SOCIAL SCIENCE TOOLS FOR COASTAL PROGRAMS

INTRODUCTION TO ECONOMICS FOR COASTAL MANAGERS

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Social Science Tools for Coastal Programs

Introduction to Economics for Coastal Managers

About This Publication

Some of the most challenging decisions in coastal management stem from the relationship between people and the environment. The National Oceanic and Atmospheric Administration's Coastal Services Center provides technical assistance to coastal management professionals addressing complex human-based problems. "Introduction to Economics for Coastal Managers" is the third in a series of publications developed to bring information to this audience about the use of social science tools in their field of work. For additional information about social science tools and applications, please visit *www.csc.noaa.gov/cms/human_dimensions/focus_socialsci.html.*

About the NOAA Coastal Services Center

The Coastal Services Center, an office within the federal government's National Oceanic and Atmospheric Administration (NOAA), works with state and local programs devoted to the wise management of our nation's coastal resources. The NOAA Coastal Services Center provides these programs with tools, training, and expertise that might otherwise be unavailable. To learn more about the products and services available from this agency, visit *www.csc.noaa.gov.*

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Introduction

Managing coastal resources often means making hard decisions about the best way to use those resources—especially when there are competing demands.

For example, do you

- Maintain the green space or build more homes?
- Develop a new marina or keep the existing oyster beds?
- Construct a mall that would draw in new industry or preserve the wetland?

Although there is no simple way to answer these questions, economic methods can help coastal resource managers understand the trade-offs and make better-informed decisions about managing the resource.

This document provides a basic introduction to economic ideas and methods that can be applied to coastal resource management. These economic concepts are illustrated by several case studies. After reading this document, coastal resource managers should have a better understanding of the powerful economic methods at their disposal.

The Power of Economic Methods and Concepts

Economic tools can be used to maximize the usefulness of coastal resources and make the community as well off as it can be—socially, economically, and environmentally. When considering the best way to manage a resource, managers can use economic tools to express the values of alternatives in common terms (usually dollars) so that an "apples to apples" comparison can be made and the alternative that maximizes the benefit to the community will be chosen.

Economics can help people consider the trade-offs they face to achieve economic and environmental goals.

Applying Economics to Coastal Resources

To apply economics to the management of coastal resources, the cost, expertise, and type of economic information required to make resource decisions should be considered.

Cost and Expertise

The cost of conducting economic research and analysis can be considerable, but knowing the economic value of coastal resources can help ensure that you don't trade off things that are worth more—for things that are worth less. Because of the difficulty in placing a dollar value on many of the benefits provided by coastal resources, these benefits are often assigned a value of zero (King 1998), even though the resources provide considerable value to the community and the local ecosystem.

For example, part of the value of a coastal resource comes from the ecosystem services it provides, such as those services supplied by a maritime forest and salt marsh:

- Habitat and feeding grounds for commercial, recreational, and other fisheries
- Habitat for threatened species of birds
- Filtration and purification of runoff water
- Protection of buildings and other infrastructure from coastal storms, by absorbing energy and holding off floodwaters
- Enhancement of aesthetics (and, consequently, market value) of adjacent homes

If these services are assigned a value of zero, cutting down the forest and filling in the wetland to build a new business district might look economically advantageous. However, the development may actually have hidden costs to the community because the true value of the resources was not considered. For example, property damage from floods may increase, causing higher insurance premiums and lower house values in the area.

That being said, development may be the right choice in some cases. Only when the true value of a coastal resource is known can one make decisions that make the most long-term economic sense for the community—be it leaving the resource alone, developing it, or designing a partial development plan with fewer impacts.

Development tends to generate benefits that are easy to count and understand, while conservation tends to generate benefits that are harder to count and understand (Boyd, Sanchirico, and Shabman 2004).

The cost of economic research and analysis depends on many factors, including

- Size of the area where the resources are located
- Number of people who use the resources
- Type of survey method
- Type of economic value involved

However, if a full economic assessment is too costly to consider, economic methods to manage coastal resources can still be used. For example, information from an existing economic study conducted by someone else can be applied to other situations that are similar. This method is called benefits transfer.

Expertise Required. Performing an economic assessment is a complex—and often controversial—process, so make sure someone who has a background in economics is involved. Even the methods that are seemingly straightforward require judgments based on economic theory.

When trying to estimate the more complicated types of economic value, it is especially important that you work with someone with proven experience with that type of valuation. Otherwise, the results may not be acceptable in certain contexts (such as damage assessments or regulations).

Economic Options

The term "economics" encompasses a broad spectrum of methods and concepts, so there are a lot of different ways to use economics to help manage coastal resources.

No single method will be appropriate for all situations, so one of the first things to consider is what type of economic option will provide the necessary information to manage the coastal resource most effectively.

For example,

- To show how the local economy would be impacted by resource management decisions, an economic profile, including information such as industries and the number of jobs, would be created. This profile would serve as an economic baseline to see whether a proposed management action, such as prohibiting fishing in some areas, would have positive or negative effects on the local economy.
- To understand the total economic value of a resource, one would estimate many different types of value and then add them together.
- To consider alternative management options, one might look at the economic benefits and costs associated with each option and choose the option that offers the best value—the greatest benefits at the least cost.

A complete economic analysis of water and related land resources can be accomplished by identifying problems and opportunities for the resource—and then assessing and selecting the best option. These principles and guidelines come from the experience of the U.S. Army Corps of Engineers, Bureau of Reclamation, and Natural Resources Conservation Service (USACE 2008):

1. **Identify problems and opportunities.** Consider potential problems (such as coastal development resulting in the loss of ecosystem services) and opportunities (such as creating a marine protected area to increase fishery stocks). Ideally, one should move beyond the local perspective and consider the resource from a regional or national perspective.
2. **Take inventory.** Determine the current state of the resource, including ecosystem services provided, and future development pressures.
3. **Decide on a focus.** Consider the problems and opportunities identified in step 1, and decide which ones to investigate further.
4. **Consider the options.** Define the alternative options for the management of the resources—for example, development, no development at all, or a modified development plan with fewer negative impacts.
5. **Assess the options.** Use an assessment method to weigh the effects of various options, such as looking at the benefits and costs associated with each.

6. **Rank the options.** Compare the options, using the results of the assessment in the previous step, and rank plans based on net benefits. For example, the options rank might be based on the ratio of benefits to costs.
7. **Select the option.** Using all the collected information, select the management option that maximizes the benefit to the community.

The rest of this document provides additional information about how economics can be applied to coastal resource management by

- Describing different ways of assigning value to resources
- Discussing a few methods for comparing and assessing different management alternatives
- Providing several case studies that show how economic methods were applied to coastal resource management in real-life situations

Economics Defined: The Long and Short of It

"Economics is the science of choice."
Nobel laureate Robert A. Mundell, *Man and Economics: The Science of Choice*, 1968

"Economics is the study of how men and society end up choosing, with or without the use of money, to employ scarce productive resources which could have alternative uses, to produce various commodities and distribute them for consumption, now or in the future, among various people and groups in society."
Nobel laureate Paul A. Samuelson, *Economics*, 1970.

How Much Are Resources Worth?

One of the most common ways of using economics to help manage coastal resources is to estimate how much resources are worth. Knowing the value of resources will help society make better decisions about the use, or non-use, of those resources and maximize the benefits.

However, assigning values to resources can be challenging:

- Value is often associated with what is important or what has meaning—which isn't always easy to put in terms of dollars.
- Value depends on a person's preferences and how those preferences contribute to that person's welfare. A community will contain many different ideas about how valuable a resource is, depending greatly on how the individual community members interact with the resource now.

The management of coastal resources can be complex, so a simpler example is better for illustrating the challenges of assigning value to a resource, in this case, a carton of eggs. What is the value of the eggs? To the person selling the eggs, the value might be the selling price. To the person buying the eggs, the value might be in their nutritional content, their flavor, or in the enjoyment of cooking them. All of these are valid ways of considering the worth of the eggs, but some of them are easier to measure than others.

The different types of value can be grouped broadly into two categories: market and non-market values. Market values are the easiest to calculate, but non-market values are usually more important to estimate if you want to determine the true worth of a coastal resource. Non-market values are categorized according to use. The aggregation of use and non-use values is the "total economic value" of the resource. Unfortunately, non-market values can also be costly and difficult to estimate.

In many situations where economic values are necessary for coastal management, there may not be enough time or money to conduct original research to assign economic values to a resource. A potential solution to this challenge is to use the benefits transfer methodology, which uses values from previous economic studies as approximate values of resources in similar situations.

Market Values

The economic value of some resources can be estimated by considering the market value, which is the net value (benefits minus price) of goods or services that are traded on the market. The most common measures of market value are the amount of money taken in by businesses (revenue) or the number of people with jobs (employment). Also important is the amount that people are paid for their jobs (income).

Generating a snapshot of the economic makeup of an area is one of the basic ways of using market values. To create an economic profile of an area, information such as the types of industry, employment rates, and average incomes is gathered. Although this kind of economic assessment doesn't apply directly to coastal resources, the information can be used to

- Consider potential pressures on coastal resources. Knowing about the types of industry in the area can help when estimating the types of resources that are required by industry to produce goods and services (inputs to production) and how much of the resources will be required. For example, the oil and gas industry requires coastal habitat for platforms and pipelines, uses water for extraction operations, and produces waste.
- Consider potential impacts that resource management actions may have on the local economy, using knowledge about the number and types of jobs as an indicator of how the local population earns its livelihood.

To estimate the market value of coastal resources, the first step would be to estimate direct impact: the sales, income, and jobs directly related to the resource. However, there are other market impacts (indirect and induced impacts) that occur only as a result of the direct impacts. A direct impact is like throwing a stone in a pond, which creates ripples on the water that can then cause additional changes.

For example, people on vacation spend money on a variety of things such as food, lodging, and transportation. These are the direct impacts. To provide these goods and services to the tourists, local firms must purchase other goods and services. For instance, a hotel must purchase items such as telephone service, running water, mattresses, food, and beverages. These purchases are indirect impacts that occur as a result of the direct impact (in this case,

a tourist needing to rent a room). Additionally, the employees in the industries affected by tourism will use their salaries to purchase goods and services; these are induced impacts. If the tourism in the area declines, employees will be laid off, and that may result in a decline in local businesses where the employees spend their salaries. All of these impacts can be calculated in dollar values and used to estimate the market value of the resource.

For coastal management, market values are extremely important ideas. Any management action taken by coastal managers has the potential to affect the local or regional economy. Being familiar with market concepts will not only contribute toward informed decisions—it will also aid in making those decisions more acceptable to those whose livelihoods are potentially affected.

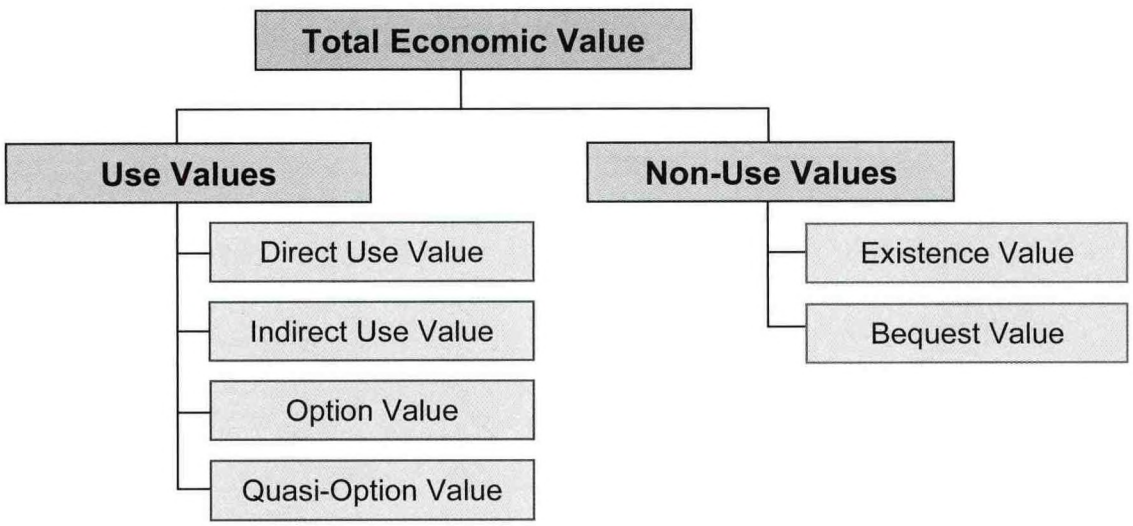
For example, creating no-fishing areas along the coast may help restore fisheries stocks in the area—both in the number of fish and the variety. A decision like this will have some negative effects on the local economy in the near term: commercial fisherman may earn less money, and there may be a decrease in tourism from recreational fisherman. So how can this decision be made acceptable to the local community? Keeping the local fisheries healthy is important to the livelihood of the community, and if it can be shown that this decision will be economically advantageous in the long term as the number of fish increase, the fishing community may be more willing to accept some short-term negative impacts.

Market values are the easiest values to calculate, but often more knowledge is gained about a resource by estimating its total economic value.

Most of the goods and services derived from coastal resources (such as recreation and flood protection) aren't traded on a market.

Total Economic Value

The total economic value of a resource can be calculated by determining the non-market use and non-use values and then adding them all together (as shown in the figure below).



Because it is not always possible to calculate an estimate for all these values (because of time or funding constraints), resource managers usually are not able to estimate total economic value. However, if only some of the values are included, the resource may be undervalued in the assessments.

Non-Market Values: Use Values

Any type of non-market economic value that is related to the usefulness (or consumption) of a resource is considered a use value. These types of value may also be called instrumental values. Typically use values make up most of the total economic value, because they are easier to assign dollar values to than non-use values. However, because use values aren't traded on the market, assigning a dollar value to them is still more difficult than it is for market values.

Four examples of use values are

- **Direct Use Value:** The current use value of a resource, based on using the resource itself. Direct use values are consumptive uses, such as cutting a tree for firewood or harvesting nuts to eat. Most people think of value in terms of direct use of a resource.
- **Indirect Use Value:** The current use value of a resource, based on using the resource indirectly. Indirect use values are non-consumptive uses, such as viewing scenery, hiking in the wilderness, or conserving wetlands that support fisheries.
- **Option Value:** The future use value of a resource. For example, keeping resources, such as a lake, available and pristine for future generations. Option values can include consumptive and non-consumptive uses.
- **Quasi-Option Value:** The potential future use value of a resource. For example, a wetland may be the home of a plant, which we will later discover has medicinal uses. Eliminating the wetland would prevent that medicine from being used, so this is another type of use value that can be estimated—although it is much harder to assign dollar values to quasi-option values.

Because use values aren't traded on the market, economists have developed techniques to assign dollar values to these types of non-market values by estimating people's willingness to pay for an environmental improvement (or their willingness to accept compensation for an environmental degradation).

There are a variety of methods to estimate the non-market value of coastal resources, two of which are briefly discussed below.

Travel Cost Method: This method assigns a value to recreational services provided by coastal resources, using the cost of travel as an approximate for price. A sample of the people who use the resource for recreation are surveyed about the number of trips that they've taken, the costs incurred in travel to the site (such as hotel costs and park entrance fees), and other factors that may affect their demand for the resource (such as income and demographic variables). The survey results are used to estimate the difference between what the consumer paid for the resource and what they would be willing to pay.

When this difference is to the consumer's benefit, it is called the consumer's surplus, and it can be used to approximate the dollar value the consumer places on the resource.

Hedonic Price Method: This method is based on the idea that there is a connection between a public good (such as beaches) and the demand for a private good (such as real estate). Specifically, this method involves creating a model in which, for example, the price of a house relates to the attributes (such as proximity to the beach, distance to a central business district, square footage, and neighborhood characteristics) that might affect price. To use this method, you would look at how one attribute (such as beach quality) would change the price of the house. If a decline in beach quality would lead to a decline in housing prices near the beach, then that dollar value can be used to estimate the non-market indirect use value of the beach.

The feasibility of the hedonic price method depends in large degree, in this case, on the availability of data both on house prices and on the attributes used. Specifically, the way in which the attribute to be valued (such as beach quality) is measured will be extremely important to the accuracy of the results.

As challenging as non-market use valuation may be, the method at least produces concrete illustrations of the value people place on resources. Non-use values are much more obscure, and their estimation is therefore more difficult.

Non-Market Values: Non-Use Values

Any type of economic value that is unrelated to the usefulness (or consumption) of a resource is considered a non-use value.

Non-use values are values that accrue to people who will never use a resource directly, but who still value it.

Two examples of non-use values are

- **Bequest Value:** Value derived through preserving a resource for future generations. This value is based on the belief that people have a responsibility to provide for future generations by curtailing current consumption, including the use of natural resources. Thus, some resources may be conserved, not for the current or future benefit of the person choosing to conserve them, but for the benefit to future generations. Although this type of value is widely understood and acknowledged, it is difficult to incorporate it into a coastal management framework because of the complexity involved with assigning a specific dollar figure to it.
- **Existence Value:** Value derived from the appreciation of something for its own sake, which does not require contact or proximity. For example, some people care deeply about the health of coral reefs in the Northwest Hawaiian Islands—even though they may not ever plan to go there. Existence values are among the most difficult to identify and estimate. Some people believe that existence values are intrinsic values (values that are related to the resource itself, rather than its uses), because existence values are unrelated to human beings altogether (Pearce and Turner 1990). Intrinsic values are just as legitimate as instrumental values, but estimating intrinsic values can be more costly and contentious.

One of the most common methods of estimating non-use values is the contingent valuation method. This method uses a survey that describes the resource being valued and then asks the people taking the survey to indicate whether they would be willing to pay for specific environmental improvements or whether they would accept environmental degradation (Mitchell and Carson 1989). The results from all the survey participants are added together and then divided by the number of participants to find the average value for willingness to pay and willingness to accept. These numbers are then used to estimate the value of the resource by assuming these are the typical responses for everyone who uses the resource—not just the survey participants.

Evaluating Alternatives Using Economic Methods

Economists have developed a number of tools that use measures of value to help choose the goods and services that make people as well off as they can be. Below are three common economic methods that coastal resource managers can use to help evaluate alternative options:

- Benefit-Cost Analysis
- Cost-Effectiveness Analysis
- Incremental Analysis

Weighing Personal Values against Public Values

As discussed earlier, people will each value a resource differently according to how they feel about the resource and how they interact with it. One of the goals of a coastal resource manager is to consider all of those different ideas of value in order to determine a value for the resource that reflects the worth of the resource to the entire group. This is an already challenging task, but it is made harder by *externalities*.

An externality is a benefit received (or a cost paid) by someone who isn't directly involved in an economic transaction. When a resource is being purchased, the natural tendency of the purchaser is to place more importance on the benefits he or she will receive—than on the possible benefits to others.

The ability to impose costs on others (such as those associated with increased pollution) or the inability to be compensated for the benefits provided to others (such as the contributions natural habitat makes to local fisheries) often puts the interests of landowners at odds with those of society at large. The benefits that accrue to society from conserved lands are externalities to the landowner, which tends to tip the balance in favor of development (Krutilla 1967, King 1998, Bennett and Morrison 1999).

Benefit-Cost Analysis: Apples to Apples Comparisons

Use benefit-cost analysis when

- There are two or more alternative options about how to manage a resource, and
- Dollar values can be assigned to all the benefits and costs.

Here's an example: A port city wants to decide if the benefits of a deeper harbor outweigh the costs associated with deepening and maintaining the harbor. To begin the analysis, the city would need to identify all the benefits and costs associated with the alternative options—in this case, to deepen the port or keep it as is. The benefits and costs should cover the entire scope of the project, including design, implementation, and maintenance. Some sample benefits and costs for one alternative are shown below.

Alternative 1: Deepening the Port

Costs	Benefits
Administrative overhead (e.g., designing the plan, getting permits, overseeing the operation)	Larger, more efficient ships can use the port
Dredging equipment	Lower cost of imported goods
Contractors to run the equipment	Lower shipping costs for exported goods
Sediment disposal costs	Fewer tidal delays
Adjustments to port facilities to allow for larger ships and increased traffic flow (such as adding additional docks and port personnel)	Fewer accidental groundings
Maintenance costs to keep the sediment from building up again	Increased volume of cargo can be handled with existing port facilities

In this type of analysis, as many costs and benefits as possible should be considered, but there may still be some unintended results. For example, deepening the harbor might release toxic chemicals trapped in the sediment, impact marine life, increase noise and local pollution (from increased ship traffic), or decrease global pollution (from more efficient ships). Sometimes these items can be foreseen, but they are often hard to measure. These externalities tend to be underrepresented in benefit-coast analyses.

Once the benefits and costs have been identified, dollar values should be assigned to all of them. One way to conduct a benefit-cost analysis is to calculate a benefit-to-cost ratio based on dollar values for each alternative option, and then compare those ratios to determine the most effective alternative.

Long-Term Dollar Values Must Be Discounted

The dollar values associated with long-term costs and benefits need to be adjusted, because a dollar received today is considered more valuable than one received in the future. Applying a discount rate helps to ensure that dollar values associated with long-term costs and benefits can be compared equally against the values of short-term cost and benefits.

The discount rate is the rate at which society as a whole is willing to trade off present for future benefits, and it helps to account for inflation and other factors. However, determining the discount rate can be a source of controversy, so it should only be calculated by someone with an economics background.

For more information, see *www.csc.noaa.gov/coastal/economics/discounting.htm.*

Cost-Effectiveness Analysis: Apples to Oranges Comparisons

Use cost-effectiveness analysis when

- There are two or more alternative ways to achieve the same goal or to produce the same type and level of results, and
- It isn't possible—or practical—to assign dollar values to all of the benefits.

Cost-effectiveness analysis allows people to compare different alternatives, even when dollar values can't be applied to the benefits. That is, it allows the comparison of items with a dollar value (apples) to items without a dollar value (oranges).

To use this method, the dollar values for all the costs associated with each alternative would be estimated. If there are short-term and long-term values, the long-term values will need to be discounted so that all the costs can be added together to get the total cost for each alternative. Since all the alternatives yield similar outcomes, there is no need to estimate their dollar value; the most cost-effective means of achieving the desired outcome is chosen.

If the alternatives are significantly different in scale, this method can't be used to identify the best alternative. However, it can still allow cost considerations to be incorporated into the decision-making.

Here's an example: A dam is blocking several types of salmon from travelling upriver to spawn, which has resulted in a decrease in the salmon population and decreased tourism in the area because of fishing restrictions. The resource manager in charge of the fisheries wants to determine the best method to ensure that specific types and numbers of salmon can get upriver. The manager can use a cost-effectiveness analysis to determine which method is the least-costly means of achieving this goal—without having to assign dollar values to the benefits associated with the improvements to the fisheries stock.

Incremental Analysis

Use incremental analysis when

- Alternatives will produce similar benefits, and
- Alternatives differ primarily in the amount (or size) of the benefit.

Instead of assigning dollar values to the benefits (as would be done in a benefit-cost analysis), this method only requires that the benefits be quantified in some manner, such as the amount that different alternatives would decrease phosphate in the water. Next, all the costs associated with the alternatives would be considered to determine which alternative was the most cost-effective for the benefits it produces. Like the other methods discussed, long-term costs need to be discounted.

Here's an example: A plan has been proposed to restore the salinity of a wetland. This plan includes several different components, like replacing undersized culverts and reopening several of the original channels. The groups funding the project want to know how cost-effective each component is, so that they can determine if any should be eliminated from the plan.

To make this determination, they perform a cost-effective analysis for each component that is being considered. Each component has the same benefit (restoring the salinity of the wetland), so it is not necessary to estimate the monetary value of the expected salinity changes. Instead, they need only to estimate the salinity change (benefit) and monetary cost of each component and convert these to some meaningful ratio (degree of change per dollar). If any component provides too little benefit to justify the cost, it can be eliminated from the plan (or replaced with a better option).

Case Studies

Three case studies are summarized on the following pages to illustrate how economic methods are applied to coastal resource management in practice:

1. Estimating Non-Market Values of Coastal Marshes (Whitehead and others 2006)
2. The Value of a Coastal Wetland (Barataria-Terrebonne NEP 1996)
3. Management of a Man-Made Lake (Washington State 2007)

Note: The economic methods and concepts discussed in this document are only a brief introduction to this field of study. The case studies on the following pages include real-life examples and a few terms that haven't been discussed. These terms are defined in the glossary.

Case Study 1: Estimating Non-Market Values of Coastal Marshes

Saginaw Bay is an extension of Lake Huron that separates Michigan's "thumb" from the rest of the Lower Peninsula. The watershed that drains into Saginaw Bay is Michigan's largest, encompassing nearly 9,000 square miles and including at least part of 22 counties. It is home to 1.4 million people.

The Saginaw Bay watershed is rich in resources that support agriculture, manufacturing, tourism, and outdoor recreation. Its resources also provide habitat for a wide variety of wildlife, including songbirds, waterfowl on the Mississippi Flyway, and 138 threatened or endangered species.

People care about all these things, which places many—often competing—demands on the resources of the watershed. Making good choices about how to meet those demands requires a careful assessment of a wide range of trade-offs. In each decision, resource managers must assess what will be gained and what will be given up.

Resource management decisions are further complicated by the fact that some of the goods and services supported by the watershed resources are commonly bought and sold, and some are not. For example,

- It is relatively easy to assess the value of the sugar beets and auto parts that are produced in the watershed. People's willingness to pay for these items, one of the best measures of value, is demonstrated in the marketplace every day. Data are collected by businesses, reported to the government, and continuously analyzed by researchers and industry experts.

- It is much harder, though, to assess the value of bird-watching or of preserving endangered species whose existence is not widely known and whose ecological significance is not widely appreciated. These non-market goods and services have real economic value, which may be significant. However, because no one pays for them (or earns money on them), their value is often treated as zero in public decision-making.

Luckily, resource managers can use economic tools and methods to estimate the value of non-market goods and services to compare them alongside market values. This will allow managers to avoid trading things that are worth more to the community for things that are worth less.

In 2005, a study was conducted to estimate the value of wetlands in Saginaw Bay. The study used two variations of the travel cost method to estimate the recreation values of Saginaw Bay coastal marshes by looking at the money spent by people who use a "free" resource as they travel to and from the site:

- The first variation looked at visits to a single site to determine the factors that influenced the number of visits to that site. This information was used to estimate the total value of Saginaw Bay marshes to recreational users using travel costs as an approximate.
- The second variation looked at the number of recreational sites available for use and assessed the cost and other factors that influenced which site was chosen. This information was used to estimate the value of adding to the existing acreage available for recreational use.

Each year Saginaw Bay wetlands provide $16 million of non-market benefits to recreational users, yielding a total value of $239 million.

However, the study also found that the value that people place on these wetlands is not limited to their recreational use. For example, people place a value on the preservation of threatened and endangered species of wildlife.

One of the survey questions asked people how much they would give in a one-time donation to a hypothetical "Saginaw Bay Coastal Marsh Trust Fund" to avoid the loss of specific non-market goods. Resource managers were able to use the contingent valuation method to use the responses to this question to estimate the value of preserving additional wetlands (or the cost of losing

them). They estimated an additional value of Saginaw Bay wetlands to be about $3,600 per acre—less than half of which accrues to recreational users.

The remaining value of the wetlands represents the value to the public of the other non-market goods and services provided by the wetlands. The study concludes that, "[a]s wetlands are lost, these values are lost."

Case Study 2: The Value of a Coastal Wetland

Coastal wetlands are one of the nation's most valuable resources, providing direct values (such as recreation) and indirect values (such as flood protection). Often, wetlands are also valued for their development potential. How do practitioners assign dollar values to these very different benefits?

The Barataria-Terrebonne estuarine system offers an example. These extensive wetlands are a valuable source of oil and gas, and they are also valued for fishing, hunting, and wildlife viewing. State officials were interested in placing a dollar value on these wetlands for two reasons:

- To compare the estimated costs for conserving the system's resources to the benefits associated with the conservation effort
- To help people see that protecting these resources can be economically beneficial in the long term

Once the types of values to be investigated were defined, several methods were used to estimate dollar values:

- Benefits transfer was used to estimate the value of recreational services. From a non-market value perspective, the economic benefits accruing from recreational activities ranged from $327 million to $1 billion.
- IMPLAN (Impact Analysis for Planning), a regional economic model, was used to estimate the market value of estuary-dependent industries to the local economy. Examples of estuary-dependent industries include oil and gas production, aquaculture industries, and commercial fishing, hunting, and trapping. The estuary's role in the commercial economy was about $3.5 billion (of which about $2.3 million was from oil and gas production).
- Avoided cost method was used to estimate the value of other wetland services on an annual, per-acre basis. Examples include protection from hurricane damage ($186), storm surges ($280 to $904), damage to the water supply ($84 to $157), and property losses from inundation ($6,599 to $7,116).

The results of this study (all in 1994 dollars) show an extremely valuable resource with a diverse set of services. These results have been used to evaluate management options and justify conservation efforts, which in some cases resulted in curtailing certain economic activity and completing other measures to ensure that the region's way of life could be sustained.

Case Study 3: Restoration of a Man-Made Lake to an Estuary

Capitol Lake provides a reflecting surface for the Washington State Capitol Building. This man-made lake was created in 1951 by building a dam on the Deschutes River, which prevents the water in the river from flowing into Budd Inlet and Puget Sound. Maintaining the artificial lake has caused several problems, including sedimentation, invasive species, and compromised water quality.

The state officials in charge of maintaining the lake wanted to evaluate the feasibility of restoring Capitol Lake to its original estuary state. To determine the best way to manage this resource, they wanted to know how much it would cost to keep maintaining the lake and how much it would cost to eliminate the lake. Some of the costs (such as removing the dam) were easy to estimate, while others (such as decreased aesthetic value and recreational services) were more complicated to estimate.

To better understand the restoration options, economists used the following process:

- Establish the geographic scale of the study (that is, the areas that are going to be impacted)
- Identify the existing conditions of the lake
- Assemble information about the physical or biological changes that estuary restoration would cause
- Determine general economic effects (both quantitatively and qualitatively) of those physical or biological changes

This process was used to determine the economic impacts of restoration on infrastructure (including ports), tourism, and the categories of ecosystem services denoted in the Millennium Ecosystem Assessment. Primarily, the benefits transfer and avoided cost methods were used to determine the costs of estuary restoration.

In general, the results were a mixture of qualitative and quantitative results—and they weren't easy to compare. In the end, the investigation team decided to look at each category individually and determine whether the economic impact from estuary restoration was

- Positive
- Negative
- Unknown (not enough information about future conditions to make a determination of the economic impact)
- Divergent (there are strongly held perspectives in the community on whether the change is positive or negative, but there is insufficient information to determine the absolute direction of the net effect)

Several phases of the feasibility study are complete, but there is still more information to collect before a decision about the potential estuary restoration can be made. Having a better understanding of the economic benefits for a wide variety of ecosystem services will help the community make a better-informed decision.

Conclusion

This document provides a brief overview and examples of some of the economic tools used by those who manage coastal resources.

Although application of economic principles to environmental choices can be challenging and costly, the use of these tools can go a long way toward making sure the community is as well off as possible from a social, economic, and environmental perspective. When the community knows the complete value of a resource, it is less likely that decisions will be made that result in valuable resources being traded for less valuable ones.

Glossary of Economic Terms

Avoided Cost Methodology – An approach to estimate the economic value of environmental services from the cost of avoiding damages caused by lost services or the cost of providing substitute services.

Benefit-Cost Analysis – A method for comparing the benefits and costs of alternatives whose effects can be well represented in monetary terms.

Benefits Transfer – An approach to estimate economic values by borrowing estimates for environmental goods or services and applying them to the same goods or services in a new location or setting.

Bequest Value – The value derived through preserving a resource for future generations.

Consumer's Surplus – The aggregate of the net of what someone has to pay for a good or service and what he or she would be willing to pay.

Contingent Valuation – A method for estimating non-use values using a survey to determine what people would be willing to pay for specified changes in the quantity or quality of the resource—or, more rarely, what they would be willing to accept in compensation for a decline in the quantity or quality of the resource.

Cost-Benefit Analysis – See Benefit-Cost Analysis.

Cost-Effectiveness Analysis – A method for comparing alternatives to determine the most cost-effective means of producing a result of a specified type and level.

Direct Impact – The amount of the increased purchase of inputs used to manufacture or produce the final goods and services purchased by visitors.

Discounting – Adjusting values to account for time preference.

Discount Rate – The weighting factor applied to values to account for time preference.

Ecosystem Services – Services (such as filtering and purifying runoff water) provided by natural resources that are beneficial to people.

Existence Value – The value derived from knowing that resources exist in a certain state. It is the appreciation of something for its own sake, which does not require contact or proximity.

Externality – Benefits received (or costs paid) by someone who isn't directly involved in an economic transaction (such as the view that is enjoyed by those who live near a forest or the impacts of water pollution on the populations downstream from a factory).

IMPLAN – IMPLAN (Impact Analysis for Planning) is an economic impact modeling system that estimates the multiplier effect of a change in demand in order to derive the total economic impact to an economy (in terms of revenue, employment, income, and value added). IMPLAN was originally developed by the U.S. Department of Agriculture, Forest Service.

Incremental Analysis – A method for comparing alternatives that have similar outputs in order to rank them according to their cost-effectiveness.

Indirect Impact – The value of the inputs used by firms that are called upon to produce additional goods and services for those firms first impacted directly by spending.

Induced Impact – Result from the direct and indirect effects of spending. Induced effects are related to persons and businesses that receive added income as a result of local spending by employees and managers of the firms and plants that are impacted by the direct and indirect effects of direct spending. This added income results in increased demand for goods and services and, in turn, increased production and sales of inputs.

Inputs to Production – The resources used in producing goods and services, including land, labor, and capital.

Instrumental Value – Refers to something that is valued because of its usefulness, or because it provides a means to some other goal.

Intrinsic Value – Refers to something that is valued for its own sake.

Market Value – The net value (benefits minus price) of goods or services that are traded on the market.

Non-Market Value – The net value (benefits minus price) of goods, services, or states of nature not traded on the market (such as a day of fishing). The price is often approximated by looking at the cost of travel (see Travel Cost Method).

Non-Use Value – Economic value unrelated to use or consumption. Non-use values may include existence values, option values, quasi-option values, or bequest values.

Option Value – Values based on the option to use coastal resources in the future.

Quasi-Option Value – Values based on the potential option to use coastal resources in the future—even though the values may not yet have been identified. The value would be lost if the resource is diminished (or not preserved).

Time Preference – People's tendency to care more about today's consumption than tomorrow's and to believe that we will be better off in the future than we are today.

Total Economic Value – The sum of use and non-use values.

Travel Cost Method – A methodology that relies on travel-related costs as a proxy for price in a non-market valuation analysis in order to estimate net economic values.

Use Value – Economic value related to use or consumption. Use values may include both direct, consumptive uses (such as cutting a tree for firewood) and indirect, non-consumptive uses (such as viewing scenery).

Willingness to Accept – How much people say they would be willing to accept in exchange for foregoing an environmental improvement (or accepting a decrease in environmental quality). This is useful when trying to estimate non-market values.

Willingness to Pay – How much people say they would be willing to pay for an environmental improvement (or to avoid a decrease in environmental quality). This is useful when trying to estimate non-market values.

References

Barataria-Terrebonne National Estuary Program (NEP). 1996. *Economic Value Assessment for the Barataria-Terrebonne Estuarine System.* Barataria-Terrebonne National Estuary Program. Thibodaux, LA.

Bennett, J., and M. Morrison. 1999. "Valuing Wetland Rehabilitation." *An International Perspective on Wetland Rehabilitation.* Pages 217 to 224. Kluwer Academic Publishers. Dordrecht, the Netherlands.

Boyd, J., J. Sanchirico, and L. Shabman. 2004. "Habitat Benefit Assessment and Decisionmaking: A Report to the National Marine Fisheries Service." Resources for the Future. Washington, D.C.

English, D.B.K., W. Kriesel, V.R. Leeworthy, and P.C. Wiley. 1996. "Economic Contributions of Recreating Visitors to the Florida Keys/Key West." National Oceanic and Atmospheric Administration. Silver Spring, MD.

King, D. 1998. "The Dollar Value of Wetlands: Trap Set, Bait Taken, Don't Swallow." *National Wetlands Newsletter.* Volume 20. Number 4. Pages 7 to 11.

Krutilla, J.V. 1967. "Conservation Reconsidered." *The American Economic Review.* Volume 57. Pages 777 to 786.

Mitchell, R.C., and R.T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Resources for the Future. Washington, D.C.

Pearce, D.W., and R.K. Turner. 1990. *Economics of Natural Resources and the Environment.* The Johns Hopkins University Press. Baltimore.

U.S. Army Corps of Engineers (USACE). 2008. "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies." Accessed April 27, 2009, at *www.usace.army.mil/CECW/Documents/pgr/pg_draft.doc.*

Washington State. General Administration. 2007. "Capitol Lake Adaptive Management Plan." Accessed May 12, 2009, at *www.ga.wa.gov/CLAMP/Plan.htm.*

Whitehead, J.C., P.A. Groothuis, R. Southwick, and P. Foster-Turley. 2006. "The Economic Values of Saginaw Bay Coastal Marshes." Department of Economics. Working Papers 06-10. Appalachian State University. Boone, NC.

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