Great Lakes. Recent research demonstrates that clear negative human health effects result from consuming fish contaminated with PCBs and that populations of children and adults in the basin suffer those effects. Clean-up of contaminated harbor sediments is possible, but expensive. From a moral stand-point, we would want to remove as much PCB from harbor systems as is physically possible. But complete clean up of all sediments contaminated with PCB would severely tax, if not exceed, the combined resources of the U.S. and Canada for environmental protection of the Great Lakes. Meanwhile, such a clean-up would still not rid the system completely of the

contamination because PCBs also are released from leaking disposal sites and old electrical equipment still in use.

*How much and when should society invest in clean up of PCB-contaminated sediments?*

## Can Economics Supply the Answers?

Can the field of economics answer such environmental policy questions for the Great Lakes region? It depends upon the question's difficulty. Number 1, above, is a straightforward economic problem that is fairly simple to answer. Question 4, on the other hand, is much more complex because it involves goods and services not traded in markets. But even where it is not conclusive, economic information certainly can help us understand more about our options. In particular, it helps policymakers define more clearly the tradeoffs for a given course of action -- in terms of market goods and services, and increasingly, non-market values, as well. The challenge for Great Lakes policymakers will be in distinguishing the appropriate role for economics in environmental decision-making -- one that neither overrates nor underutilizes the power and quality of economic information.

## Trade-offs and the Environment

Trade-offs are a fact of life. We face them in every aspect of our existence, from where we live to what we do for a living. Sometimes we make choices fully aware of what the trade-offs may imply, but more often we are forced to choose in the dark. The more complex the context for our choice, the more often we must choose among options with incomplete knowledge of the final outcomes. In these cases, we can be surprised by the consequences of our actions.

Certainly, society has faced tremendous surprises as a consequence of its choices with respect to the environment -- the most complex system of all. Had society known that the construction of the Welland Canal would lead to a sea lamprey infestation in the Great Lakes, it might have urged investment in a prevention measure at the outset, rather than accept the permanent price of lost fishery resources and chemical lamprey control in the lakes. Many of those who chose before environmental regulations to dispose of factory wastes in Great Lakes rivers and harbors did so because they were unaware of the consequences contaminated sediments would have for the health of Great Lakes anglers and their offspring for generations to come. Had they known, many would have handled disposal differently. Are these oversights relegated only to the past? Members of Great Lakes industry have argued that the prospective environmental benefits of more stringent effluent standards do not warrant the expense of implementing the regulations that create them, and that nonpoint source pollution control would render greater benefits to the environment for the price. These individuals anticipate that society will later wish it had spent more on nonpoint source pollution control and less on point source.

Today, society has better information than it ever has had on the implications of its decisions for the environment -- information it has gleaned from an all too rocky track record. With this information, theoretically, society can understand the trade-offs it faces and make more informed choices about its use of the environment. What makes this comparison less than straightforward in practice, however, is the strikingly different nature of costs and benefits associated with environmental protection. As an example, the cost of preventing new introductions of exotic species via the ballast water of ships takes the form of easily monetizable goods, like equipment installed in ships or ballast exchange at sea. In contrast, many of the benefits of prevention are intangible and not traded directly in markets (such as conservation of bio-diversity) and those that are traded can be difficult to estimate (such as the avoidance of added maintenance costs for raw water users associated with a yet unrealized exotic species invasion). The same contrast exists with respect to habitat conservation and toxic discharge reductions.

In an effort to clarify these choices, economists have developed approaches to detecting changes in the value of environmental amenities associated with changes in the environment. These techniques can be employed to

estimate the potential improvement in environmental benefits, if any, associated with changes such as a wetlands conservation project, a new environmental regulation, or a project to remediate a contaminated sediment site. Such techniques -- as surveys to estimate public preference (contingent valuation); determination of the effect of environmental changes on real estate value (hedonics); and calculation of the amount the public travels to enjoy certain benefits, like fishing (travel cost analysis) -- are ingeniously employed to arrive at these estimates.

## Valuation and the Great Lakes

The valuation of environmental benefits can come into play in public policy in a number of ways. The three most common formal applications are cost-benefit analysis, cost-effectiveness analysis, and benefits valuation for purposes of compensation for environmental damages. These applications pertain to a particular project which may change the value of environmental amenities and provide an estimate of that change. The techniques can be applied whether the change in the environment is an improvement or a degradation. That is, the proposed intervention could be a new environmental regulation or a new wetland development project. As noted below, benefits assessment in the context of each of these applications has played or could play an important role in Great Lakes environmental policy.

*Cost-benefit analysis* is the comparison of any positive (or negative) changes in the value of environment amenities with costs (or benefits) of implementing the proposed change. The assumption is that costs and benefits can be estimated to an equivalent extent, allowing meaningful comparison. With much of the low-hanging fruit in environmental protection depleted, there is increasing interest in evaluation of the environmental pay backs relative to costs associated with proposed environmental improvements. President Clinton issued Executive Order 12866 in 1993 requiring cost-benefit analysis on any new federal regulations with a price-tag exceeding \$100 million. In the Great Lakes region, a major cost-benefit analysis was undertaken pursuant to this requirement on the Great Lakes Water Quality Initiative. The analysis predicted positive net benefits for the region. This information, taken together with other data, helped move the Great Lakes Water Quality Initiative forward.

*Cost-effectiveness analysis* assumes that the decision to implement an intervention (such as a cleanup) has been made. Normally, it is used to test various implementation approaches to determine the least costly. For example, a cost-effectiveness study would help determine the most efficient way to achieve a waste-load reduction allocation pursuant to a Lake-wide Management Plan. The cost of prevention approaches necessary to achieve the goal could be weighed against the cost of engineered approaches. In these cases, there is no need to calculate the benefits since they are constant. However, an analogous technique also could help determine the way to maximize Great Lakes benefits when the cost is fixed. Such an analysis might reveal to a Remedial Action Planning Committee the way to use a limited sum of clean-up money in order to yield the greatest environmental benefits for the harbor. In this case, a series of benefits assessments for a variety of clean-up scenarios would be generated and compared.

*Damage assessments*, such as those carried out under Superfund, help society estimate the amount that affected parties should be compensated for damages to natural resources by a pollution event. For this estimate to be accurate, the changes in benefits derived from environmental amenities caused by a pollution event must be estimated. An example of the damage assessment lies in the newly established Great Lakes Environmental Trust Fund. This fund was created to compensate the State of Michigan and its public for lost fishing benefits created by an improperly designed water intake on a power plant. It now provides a continuing source of funds for environmental projects that benefit the region.

Benefits assessment also plays an informal role in policymaking through *shining a spotlight* on formerly hidden values. In these cases the benefits assessment may not pertain to a particular project but to a set of benefits or potential benefits that may have been too little noticed in the past, and therefore poorly stewarded. For example, the International Joint Commission's Sediment Priority Action Committee recently recommended benefits assessments of sediment remediation in Great Lakes harbors in order to help clarify for Great Lakes residents what they could stand to gain by taking on a clean-up project. On a grander scale, in an article published recently in the

journal *Nature*, Robert Costanza and coauthors valued the world's natural resources in order to help illustrate the importance of global conservation efforts.

## Grappling with the Grey Area

Society is not always interested in making decisions strictly on the basis of market economics. For example, recent research on the cost to society of cigarette smoking revealed that smokers cost society less because their lives were shorter. Yet it is unlikely that a national campaign to promote smoking will ensue from this research. In the same way, many argue that economic benefits of environmental improvement cannot be the sole deciding factor around environmental policy decisions. For example, if research cannot show a net economic loss associated with diminished child Intelligence Quota scores, society should not assume that the diminishment is therefore of no importance.

In fact, some of the environmental amenities or services which flow from natural resources are more easily quantified than others. The difficulty is particularly evident in those resources that are not traded in markets. For example, the value of preserving a species (or the cost of its extinction) is difficult to estimate because there is no way to predict the potential value the species might have had for future generations. Likewise, the value of preventing further global climate change is difficult to gauge because we cannot be sure of all the potential outcomes of no action until they are upon us, and it is no longer possible to prevent them.

This grey area in the relationship between economics and policy has spawned different responses from experts and users of economics. Some experts attempt to fashion new techniques that are consistent with formal economics but which expand its scope to reliably capture more of the values that humans place on environmental and other social amenities. For example, these newer methods could incorporate the value that we place on longevity in a cost-benefit analysis of smoking, reflecting in the study results society's willingness to pay for the long life of self and loved ones. Such an estimation of general preference likely would yield opposite results from a study based solely on a comparison of medical costs.

These techniques, known as contingent valuation, are still new enough that they are controversial in some applications, especially legal ones. In light of the importance of measuring these difficult-to-assess values, federal and state governments are seeking criteria and guidelines for their effective use. For example, a State of Michigan law restricts the use of contingent valuation in natural resource damage assessments until guidelines for its appropriate use are developed. A set of national guidelines for economic valuation, including contingent valuation, was recently developed by a blue-ribbon panel convened by the National Oceanic and Atmospheric Administration.

In addition to those pursuing the envelope of conventional economic theory are those who advocate revision of fundamental economic principles to better accommodate environmental values. Experts in the fields of ecological economics and environmental justice are developing ways to revise fundamental economic theory to correct inherent biases that lead to resource exploitation and an uneven distribution of environmental hazards. Still experimental in nature, these fields no doubt over time will generate ways to improve the accuracy and fairness of environmental benefit assessments.

Meanwhile, those who require information now on environmental benefits related to particular proposed interventions -- i.e., the users -- have responded to the difficulty of monetizing environmental amenities by placing bounds around the use and implications of economic information in environmental policy decisions. Executive Order 12866, which requires cost-benefit analysis in decisions relating to policies that may cost society more than \$100 million, hedges on the decisiveness of the cost-benefit study it requires. While requiring the study, the Executive Order does not require adherence to the study outcome, simply consideration of it. Legislative language in the Water Resources Development Act is even more clear in the advisory nature of the economic information associated with sediment clean-up decisions. For these users, benefits assessment exercises are valuable as a spotlight illuminating for society the hidden benefits of environmental quality, thereby informing decisions, but

not as a strict decision-making formula.

Other users, especially some within industry, respond to the grey area in environmental valuation by restricting the scope of legitimate economic analysis. These users contend that decisions indeed should be based on cost-benefit comparisons, but that values that are not readily monetizable should not be added into the cost-benefit calculus at all. Using this approach, they argue, the cost-benefit analysis is guaranteed to compare apples with apples, providing the best information to society about the implications of a change in the environment for economic well-being and overall welfare.

The outcome of these diverging points of view is that there is more agreement about the idea of economic valuation of environmental benefits than about how it is to be carried out and when it is to be used. Yet as cost-benefit analysis in particular gains popularity as a decision-making tool, more consensus around approaches and uses of benefits assessment is critical. With major policy decisions for the Great Lakes hanging in the balance, it is time for the Great Lakes community to explore the approaches to and uses of benefits assessments in resource management decisions.

## Next Steps

In an effort to increase understanding and consensus regarding the role of economics in Great Lakes environmental decision making, the Northeast-Midwest Institute launched a two-year project in cooperation with the National Oceanic and Atmospheric Administration and with support from the George Gund and Joyce Foundations. The project's purposes are to stimulate informed discussion and forge greater consensus within the Great Lakes region on the appropriate use of economics in environmental decision making. The project also was designed to chart and catalyze the best next steps in improving economic research related to Great Lakes environmental policy.

The project convened a blue-ribbon panel of leading resource economists from the Great Lakes and nationally in order to focus on the application of environmental valuation methods to Great Lakes environmental concerns. The panel cooperatively developed a draft guidebook for environmental decision makers, communicating the state-of-the-art in valuation of environmental amenities and illustrating the application of valuation methods to Great Lakes environmental policy questions. The guidebook focused on techniques that are either well-accepted or increasingly accepted in actual policy applications. Because it is geared to environmental management practitioners, the guidebook describes cutting-edge theory -- for example, that which is emerging from the new field of ecological economics -- in less detail. Rather than advocate the use of certain economic techniques, the guidebook takes an objective look at the strengths and weaknesses of the techniques currently available.

The Institute convened a stakeholders forum in July 1998 for representatives of key interest groups to respond to the "state-of-the-art" approaches contained in the guidebook. Participants agreed that more information about potential changes in the value of environmental amenities should accompany estimates of direct costs to industry in environmental policy discussions. However, some interest groups felt that the economic tools will have to evolve further from traditional economic theory in order to adequately measure the often intangible values inherent to the Great Lakes environment. Others felt the existing set of techniques was already too far toward the fringe of formal economics to provide useful information. All agreed, however, that economic information is valuable but must not be confused with "the answers" to environmental policy questions. Instead, that information should serve simply as an input into a broader decision-making process incorporating non-economic considerations. Moreover, the specific questions that a given economic study does answer should be distinguished carefully from the broader environmental policy issues. This approach to incorporating economics into Great Lakes environmental policy -- i.e., only very carefully -- makes considerable sense given the specialized nature of the questions that the various valuation methods may in fact answer.

The Northeast-Midwest Institute, together with its collaborators, will wrap-up the economic valuation project with training sessions based on the final guidebook. The Institute hopes to follow-up the project with more work in this area. In particular, the Institute is interested in facilitating consensus criteria for the region in order to undertake

and use valuation studies in environmental decision making. The Institute also hopes to catalyze a foundation of primary economic research on the benefits of Great Lakes environmental protection and restoration. Used properly, this information will further illuminate our options: what we stand to gain, or trade away, in our decisions regarding the protection and restoration of our main source of wealth, the Great Lakes ecosystem.

## **Select Federal and State Laws and Guidance Pertaining to Benefits Assessment**

### **Federal Statutes**

#### **Safe Drinking Water Act Amendments of 1996**

Before promulgating each new drinking water standard, the Environmental Protection Agency (EPA) must conduct a cost-benefit analysis, reviewing the quantifiable and nonquantifiable health risk reduction costs and benefits, as well as the incremental costs and benefits of each alternative maximum contaminant level.

EPA may use valid approaches for the valuation of benefits, including consumer willingness to pay for reductions in health risks from drinking water contaminants.

If the benefits of a drinking water standard do not justify the costs of complying with the level, EPA may, after notice and opportunity for public comment, promulgate a maximum level for the contaminant that maximizes health risk reduction benefits at a cost that justifies the benefits.

EPA is authorized to receive \$35 million for each fiscal year through 2003 to conduct studies, assessments, and analyses in support of regulations or the development of methods.

#### **Marine Protection, Research, and Sanctuaries Act of 1972**

In order to designate a marine sanctuary, the National Oceanic and Atmospheric Administration (NOAA) must consider many factors, including: (1) the public benefits from sanctuary status, with emphasis on the benefits of long-term protection of the resources; (2) the negative impacts produced by management restrictions on income-generating activities; and (3) the socioeconomic effects of sanctuary designation.

NOAA is directed to assess the damages to the natural resources from spills of petroleum or petroleum products. Under this responsibility, NOAA is required to develop and assess techniques to define and quantify the degradation of the marine environment.

When damage occurs at a marine sanctuary, NOAA must include within its damage assessment: (1) the cost of replacing, restoring, or acquiring the equivalent of a sanctuary resource; (2) the value of the lost use of the sanctuary resource pending its restoration or replacement; (3) the value of a sanctuary resource if the resource cannot be restored or replaced; and (4) the cost of the damage assessment.

#### **Oil Pollution Act of 1990**

NOAA, EPA, and the U.S. Fish and Wildlife Service are directed to promulgate regulations for the assessment of natural resource damages resulting from an oil spill.

Natural resource damages include cost of restoring, rehabilitating, replacing, or acquiring the equivalent of the damaged natural resources; the diminution in value of those natural resources pending restoration; and the cost of assessing damages.

## **Comprehensive Environmental Response, Compensation and Liability Act of 1980**

EPA is directed to promulgate regulations for the assessment of damages for injury to, destruction of, or loss of natural resources resulting from a release of oil or hazardous substances.

The regulations must specify: (1) standard procedures for simplified assessments requiring minimal field observation, including establishing measures of damages based on units of discharge or units of affected areas; and (2) alternative protocols for conducting assessments in individual cases to determine the type and extent of short- and long-term injury. Regulations must identify the best available procedures to determine damages, including both direct and indirect injury, and shall take into consideration factors including, but not limited to, replacement value, use value, and ability of the ecosystem to recover. Regulations shall be reviewed and revised as appropriate every two years.

## **Executive Order**

### **Executive Order #12866, Regulatory Planning and Review, September 30, 1993**

Agencies are required to prepare a Regulatory Plan for significant actions that result in an annual effect on the economy of \$100 million or more, or have other substantial impacts.

Under the Regulatory Plan, agencies are required to include preliminary estimates of the anticipated costs and benefits of the regulatory action and feasible alternatives. Benefits include both quantifiable measures and qualitative measures that are difficult to quantify, but nevertheless essential to consider. The agencies are directed to select the regulatory approaches that maximize the net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless another regulatory approach is required by statute. Because some costs and benefits are hard to quantify, agencies are directed to adopt or propose a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.

## **Federal Guidance and Reports**

### **OMB's "Economic Analysis of Federal Regulations under Executive Order 12866"**

In January 1996, the Office of Management and Budget released its guidelines that describe best practices for preparing the economic analyses required in Executive Order 12866.

### **EPA's "Guidelines for Performing Regulatory Impact Analysis"**

This EPA report provides guidelines for performing benefit-cost analysis on proposed environmental regulations. The focus is on measuring and valuing both health and environmental effects which are done through transferring benefit values from existing literature. EPA is in the process of revising these guidelines.

### **NOAA Panel on Contingent Valuation**

In 1993, the NOAA Panel on Contingent Valuation concluded that contingent valuation studies can produce estimates reliable enough to be the starting point for a judicial or administrative determination of natural resources damages, including nonuse values.

The NOAA Panel developed a set of guidelines for contingent valuation surveys. The panel concluded that studies adhering to the guidelines, without major deviations, can provide reliable information in a damage assessment process.

## **Great Lakes State Laws**

### **Michigan Environmental Protection Act § 324.20104**

The Michigan Department of Environmental Quality (DEQ) is restricted from using contingent valuation or other valuation methods to quantify nonuse values in natural resource damage calculations. DEQ will be able to use nonuse valuation methods in the future if it determines that the methods satisfy principles of scientific and economic validity and reliability and if it promulgates rules for their use.

### **Illinois Environmental Protection Act § 27(b)**

The Department of Commerce and Community Affairs must conduct a study of the economic impact of proposed rules. This study must address the economic, environmental, and public health benefits that may be achieved through compliance with the rule.

The Illinois Pollution Control Board must determine, based on the economic impact study and other evidence, whether the proposed rule has any adverse economic impact before adopting the rule.

### **Natural Resources Chapter of Wisconsin Statute § 293.65**

The Wisconsin Department of Natural Resources will deny a permit for the diversion of surface water for the purposes of metallic mining if the injury to the public exceeds the public benefits generated by the mine.

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