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Economic Tools for Use in Coastal Management Decisionmaking

Several types of economic information are useful for coastal decisionmaking. Environmental value is important in some of these: benefit-cost analyis, natural resource damage assessments and sustainable development assessment. Other kinds of information such as economic impact analysis are often confused with value measures, but provide different information to the decision process.

Economic Tool Kit

- Economic Impact Analysis
- Cost-Effectiveness Analysis
- Benefit-Cost Analysis
- Natural Resource Damage Assessment
- Sustainable Development

Coastal management and policy decision making requires information that ranges widely from land-use impacts on natural resources to economic implications of changes to terrestrial and aquatic ecosystems. While the availability of accurate information does not mean that such decision making will necessarily be good, it is clear that the lack of accurate information will almost always contribute to uninformed decisions.

While the focus of this handbook is on environmental valuation, namely, determining the dollar value of natural and environmental resources and resource services, it is important for coastal managers and planners to recognize a variety of alternative economic approaches to generating and presenting economic information. Each approach calls for different skills and research procedures, and each is intended to answer a different question.

Which of these economic approaches planners choose depends on what they want to know. This chapter provides a brief review of the most important economic approaches that can be applied to coastal zone planning and management.

ECONOMIC IMPACT ANALYSIS

Economic impact analysis is a methodology for determining how some change in regulation, policy, or new technological breakthrough, or other action affects regional income and other economic activities including revenues, expenditures, and employment. Economic impact analyses can be focused at any level, for example:

- Local environmental groups may want to assess the impact of a wetlands law on the rate of population growth and tax base in their community
- Regional groups might need to understand the impacts of a national regulation on their particular economic circumstances
- International agencies might be interested in how efforts to control CO_2 emissions might impact the relative growth rates of rich and poor countries

To begin with, we must first distinguish economic activity from economic value. Companies supporting the worth of a proposed development plan, for example, will often cite figures on sales volume or increases in jobs. They may claim that the new development will boost sales of other companies. These numbers are measures of eco-

nomic activity; they are not measures of social value, or what things are worth to people (see Chapter 2, Concepts in Environmental Valuation). Techniques for measuring the economic or market activity that such development generates is sometimes called economic impact analysis.

If a new establishment moves into a region, economic impact analysis would measure the impact or effects of this new establishment on other businesses. Assume the establishment hires local workers, buys products from local suppliers, and purchases transportation facilities or other services. The individuals and firms that the new establishment buys from may then increase their purchases from other suppliers. Economic activity, then, measures the additional income that is generated by the new spending.

Economic impact analysis does not account for social benefit or value. It does not account for what is being given up, nor what alternatives are foregone (i.e., opportunity costs). For example, an impact analysis of recreational fishing does not contain an analysis of what people would do with their time and money if, as the result of a fishery closure or moratorium, they couldn't go fishing. Would they go bowling instead of fishing? If so, would they generate more or less economic activity in the alternative activity? In addition, impact analysis does not take into account anything that is not traded on the market.

Economic Impact Vs. Social Value

Natural disasters offer examples of why economic activity is not a measure of social value. Most people would have considered society better off had Alaska's Exxon Valdez oil spill not occurred. Likewise, society would have been better off had Hurricane Andrew not hit south Florida. However, each of these disasters generated increased amounts of economic activity. A good deal of money changed hands in the form of increased demand for services, oil spill cleanup employment, construction, sales of plate glass and household supplies. While no one would claim that society benefited as a whole (clearly some individuals and businesses did), the economic impact of these events was positive.

While these expenditures represent revenue to a local community, they also represent costs to the recreationists. Furthermore, expenditures do not measure the loss of value to the angler that would result should fishing no longer be available in an area, or the gain in value to the angler that results from establishing a new fishing opportunity. From a broader perspective, increased fishing activity in one area may generate more expenditures within that area but may also mean an offset of activity and, therefore, expenditures in another area. As a result, the net gain in economic activity between areas may be zero, or even negative.

COST-EFFECTIVENESS ANALYSIS

Cost-effectiveness analysis is a methodology that can be applied whenever it is unnecessary or impractical to consider the dollar value of the benefits provided by alternatives under consideration (e.g., each alternative has the same benefits expressed in monetary terms or each alternative has the same effects but dollar values have not been assigned). A project is cost-effective if it is determined to have the lowest cost of competing alternatives in present value terms for a given amount of benefits.

Suppose a community determined that its current water supply was contaminated with some chemical, and that it had to switch to an alternative supply. Assume there are several possibilities: the community could drill new wells into an uncontaminated aquifer, it could build a connector to the water supply system of a neighboring town, or it could build its own surface reservoir. A cost-effectiveness analysis would estimate the costs of these different alternatives with the aim of showing how they compared in terms of, say, the costs per million gallons of delivered water into the town system.

A cost-effectiveness modeling approach avoids the issue of evaluating benefits by setting desired objectives beforehand and searching for the lowest-cost ways of achieving these. Such an approach can facilitate the comparison among alternative policy or management plans. Cost-effectiveness analysis can help you eliminate those actions that cost more than equally, or less, effective alternatives or those actions that cost the same as more effective options. Such an approach also allows decision makers to build a "frontier" of cost-effective actions that highlights the higher marginal costs associated with different alternatives.

It may make good sense to do a cost-effectiveness analysis even before there is a strong public commitment to the objective you are costing out. In many cases, it may not be obvious how much people value a given objective. Once a cost-effectiveness analysis is done, they may be able to tell, at least in relative terms, whether any of the different alternatives would be desirable. They may be able to say something like: "We don't know exactly how much the benefits are in monetary terms, but we feel that they are more than the costs of several of the alternatives that have been costed out, so we will go ahead with at least one of them."

BENEFIT-COST ANALYSIS

Benefit-cost analysis is a methodology that compares the present value[3] of all social benefits with the present value of opportunity costs in using resources. It can give valuable insights into the economic efficiency of management and regulatory actions. If the net value (benefits minus costs) of a project or action is greater than zero, then the that project is considered to be economically efficient. The more the benefits exceed the costs, the better off society is in economic terms as a result of the activity.

It is important to note at the outset that the basic benefit-cost framework has limitations, among them, determining the discount rate of future costs and benefits, discounting and future generations, distributional issues, uncertainty and risk, and irreversibility; these factors will be discussed further in Chapter 7, Theory and Application: Reconciling Differences.

Despite these limitations, benefit-cost analysis is the major tool for conducting economic evaluation of public programs in natural resource management, such as flood control, irrigation, hydropower, harbor improvements, and alternative energy supply projects. It is a four-step process that includes the following elements.

► ***SPECIFY THE PROGRAM.*** Benefit-cost analysis is a tool of public analysis, though there are actually many publics. Thus, the first step is to decide on the perspective from which the study is to be done. If you are doing a benefit-cost study for a national agency, the "public" normally would be all the people living in the particular country. But if you are employed by a city or regional planning agency to do a benefit-cost analysis of a local environmental program, you would undoubtedly focus on benefits and costs accruing to people living in those areas. The first step also includes a complete specification of the main elements of the project or program: location, timing, groups involved, connections with other programs, etc.

► ***DESCRIBE QUANTITATIVELY THE INPUTS AND OUTPUTS OF THE PROGRAM.*** For some projects, determining the input and output flows is reasonably easy. In planning a wastewater treatment facility, the engineering staff will be able to provide a full physical specification of the plant, together with the inputs required to build it and keep it running. For other types of programs, such determinations can be much harder. A restriction on development in a particular region, for example, can be expected to deflect development

Benefit-Cost Analysis is a Four-Step Process

- **Specifiy the project or program and alternatives.**
- **Describe quantitatively the inputs and outputs of the program.**
- **Estimate the social costs and benefits of inputs and outputs.**
- **Compare benefits and costs.**

[3] Field, B.C. 1994. Environmental Economics. McGraw-Hill, Inc., New York.

Benefit-cost analysis involves measuring, adding up, and comparing all the benefits and all the costs of a particular public project or program.

elsewhere into surrounding areas. In this step, we first have to recognize the great importance of the time it can take to complete large undertakings: environmentally related projects or programs may require years. Therefore, the job of specifying inputs and outputs involves predictions of future events, sometimes many years after a project begins. Consequently, having a good understanding of factors such as future growth patterns and future rates of technological change and possible changes in consumers' preferences is important.

► **Estimate Social Costs.** Assigning economic values to input and output flows is to measure costs and benefits. The methods for such measurements are the subject of Chapter 4, Measuring the Value of Goods and Services Traded in Markets and Chapter 5, Measuring the Value of Non-Market Goods and Services.

► **Compare Benefits and Costs.** In this final step, total estimated costs are compared with total estimated benefits. Table 3.1 illustrates the estimated benefits and costs associated with a regulatory program to control various airborne and waterborne pollutants coming from a group of marinas.

Table 3.1. Results of a Benefit-Cost Analysis of a Proposed Emission Reduction Program for a Group of Marinas

	Totals over life of the program ($ millions)
Costs	
Private compliance	
Capital equipment	**580**
Operating	**560**
Public monitoring and enforcement	**96**
Total	**$1,236**
Benefits	
Increased benefits to recreators from improved water quality	**1,896**
Increased property value from reduced air emissions	**382**
Nonuse value increase related to ecological integrity	**749**
Total	**$3,027**
Net benefits	**$1,791**

Guidelines for Benefit-Cost Analysis that Incorporate Environmental Valuation

While legislation requires net economic benefit analysis, and there are clear applications for environmental valuation, the guidelines for actually doing such an analysis are limited. The two most widely referred to guidelines are the following:

▸ WATER RESOURCES COUNCIL. ***The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, 1983,*** **is the latest in a series of guidelines published by the Water Resources Council under the Water Resource Planning Act. It provides the required guidelines to be used for estimating the benefits and costs of constructing a public works project. The early versions of these guidelines first codified the use of applied welfare economics in evaluating public projects. The guidelines establish the elements that need to be taken into account when assessing the benefits and costs of a project, and incorporate the concepts of consumer and producer surplus measures in markets, as well as their counterpart in non-market settings. Unfortunately, the methodological prescriptions are somewhat out of date.**

▸ ENVIRONMENTAL PROTECTION AGENCY. The Environmental Protection Agency's *Guidelines for Performing Regulatory Impact Analysis*, 1991, provides the latest set of guidelines for performing benefit-cost analysis on proposed environmental regulations, as mandated by Executive Order 12291. These guidelines are, for the most part, quite good and are continually being revised to reflect methodological advances. The focus is on measuring and valuing both health and environmental effects. Techniques for valuing the benefits of environmental improvements include travel cost, hedonics, and contingent valuation. The guidelines show an awareness of distributional considerations, both across the current population and between generations.

These emissions reduce the water quality in the bay on which they are located and contribute to air pollution in the vicinity of the marinas. The dollar values are totals of various cost and benefit categories over the life of the regulatory program. Compliance costs in the industry consist of $580 million of capital equipment costs and $560 million of operating costs. Public-sector monitoring and enforcement required to achieve an acceptable level of compliance total $96 million. There are three major benefit categories: recreationists (fishers and boaters) benefit from improved water quality at an estimated value of $1,896 million; property values of local homeowners are expected to increase to $382 million because of improved air quality and visibility resulting from reduced airborne emissions;

nonuse values associated with the general improvement in the ecological integrity of the bay are estimated at $749 million.

We can compare total benefits and costs in several ways. One way is to subtract the total costs from total benefits to get "net benefits." In Table 3.1, the net benefits are $1,791 million ($3,027 minus $1,236). Another criterion is the benefit-cost ratio, found by taking the ratio of benefits and costs. This shows the benefits the project will produce for each dollar of costs; the benefit-cost ratio is 2.5 ($3,027 divided by $1,236)

NATURAL RESOURCE DAMAGE ASSESSMENT

Natural resource damage assessment is a methodology for determining the liability for injury to natural assets that results from release of oil or hazardous substances. Three federal statutes — the Clean Water Act, CERCLA, and the Oil Pollution Act — all impose liability assessments for injury to natural assets that result from oil spills or hazardous wasters and other substances. Under these acts regulations for comprehensive natural resource damage assessments have been developed by the Department of the Interior and NOAA. The process includes three steps: (1) injury determination; (2) quantification of service effects; and (3) damage determination. Environmental valuation plays a role in the latter step. Natural resource damages are the sum of:

- Restoration costs
- Compensable value (diminution in value of foregone natural resource services prior to restoration)
- Damage assessment costs

► **RESTORATION COSTS** (which also include costs of rehabilitation, replacement, and/or acquisition of equivalent resources) include both direct and indirect costs. Direct costs are costs charged directly to the conduct of the selected alternative, such as staff time, materials, equipment, and the like. Indirect costs are costs of activities or items that support the selected alternative but cannot be directly accounted for, such as overhead.

► **COMPENSABLE VALUE** is the amount of money required to compensate the public for natural resource services losses between

the time of the release and the time when these services are fully restored to their baseline condition. Compensable value excludes any losses associated with secondary economic impacts resulting from the release, such as losses incurred by businesses patronized by users of the injured resources (e.g., bait and tackle shops).

► **Damage Assessment Costs** are the costs of peforming the studies to determine the other costs mentioned above.

SUSTAINABLE DEVELOPMENT ASSESSMENT

Sustainable development — development that meets the economic needs of the present without compromising the ability of future generations to meet their economic needs — links two basic ideas: ecological sustainability, which implies that biological elements (including humans) and processes that keep ecosystems productive and resilient, should be maintained; and economic development, which seeks to maintain economic growth or expansion, should be undertaken.

Ecological sustainability and economic development must be linked when implementing policies that would lead to sustainable development. The ability to implement such policies requires multidisciplinary approaches which blend the perspectives, the goals, and objectives of disciplines such as ecology, social science, and economics.

Determining the value of natural resources and environmental assets in the sustainable development framework is useful in a number of ways, including:

- National and regional income accounting
- Strategic benefit-cost analysis
- Project level benefit-cost analysis

► **National and Regional Income Accounting.** Environmental values may be used to modify national income accounts so that they reflect improvements and declines in environmental resources. The objective is to obtain a better index of economic well-being and avoid net loss transfers of wealth between the market and non-market sectors. Standard gross domestic product (GDP) accounts reflect only a portion of a nation's economic productivity (the portion traded in ordinary markets). Using standard accounts, a

county or region could destroy its resource base but show an increase in wealth. For sustainable development to be operational in economic policy, environmental accounts and standard economic accounts must be integrated.

► **Strategic Benefit-cost Analysis.** The objective of strategic benefit-cost analysis is to set priorities and make trade-offs across a range of alternative policies. Such analysis is motivated by the economic consequences of environmental investments. For instance, strategic analysis may assess the benefits of investments in salmon habitat restoration relative to nonpoint source pollution controls. Alternatively, such an analysis may respond to questions such as, "How much should we clean up? What level of investment should we make in nonpoint source pollution control or salmon habitat restoration?" Beneficial policies are selected and put together to construct an overall policy package or agenda.

► **Project-Level Benefit-Cost Analysis.** Examines the benefits and costs of specific policy actions and controls and extends conventional benefit-cost procedures to the non-market sector. This extension is increasingly common in development decisions. For example, a study might estimate a household's willingness to pay to hook up a centralized sewer system in order to reduce nonpoint source pollution. In controlling nonpoint source pollution, project-level analysis examines the benefits and costs of specific actions. It addresses the means and methods of control once the general direction of policy is set.