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Extension FactSheet

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Pricing the Environment: An Introduction

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Environmental goods and services are quite valuable. For example, Americans spend considerable time engaged in recreational activities in public parks. They pay more for homes with nice natural surroundings. They support laws and regulations to improve environmental amenities. And they spend considerable resources avoiding the potential health effects from pollution. Bergstrom and Cordell (1991) suggest that outdoor recreation in the United States is worth $172 billion per year (1997 U.S. dollars) to U.S. consumers. We clearly value environmental amenities.

Unfortunately, these benefits are often neglected when policy is being made. Instead, when it comes to the environment, we focus heavily on the costs, including jobs and lost economic activity. No one can debate the importance of strong local economies, yet no one can debate the importance of environmental quality for the well being of society. How do we begin to balance economic costs with environmental benefits if little attention is paid to the benefits?

This fact sheet describes several techniques that have been employed in recent years to estimate the value that citizens place on environmental goods and services. These methods can be used to evaluate the impacts of environmental policy and management decisions. They have been widely used in national policy debates, such as with the Exxon Valdez incident, administrative rules related to the Clean Air and Clean Water Acts, and national legislative proposals, but they have been less widely used at the state and local level.

Here in this fact sheet, the techniques are introduced, and a number of estimates from different studies are provided to give readers a sense for the potential scale of environmental benefits. Future fact sheets will provide more explicit information on applying these estimates to particular issues.

Techniques for Valuing Environmental Resources

We all are used to paying a price for goods we purchase in a store, such as groceries. Market prices simply record the value of the trade-offs we make for goods and services we buy everyday. Paying for anything means we make a trade-off — we cannot buy something else with the money we just spent. Environmental resources, like clean water, clean air, nice views, and healthy forests for hiking, are not bought and sold on the open market, and therefore do not have market prices. Decisions over how much of them to provide are made publicly by officials we elect. Information on the price, or value, of different resources could provide public officials with helpful information to balance the benefits and costs of alternative policies.

Economists use two different types of information to estimate values for public environmental resources — observations on actual behavior and population surveys designed to elicit values. Observations on actual behavior are useful because we respond to different types of environmental conditions by changing our behavior. These changes in behavior are often recorded in purchasing decisions, travel decisions, and recreational decisions. Economists use data on these changes to assess the value we place on environmental resources.

For example, a number of Lake Erie beaches experience high levels of *E. Coli* in the water during the summer. When beach advisories are issued cautioning visitors about the potential health effects, some visitors decide not to go to the beach, and some visitors switch to beaches that do not have advisories. People change how far they travel and how much they travel to beaches as a result of the advisories. These changes in behavior have economic implications that can be measured to assess the value of the advisories.

In many cases, however, environmental values are not recorded by behavior. Local residents value their parks, even if they do not visit them regularly. They would be willing to pay for the option to visit the parks, or they simply value the parks because they like to drive by the natural areas on their way home from work. These values are not recorded by behavior, but economists have developed techniques for eliciting these values using surveys. Such methods are similar to methods companies use when they are preparing to try new products in the market.

Two types of values are important when policy changes that affect the environment are made, *economic impacts* and *environmental values*. Economic impacts are the effects that policy has on local businesses. For recreational activities, this can include convenience stores, restaurants, and rental facilities that cater to recreators. Economic impacts are important values for local policy makers to consider; however, they do not measure all environmental values.

In 1970 when Lake Erie was highly polluted, economic impacts around the lake were high due to the high level of industrial activity. There was large value associated with using Lake Erie to recycle waste material. Reducing pollution in the lake reduced economic impacts in a number of important "smokestack" industries, but it also increased economic impacts in recreational industries. Overall economic impacts may have increased or decreased over the past 30 years. Reducing pollution, however, has clearly increased the environmental value of Lake Erie. Thus, while the overall economic impacts may increase or decrease with an improvement in environmental quality, environmental values definitely increase.

Environmental values, on the other hand, provide information on the "demand" or "willingness to pay" for environmental benefits or amenities. Techniques designed to measure environmental values focus on measuring value for individuals who directly benefit from the environmental amenity rather than industries and businesses that indirectly benefit. Both environmental values and economic impacts are important for policy decisions, although economic impacts are more widely known and used in policy today. This fact sheet focuses on describing economic values because they are less well known but are equally important for understanding how policy decisions on the environment affect people's well being.

Recreational Values: The Travel Cost Method

The travel cost method estimates the value people place on recreational locations or amenities (such as nice trees for hiking or nice sand for laying on the beach). The theory is that a person's decision to participate in recreational activities in a specific place is a function of the costs of traveling to that place (the price for the trip) and the environmental amenities they will obtain by traveling there. The costs include gasoline, wear and tear on automobiles, and the time traveling. Time traveling is often the most costly component of a trip, given the many demands we have for our time in modern society. Different places have different levels of amenities, but they also have different costs of traveling. By exploring the decisions people make over where to engage in recreational activities and the costs incurred, economists can estimate the value of specific recreational places or the value of changing the amenities associated with those places.

Household Location Values: The Hedonic Pricing Method

The hedonic pricing method focuses on how people decide where to live. Housing location for many people often depends directly on local environmental factors. For instance, there is evidence from many cities that housing values are directly affected both by local air and water quality. There is evidence as well that industrial facilities and chemical spills reduce the value of nearby homes. Alternatively, there is evidence that individuals place high value on having nice views or parks nearby, or on having high water or air quality in their neighborhoods. These "hedonic" values are often measured by exploring the relationship between housing values and these amenities.

Substitution in Markets: Market Methods

In response to a number of environmental impacts, ordinary citizens and public agencies respond with defensive expenditures or by substituting products. City water supplies respond to water pollution upstream by installing new technology to clean the water. You and I respond to concerns about water safety by purchasing bottled water. In many cases, the value of these defensive expenditures can be used to estimate our willingness to pay for improvements in environmental quality. Market methods refer to directly estimating the effects of an environmental impact by measuring the economic value of changes in behavior. The hedonic pricing method discussed earlier is a specific form of a market method that seeks to assess market impacts in a specific market (the housing market). Market methods, however, apply more broadly and can often be conducted fairly inexpensively with data obtained locally.

Non-Use Value: The Contingent Valuation Method

All of the methods previously mentioned rely on information about actual human behavior. Many environmental impacts or policy decisions, however, have values not observed in markets. Many policy proposals are made before impacts can be measured in markets. Alternatively, people often value environmental resources even if they do not travel to visit them. For instance, a large proportion of American society values the 107-million-acre national forest system even though most of us will never actually visit a national forest and its recreational activities. These forests host biodiversity and endangered species, they store carbon, and they supply water. We are willing to pay to maintain them, but this willingness to pay cannot be measured by markets.

The contingent valuation method is used to value environmental benefits that truly exist outside of markets. The contingent valuation method uses survey data to estimate the willing-

ness to pay for an improvement in environmental resources. The method uses hypothetical questions to assess how a population of people value the resource in question. The resulting estimate of the price people are willing to pay can be used by policy makers to judge how supportive their constituents would be to the action. The contingent valuation method is similar to polling practices and market research conducted by most large companies. However, the contingent valuation method differs from polls because it recognizes that all public decisions require re-allocation of financial resources from one activity to another. The contingent valuation method attempts to determine the size of this re-allocation that the public is willing to accept.

Benefit Transfer

While collecting data and conducting studies using the methods described earlier are often necessary, many local governments may not have the time or the money available to conduct one of these studies before making a decision on a particular policy. It is nonetheless useful to consider how environmental values would be affected by the policy decision. In recent years, economists have explored how the large number of existing studies could be used to provide useful information that can be applied in new situations. The technique these individuals use is called benefits transfer. The idea is to transfer existing estimates from similar studies in a different region to the particular region or policy in question.

The benefits transfer technique is promising; however, policy makers have to be careful interpreting estimates from one study and applying them elsewhere. Prices for most market goods and services vary from one region of the country to another depending on supply and demand conditions. It is entirely likely that prices for environmental quality also vary from place to place. Important regional differences affecting the price for environmental quality must be carefully considered before transferring an estimate from one region to another.

Despite the potential for over or under estimating the value of an environmental improvement, many economists argue that the alternative — assuming no value for environmental benefits — is potentially more misleading. Thus, while benefits transfer should be used with caution, it should be used when the alternative is either no study or assuming no value.

Environmental Values: Results From Past Studies

This section presents estimates of several types of values that are important for environmental and natural-resource management decisions in Ohio. The purpose of the section is to illustrate the potential value associated with environmental amenities, not to value specific situations in Ohio. Many of the estimates are derived from studies conducted in Ohio, although a number of the estimates were conducted in other regions.

Benefits of Recreational Trips

Estimates of the per trip environmental value for a number of recreational activities available in Ohio are shown in Table 1. The values shown provide an indication of the value of different types of recreational activity. These estimates can be combined with information on visitation at recreational sites to estimate the value of those sites. Given that much recreation occurs on public sites, such information may be useful for managers who must decide how to allocate resources among different recreational activities. Alternatively, the values can be used to estimate the potential value of adding new public recreational sites.

A range of values from different studies is shown. Studies predict different values for a number of reasons, including the region where the study was conducted, the type of recreational activity investigated, and the methods used to conduct the survey and to analyze the data. While this information provides a useful indicator of the potential economic value arising from different recreational activities, we note that values estimated locally can differ substantially from other studies.

Water-Quality Improvements

In addition to considering the value of recreational activities and recreational sites, the valuation techniques described in this fact sheet can be used to estimate the value of improving environmental quality. Many environmental decisions revolve around deciding whether to take an action that improves environmental conditions. The results of these studies are more difficult to transfer to other regions because they are often case specific. Nonetheless, the estimates provided in other studies can provide useful examples to help policy-makers understand the potential scale of environmental value.

Table 2 shows a number of contingent valuation studies conducted to explore the value of improvements envisioned by the Clean Water Act. Contingent valuation studies estimate values that apply both to users and to non-users alike. The range of estimates from these studies is $14 to $46 per household (one-time payments in 1997 U.S. dollars) for improving water quality from current conditions to swimmable. Contingent valuation estimates do vary considerably across the scenarios used in the different studies, but the estimates appear to center on approximately $20 per household.

Water-quality improvements potentially have their largest effect on recreational users. The travel cost methods discussed previously have been used to value specific scenarios of improvements in water quality. Table 3 presents a number of these results. Because these studies are focused on changes in site quality (rather than overall site value as in the section earlier), the estimates provided are for the change in value for each trip taken. Although these values seem small compared to the values shown in Table 1, when multiplied by the population of visitors affected, they can become quite large.

Table 1: *Travel Cost* Estimates of Value per Trip for Different Types of Recreation (1997 U.S. Dollars).

Value per Trip	Recreation Activity	Population	Source
$9.12 – 10.58	Motorboat/Skiing	Great Lakes States	Bhat *et al.* (1998)
$5.58 – 7.20	Camping		
$20.47 – 30.92	Fishing		
$3.92 – 7.29	Hunting		
$8.17 – 17.01	Sportfishing	Lake Erie, Ohio	Hushak *et al.* (1988)
$22	Sportfishing	Lake Erie, Ohio	Hushak *et al.* (1999)
$15.50 – 25.60	Beach Visits	Lake Erie, Ohio	Sohngen *et al.* (1998)
$11.69	Boating	Hocking River Valley, Ohio	Sommer (2001)
$12.54	Fishing		
$12.93 – 27.55	Developed Camping	United States	Bergstrom and Cordell (1991)
$16.74 – 24.48	Picnicking		Walsh *et al.,* (1987)
$17.21	Biking	*Note*: The range presented in	
$15.12	Day Hikes	these results reflects the	
$36.56 – 41.09	Backpacking	range in average values	
$16.93 – 43.54	Hunting	presented in the two studies.	
$17.90 – 68.78	Canoeing	Biking and day hikes were	
$23.06 – 44.59	Motor Boating	considered only in	
$17.70 – 33.27	Warmwater fishing	Bergstrom and Cordell (1991).	

Conclusion

The purposes of this Fact Sheet are to introduce readers to several of the techniques that can be used to value the environment and to provide information on values that may be relevant to environmental issues in Ohio. While the area of environmental valuation is still a relatively new area of research, a number of studies have been accomplished in Ohio. These studies can provide data, estimates, and information that could be useful to citizens and policy makers alike as they engage in important debates over public policy related to the environment. Although the set of studies for Ohio is incomplete in that the economic benefits and costs of many environmental issues have not been explored to date, future studies are planned, and as these studies become available, this Fact Sheet will be updated to provide new information.

References

Bergstrom, J. C. and H. K. Cordell. 1991. An analysis of the demand for and value of outdoor recreation in the United States. *Journal of Leisure Research.* 23(1) 67-86.

Bhat, Gajanan, John Bergstrom, R. Jeff Teasley, J. M. Bowker, and H. Ken Cordell. 1998 An Ecoregional Approach to the Economic Valuation of Land- and Water-Based Recreation in the United States. *Environmental Management*. Vol. 22, No. 1. pp. 69-77.

Bockstael, Nancy E., W. Michael Hanemann, and Catherine L. Kling. 1987. Estimating the Value of Water Quality Improvements in a Recreation Demand Framework. *Water Resources Research.* Vol. 23, No. 5. pp. 951-960.

Feather, P., D. Hellerstein, and T. Tomasi. 1995. A discrete-count model of recreational demand. *Journal of Environmental Economics and Management.* 29: 214-227.

Greenley, Douglas A., Richard G. Walsh, and Robert A. Young. 1981. Option Value: Empirical Evidence from a Case Study of Recreation and Water Quality. *The Quarterly Journal of Economics.* November 1981. pp. 657-673.

Hushak, L. J., J. M. Winslow, and N. Dutta. 1988. Economic Value of Great Lakes Sportfishing: The Case of Private-Boat Fishing in Ohio's Lake Erie. *Transactions of the American Fisheries Society.* 117: 363-373.

Table 2: *Contingent Valuation* Estimates of Improving Water Quality (1997 U.S. Dollars).

Benefit per Person*	Pollutant (Measurement)	Population	Source
$46.65 (users) $14.65 (nonusers)	Improve Water Quality from Unswimmable to Swimmable	Baltimore-Washington Metropolitan Area United States	Bockstael *et al.,* 1989
	Improve all U.S. waters to:		Carson and Mitchell (1993)
$24.49	Boatable		
$20.8	Fishable		
$20.54	Swimmable		
$26.25 - 32.66	Improve water quality from fair to good	Iowa - Illinois	Lant and Roberts (1990)
$16.40	Mitigate heavy metal concentrations to remove potential health hazard.	South Platte River Basin, Colorado	Greenley, Walsh, and Young (1981)
$42.14	Anti-degradation rules	Ohio Boaters and Fishers	Irvin *et al.,* (2001)

* Willingness to pay for improvements: one-time payment.

Hushak, L. J., D. O. Kelch, and S. J. Glenn. 1999. The economic value of the Lorain County, Ohio, artificial reef. Fish Habitat: Essential Fish Habitat and Rehabilitation. American Fisheries Society Symposium. 22: 348-362.

Irvin, S., T. Haab, and F. Hitzhusen. 2001. Economic benefits from agency pollution control. Mimeo. Department of Agricultural, Environmental, and Development Economics, The Ohio State University.

Kling, Catherine L. 1989. A note on the welfare effects of omitting substitute prices and qualities from travel cost models. *Land Economics.* Vol. 65, No. 3, pp. 290-296.

Murray, C., B. Sohngen, and L. Pendleton. 2001. Valuing water quality advisories and beach amenities in the Great Lakes. Forthcoming: *Water Resources Research.*

Parsons, G. P., P. M. Jakus, and T. Tomasi. 1999. A comparison of welfare estimates from four models for linking seasonal recreational trips to multinomial logit models of site choice. *Journal of Environmental Economics and Management.* 38: 143-157.

Parsons, G. P. and M. J. Kealy. 1992. Randomly drawn opportunity sets in a random utility model of lake recreation. *Land Economics.* 68(1): 93-106.

Sommer, Allan. 2001. Determining the value of improved water quality in the Hocking River valley to Ohio boaters and fishers. Master's Thesis. AED Economics, The Ohio State University.

Walsh, Richard G., Donn M. Johnson, and John R. McKean. 1992. Benefit Transfer of Outdoor Recreation Demand Studies, 1968-1988. *Water Resources Research. V*ol. 28, No. 3. pp. 707-713.

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Table 3: *Travel Cost* Estimates of Per Trip Value of Improving Water Quality for Different Types of Recreation.

Benefit per trip per person	Pollutant (Measurement)	Population Size	Source
	30% Reduction in:	Boston, MA	Bockstael *et al.* (1987)
0.69	oil at beaches		
1.06	* COD at beaches		
0.42	fecal coliform at beaches		
1.79	all plus turbidity at beaches		
	** D.O. ≥ 5 ppm		
	Recreational Group:	Wisconsin	Parsons and Kealy (1992)
$4.83	Boaters		
$1.08	Fishers		
$6.66	Swimmers		
$6.35	Viewers		
$1.77 - $1.83	Eliminate PCB Contamination Advisories	Tennessee	Parsons *et al.* (1999)
($6.63) – (7.10)	Loss of Contaminated Fishing Site		
$1.94 - 3.49	10% improvement in W.Q. Chesapeake Bay Beaches	Chesapeake Bay, MD	Kling (1988)
$1.73 - $2.12	Eliminating one beach advisory on Lake Erie Beaches	Ohio	Murray *et al.* (2001)
$0.18 - $1.24	Increasing lake clarity for fishers	Minnesota	Feather *et al.* (1995)

* COD = chemical oxygen demand.

** D.O. = dissolved oxygen; ppm = parts per million.

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