4. UNDERSTANDING THE TOOLS: A SUMMARY OF METHODS FOR CHARACTERIZING THE GAINS AND LOSSES

The purpose of Chapter 4 is to provide the reader with an overview of "social science" methods and a basic understanding of their relative advantages and disadvantages. The descriptions are intended to help the reader gauge which methods might be applicable to his or her situation. Rather than providing detailed instructions on how to apply each method, the chapter references other sources that provide further detail. In most cases, the assistance of qualified experts should be sought to select and implement the most appropriate method for eliciting preferences. The information provided in this chapter, along with the general framework for evaluating management options and the conceptual models described in Chapter 3, can be used to inform and improve the decision-making process for WQS. A common goal of these methods is to help decision-makers better understand the insights, perceptions, attitudes, objectives, and preferences of relevant stakeholders in the affected community and to apply this information to improve policy decisions. Using the term *affected community* implies that decision-makers should consider those individuals impacted by the use-attainment decision. However, according to the *Interim Economic Guidance*, the relevant geographic area must include the water segment under consideration, but no rules exist for defining the community (U.S. EPA, 1995). It is up to the applicant and state, but U.S. EPA must review the decision.

This may not capture the relevant community for the process presented in this report. U.S. EPA (2002) suggests that the community is defined by both the people and the place. The people might be connected by social interaction or a common activity while the place might be based on a geographic setting or political boundary.

In the economic literature, determining the "market area" is a similar problem to determining the relevant community. Freeman (1993) points out that determining the market area is an important research question, but the significance of the resource can help determine the geographic area. Loomis and Gonzalez (1996) examine this empirical question and find that not including nonresident values for reducing wildfires to protect habitat in California and Oregon will understate the total benefits by 80%. Pate and Loomis (1997) find that the extent of the market might be based on total cost of the program and who will bear those costs. Understanding who is in the relevant community is not easy to determine and not likely to have a right answer,

but it must be considered part of the process to avoid problems created by the use attainment decision.

This chapter divides the social science methods into two main categories: sociocultural and economic methods. As discussed in more detail in the chapter, the main distinguishing feature of economic assessment methods is that they are based on a common conceptual framework for evaluating the human welfare effects and the benefit-cost trade-offs involved in policy decisions (i.e., for conducting economic analyses). Sociocultural assessment methods, in contrast, provide a number of alternative perspectives and approaches for eliciting, evaluating, and applying community preferences and stakeholder input in the decision-making process.[1] Applying these methods to support WQS decisions is consistent with EPA's stated interest in more fully and effectively using the knowledge base from social and behavioral sciences in environmental decision-making (NRC, 2005).

To present the social science methods, the chapter begins in Section 4.1 by defining a general decision-making process for WQS and identifying the stages in the process where these methods can be applied most effectively. It presents several specific sociocultural and economic methods and describes some of their distinguishing features. Section 4.2 then identifies and describes the information and data collection approaches that are used to support the assessment methods.

Section 4.3 provides more detailed discussion and comparisons of the sociocultural and economic methods. It describes the types of data collection techniques required for each method. It also compares and rates each method according to "cost/complexity"—relating to the time, data, resources, and specialized technical skills required to implement the method. The section then provides a short (one to two pages) description of each method, including a discussion of the advantages and disadvantages of the method, the types of outcomes associated with their application, and a brief example of their use.

4.1. APPLYING SOCIAL SCIENCE METHODS TO THE DECISION-MAKING PROCESS FOR WQS

Figure 4-1 illustrates, in general terms, the decision-making process for setting WQS. It builds on the process illustrated in Figure 3-1 by specifically highlighting areas where social

[1] A key resource for these methods and this chapter was U.S. EPA (2002).

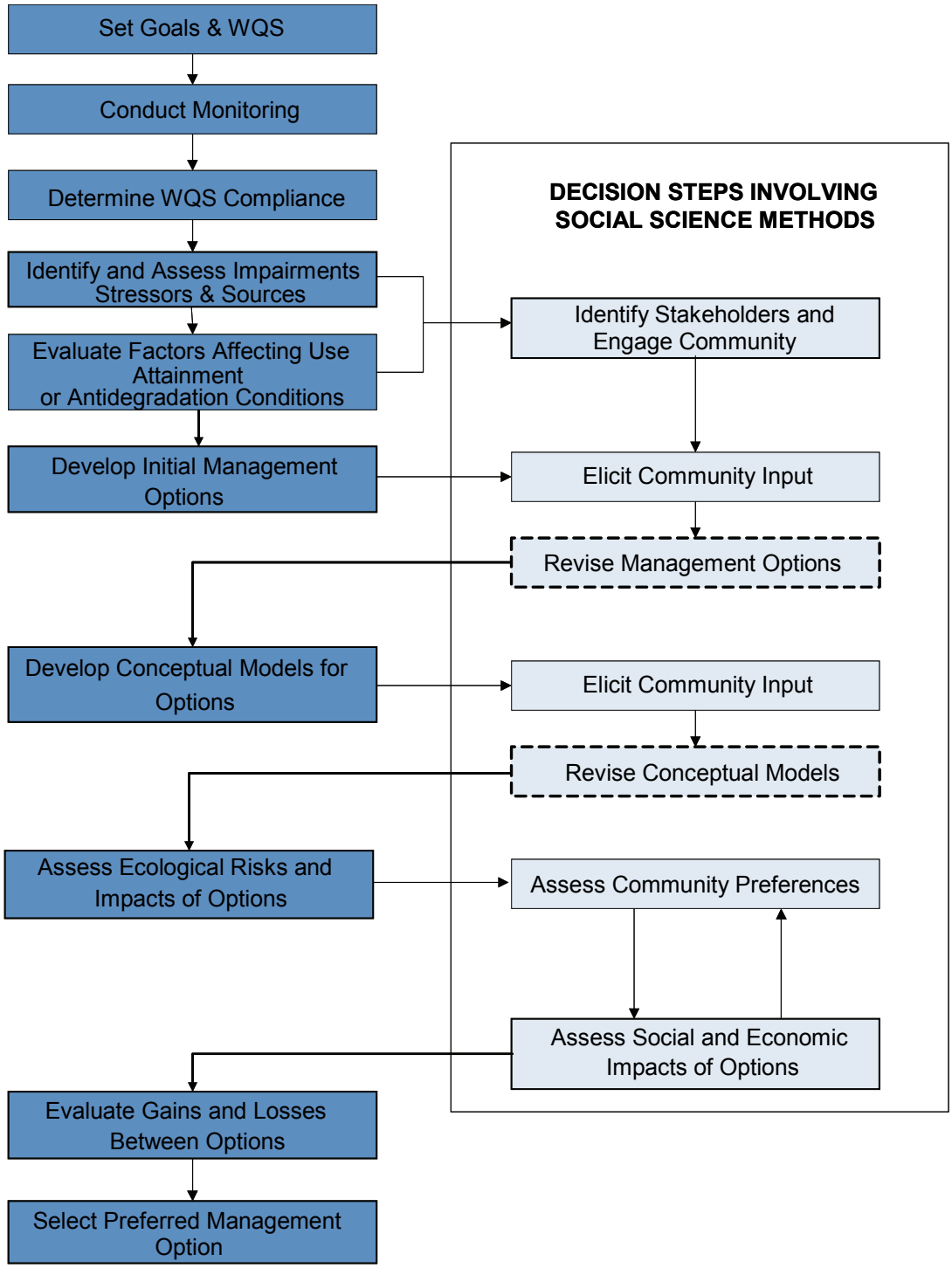

FIGURE 4-1

Incorporating Social Science Methods into WQS Decision-Making

science methods can be used to inform and enhance this process. The overall goal of the decision-making process is to select the management option that meets the highest attainable use of the water and best addresses the needs and priorities of the affected community. Throughout this process, social science methods can be used to address three supporting objectives:

(1) involve the community in framing the key elements of the WQS decision,

(2) assess community preferences for different management options to meet the highest attainable use, and

(3) assess the expected social and economic impacts of the different options.

Below we discuss the types of social science methods that are best suited to addressing each of these objectives. This discussion is divided into two sections, the first focusing on sociocultural methods and the second on economic methods.

4.1.1. Sociocultural Methods

Sociocultural assessment methods include a variety of perspectives and approaches for engaging the community in the decision-making process, eliciting input from stakeholders, and assessing and applying community preferences in the decision-making process. Table 4-1 lists several of these methods and distinguishes them according to whether they are "deliberative," "analytical," or combined deliberative-analytical techniques. These distinctions are discussed in more detail in the following sections. Table 4-1 also lists the section number later in this chapter where a more detailed description of each method can be found.

4.1.1.1. *Deliberative Sociocultural Methods*

A number of social science methods can be broadly categorized as "deliberative" or "participatory" approaches. Deliberative methods involve the consideration of an issue by an assemblage of stakeholders who ponder, discuss, and collectively assess the issue at hand. They range from large public hearings to representative advisory committees (other examples and descriptions of deliberative methods are provided later in this chapter).

When applied to environmental decision-making, these deliberative methods find their theoretical underpinnings in a wide range of disciplines, including anthropology, conservation

TABLE 4-1

Summary of Sociocultural Methods: Key Characteristics

	Analytic	Deliberative	Section Number With Detailed Description
Mental Model Approaches	✔		4.4
Public Meetings		✔	4.5
Delphi Method	✔	✔	4.6
Multiattribute Trade-Off Analysis	✔	✔	4.7
Multicriteria Decision-Making	✔	✔	4.8
Focus Groups Interviews	✔	✔	4.9
Advisory Committees		✔	4.10
Value Juries		✔	4.11
Opinion and Attitudinal Surveys	✔		4.12
Referenda	✔		4.13
Affective Images	✔		4.14
Narrative	✔		4.15
Damage Schedules	✔		4.16

and ecology, social policy, and sociology. Although the specific theoretical orientations and assumptions of these and other social sciences vary widely, they are largely unified by a holistic, systemic approach that encompasses the complex relations between people and their environments (Moran, 1990). Deliberative social science methods are, as a result, intended for use with a diversity of stakeholder groups and in relation to a diversity of environmental questions and issues. Many of these social science methods also are well suited for examining and addressing environmental equity issues. That is, they can provide useful forums for exploring, and when possible addressing social inequalities in environmental decision-making (Lubchenko, 1998).

In the context of WQS, deliberative methods can strengthen the decision process in several ways, including by helping to define and frame the main elements of the decision. As shown in Figure 4-1, there are at least three points in the decision process where deliberative methods can be used to elicit community input and allow community residents to contribute their unique insights and expertise. First, these deliberative processes can provide policy makers with an initial sense of the public's concern and engagement in a WQS decision and, in so doing, suggest generally appropriate governmental responses. Second, after technical experts develop initial management options, deliberative methods can be used to provide a forum for community members to describe local resource use patterns and priorities, and then the management options could be refined for subsequent discussion and assessment.

Third, these methods can be used to develop and finalize conceptual models for the set of management options under consideration. For example, when holding a public meeting or using focus groups, the participants could help narrow the list of important services or provide important local knowledge about the study area. As described in Chapter 3, these models illustrate the links between affected ecological and human systems and compare, in descriptive terms, the expected ecological and human welfare effects of the different options.

In addition to providing structured approaches for eliciting community input on technical matters, deliberative methods also can be used to elicit and assess community preferences. That is, through organized group discussions such as public meetings or focus groups, they allow community members to express their preferred options (and the specific features of different options they prefer) and the strength of these preferences. The insights gained into community preferences and how they differ across stakeholder groups can help WQS decision-makers

improve their understanding of the gains and losses and consequences associated with alternative management approaches.

Finally, deliberative methods offer the advantage of encouraging active community involvement in the decision-making process. When applied early in the process and used to address a controversial resource issue, this engagement of stakeholders can be critical for ensuring that the final decision is acceptable to the affected community.

4.1.1.2. *Analytic Sociocultural Methods*

Sociocultural methods also can elicit and assess community preferences for environmental decisions in the absence of direct deliberation and participation in the decision-making process. In brief, these analytic methods differ from deliberative ones in that data regarding community preferences are structured and analyzed by decision-makers without engaging in dialogue with stakeholders about the process followed. Analytic methods often are typified by a set of standardized and prescriptive methods for reducing data into specific answers to factual questions. These analytical approaches can be used when the options are particularly complex or community residents are unable or unwilling to arrive at a workable consensus in participatory formats. In these situations, certain social science methods can be used to describe the various scenarios available and provide residents the opportunity to indicate the preferred scenario. These methods have the advantage of providing decision-makers with a rigorous and structured set of responses on which they can base their selection of the final WQS management option. Surveys and referenda are examples of such analytic approaches that do not include deliberative or participatory approaches.

4.1.1.3. *Integrated Analytic-Deliberative Sociocultural Methods*

Although deliberative and analytical methods each can contribute independently to a sound analysis, some researchers have advocated decision-making processes that integrate both deliberative and analytic components into socioeconomic assessments. This argument, as well as the distinction between analytic and deliberative methods in general, is detailed in a report issued by the National Research Council (NRC, 1996) entitled *Understanding Risk: Informing Decisions in a Democratic Society*. Table 4-1 introduces several examples of these methods and lists the section number at the end of this chapter where a more detailed description of each

method is provided. Focus group interviews or the Delphi method of preference elicitation are examples of methods that can be used to support participatory, deliberative decision-making as well as to provide data for use by social scientists to assess community preferences in subsequent analysis.

Some of these assessment methods can be used or adapted to support economic analyses. For example, multicriteria decision-making, referenda, and damage schedules can be used to collect, measure, and compare monetary values for different options; however, these methods do not necessarily include economic measures, and they are not necessarily or primarily based on the conceptual framework described in Section 4.2. For these reasons, they are not classified as economic assessment methods. Similarly, some of the methods classified as economic assessment methods can be used to gather preference information that is not expressed in monetary or economic terms. For example, conjoint analysis can be used to evaluate preferences in several dimensions, not just in terms of monetary trade-offs. These examples illustrate the fact that the two broad categories of social science methods—economic and sociocultural—are not necessarily mutually exclusive.

4.1.2. Economic Methods for Assessing Preferences and Socioeconomic Impacts

Economic analyses of environmental regulations and related policies are geared toward understanding (1) how society's resources, including its natural resources, are used or exchanged as a result of policy actions and (2) how human welfare (that is, human well-being) is affected by these uses or exchanges. Addressing the first issue requires, among other things, models of human behavior. Market modeling, which simulates the behaviors and interactions of producers and consumers (i.e., supply and demand) under alternative conditions, is one example of the types of tools economists use for this purpose.

Addressing the second issue related to effects on human welfare requires "normative" models. These are models that define measures of well-being and establish corresponding criteria for determining whether society is better off as a result of a policy. Two commonly used criteria in economic analyses are efficiency and equity.

The main questions underlying the efficiency criterion are whether and to what extent the gains to society (benefits) exceed the losses to society (costs) from a given policy. The most efficient policy is defined as the one for which the difference between benefits and costs (net

benefits) is the greatest. The efficiency criterion is therefore also the basis for BCA (Arrow et al., 1996; Freeman, 1993; U.S. EPA, 2000). As discussed briefly in Chapter 2 of this report, BCA is a widely used economic analysis method for assessing the overall impact of a policy on society's well-being. It involves identifying, quantifying, and valuing the positive and negative impacts on society's well-being that result from policy changes.

The main questions underlying the equity criterion have to do with how the gains and losses are distributed across society (U.S. EPA, 2000). In particular, who are the "gainers" and who are the "losers" as a result of a policy? Analyses of equity impacts are also often focused on distinct subpopulations, such as disadvantaged or particularly vulnerable individuals. They examine how these groups of individuals are specifically affected by policies. In contrast to the efficiency criterion, for which there is a generally accepted core measure of human welfare effect (net benefits) and a main assessment method (BCA), there is no generally agreed upon measure of equity or a corresponding assessment method (although U.S. EPA [2000] provides a framework). Nevertheless, the process of developing and conducting BCA often requires separate estimation of different types and sources of benefits and costs, which also can be useful for informing equity concerns.

In practice, most economic assessment methods for evaluating environmental policies have been designed to support efficiency analyses and BCA. Actions taken to protect environmental quality (e.g., water quality) typically will involve both benefits and costs. By enhancing the flows of environmental services, they ultimately will have positive effects on human welfare (benefits). However, by diverting resources from other valued activities in order to control pollution, they also will have negative effects on human welfare (costs). In other words, the impacts of these actions, both the benefits and costs, ultimately will be experienced as changes in well-being for households/individuals. This idea is represented in simplified terms in Figure 4-2, which depicts interactions between three "systems:" household, market production, and environmental systems. Human welfare is shown as emanating from household systems because this is where individuals primarily reside. However, households also are closely connected with the other systems. They buy and sell goods, services, and labor through interactions with market systems. As described in detail in Chapter 3 of this report, they also receive important services from environmental/ecological systems. Moreover, some of the services from the environment are experienced indirectly by individuals through their

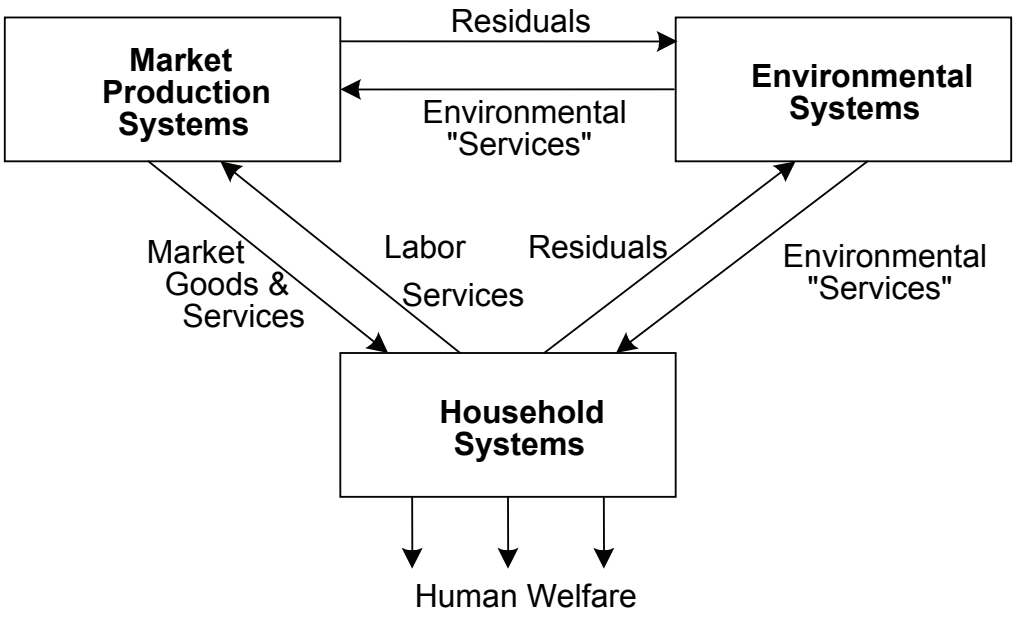

FIGURE 4-2

Interrelationships Between Market, Environmental, and Household Systems and Their Contributions to Human Welfare

interactions in market systems. For example, aquatic ecosystems support commercial fishing and aquaculture, which are in turn sources of food and livelihood for individuals. Figure 4-2 also shows that potentially harmful residuals are released to the environment from both household and market production activities. To some extent, environmental systems can absorb and break down these residuals, which, as described in Chapter 3, is one of the important services provided by these systems. However, when releases of residuals exceed the absorptive capacity of the environment, they cause impairments in environmental systems and degrade the other services they provide.

One of the main challenges in applying BCA to evaluate environmental policies related to meeting WQS, is that it requires methods for expressing human welfare changes in money terms (see, e.g., Freeman, 1993). In certain instances, this process is relatively straightforward because the changes are experienced by humans as monetary gains or losses. For example, if producers are required to install systems that reduce pollutant loads to surface waters, these additional expenditures are likely to reduce their profits, which economists term their "producer surplus." The dollar value of these reductions in producer surplus is a measure of costs. Furthermore, if some of the expenses for installing these systems are passed on to consumers in the form of price increases, then it also reduces consumer welfare. The dollar value of these reductions is referred to as a change in "consumer surplus," and is also a measure of costs.

In other instances, welfare changes are not directly associated with monetary gains or losses. As discussed in Chapter 3, such "non-market" changes might, for example, include the welfare gains from improved recreational opportunities at a water body. In these cases a surrogate measure of gains or losses must be used. Economists and other practitioners of BCA generally accept "willingness to pay" (WTP) as the conceptually correct measure for valuing changes in individuals' welfare.[2] WTP is the maximum amount of money that an individual would be willing to pay for a specified change (i.e., what someone is willing to give up to receive something else). As such it is the monetary equivalent of the welfare gain from the change. For instance, if water quality changes improve fishing conditions at a lake, the anglers who use the lake experience an increase in well-being. The dollar value of this welfare change—

[2] Willingness to accept (WTA) is the minimum amount an individual is willing to accept to forego the change. Both WTA and WTP are correct measures for valuing changes. However, to simplify, we only use WTP in this report. Freeman (1993) provides information on the differences between WTA and WTP and how to choose the appropriate measure.

the benefit to anglers—can be expressed as the maximum amount they would be willing to pay for the change if they could only acquire it by paying. Notice that WTP is constrained by the individual's income.

Economists have developed a wide variety of methods for assessing these different components of human welfare changes associated with policy changes. Table 4-2 lists several commonly used economic assessment methods. These methods are geared mainly toward expressing these changes in a common metric (i.e., dollars) so that the benefit-cost trade-offs involved in policy making can be compared directly. In many instances, these methods also can be used or combined to address equity-related issues, by measuring how costs, benefits, and other economic impacts are distributed across the affected population.

TABLE 4-2

Summary and Comparison of Economic Assessment Methods: Key Characteristics

	Preference Elicitation	Preference Revelation	Other	Section Number With Detailed Description
Contingent Valuation	✔			4.17
Conjoint Analysis	✔			4.18
Hedonic Property Value		✔		4.19
Recreation Demand		✔		4.20
Averting Behavior		✔		4.21
Market Models			✔	4.22
Replacement/Restoration Cost			✔	4.23
Benefit Transfer			✔	4.24
Economic Impact Analysis			✔	4.25

Most of the economic methods developed for assessing the benefits (rather than the costs) of environmental policies are described as nonmarket valuation methods because they measure values for things that generally are not exchanged in markets. These methods can be classified broadly as either preference elicitation or preference revelation methods. The discussion below begins by describing these two general nonmarket valuation approaches and then describes other related economic assessment methods. Table 4-2 also distinguishes methods according to whether they are primarily preference elicitation (stated preference) or preference revelation (revealed preference) methods or whether they cannot be classified in this way ("other"). In addition, it lists the section number later in this chapter where a more detailed description of each method can be found.

4.1.2.1. *Preference Elicitation (Stated Preference) Methods*

These methods predominantly use surveys to elicit preferences from individuals. Although several different variations of these methods have been developed, most are similar to or fall broadly within two categories: contingent valuation (CV) and conjoint analysis. Because markets for changes in environmental quality typically do not exist, values for these changes cannot be measured directly from market prices and quantities. Stated preference surveys allow researchers to present respondents with hypothetical choices that are similar to market purchase decisions. One of the main advantages of these methods is that they give the researcher substantial flexibility for framing the choice and defining the change to be valued. Based on individuals' responses to these hypothetical scenarios, it is possible to directly elicit or to infer their WTP for the defined change. Another important advantage is that these methods are capable of capturing both use and nonuse values related to the defined changes. As discussed in Chapter 3, individuals may benefit from ecosystem services in ways that are unrelated to their use of the ecosystem. Nonuse values for these services are therefore not revealed in their use of the ecosystem, but they can be expressed in responses to stated preference surveys.

The main drawback of these preference elicitation methods is the difficulty of verifying whether respondents are providing truthful and accurate preference information. In some cases, respondents may respond strategically, either overstating or understating their WTP or choices if they perceive that they can favorably influence the policy outcome by doing so. In other cases, responses may be biased by the format or context of the questions or by the interviewer's

technique. The hypothetical nature of the questions may result in responses that are not carefully thought out by respondents. Many of these limitations can be addressed at least partially through careful design and thorough pretesting of the stated preference survey instrument.

4.1.2.2. *Preference Revelation (Revealed Preference) Methods*

These methods use data on human behaviors in actual rather than hypothetical conditions to infer their values for specific changes. They assume that individuals always act to optimize their own welfare; therefore, their actions reveal how much they value things they cannot purchase directly. For example, by paying more for a home that is next to a less polluted water body, individuals reveal their value for cleaner water. To measure these values, hedonic property value methods are often used to estimate the specific effect that differences in local water quality have on housing prices. Another example is where individuals reveal their values for safer drinking water through purchases of water purifiers or bottled water. Averting behavior methods examine these types of behaviors to measure these values. In a third example, individuals who travel longer distances to recreate at sites with cleaner surface water reveal values for clean water. Recreation demand models examine these types of behaviors.

Although very useful for measuring nonmarket values, revealed preference methods also have a number of limitations. First, because they require data on actual behaviors, these methods offer researchers less flexibility than stated preference methods for framing the choice and defining the change to be valued. Second, because values are implied rather than directly expressed through these observed behaviors, more complex analytical methods often are required to measure values from revealed preference data. Third, revealed preference methods cannot be used to measure nonuse values for environmental resources because by definition these values are not revealed in individuals' use of the resources.[3]

4.1.2.3. *Other Economic Assessment Methods*

Conducting original stated or revealed preference analyses typically requires substantial time and resources. When it is not feasible to conduct a reliable stated or revealed preference study due to time and resource constraints or for other reasons, it may be possible to apply results

[3] Some of the limitations of stated and revealed preference methods can be addressed by combining the two methods. See Adamowicz et al. (1994) and Kling (1997).

from existing studies to the new policy case, a practice called "benefit transfer." The accuracy of the benefit transfer method for estimating benefits depends on the quality of the original studies and the comparability of the study context with the policy context of interest. Some differences between the two contexts can be overcome by systematically adapting or adjusting the transferred estimates—for example, values may be rescaled to account for price inflation, differences in income, or differences in the size of the effect being evaluated—but this process generally introduces additional uncertainty.

Another method that sometimes is used for approximation in benefits assessment is to estimate avoided replacement/restoration costs. For example, if poor water quality causes damages to wetlands, then one of the benefits of improving water quality may be the avoided costs of restoring the affected wetlands. This type of valuation approach is relatively easy to implement, but it provides, at best, a crude approximation of the value humans attribute to the affected wetlands because it mixes costs and benefits (see, for example, Bockstael et al. [2000] or Section 4.23).

One method that potentially can assess both the benefits and costs resulting from environmental management options is the market models method. A market model simulates supply and demand conditions for a specific good (or service) and shows how the interaction between these two forces determines the market price for the good and the quantity of the good that is bought/sold over a specific time period.[4] More importantly, these models also can estimate how supply and demand conditions change (and prices and quantities adjust) in response to environmental policies. For instance, if the policy requires producers to make new expenditures (e.g., on pollution control equipment), market models can be used to assess the societal costs of the policy. These costs are measured as *reductions* in producer surplus and consumer surplus in the affected market(s). If the environmental resources improved by the policy also directly support market activities—for example, if the affected aquatic resources support commercial fishing—then market methods also can be used to measure specific benefits of the policy. These benefits are measured as *increases* in producer and consumer surplus in the affected market. By distinguishing between changes in producer and consumer surplus, market

[4] Market models also can vary significantly in their scope and complexity. "Partial equilibrium" market models, which typically include one or perhaps a small number of related markets, commonly are used. In contrast, "general equilibrium" models represent multiple market interactions within an economy and are, therefore, less appropriate for estimating the societal costs of policies that target a small sector of the economy.

methods also can be used to examine the equity-related issues—i.e., how gains and losses are distributed between consumers and producers.

The market models method is designed to provide conceptually valid measures of human welfare changes, which are appropriate for use in BCA. In contrast, economic impact analysis methods are designed to measure policy-related changes in specific economic indicators, such as changes in expenditures and sales, employment levels, incomes, and tax revenues. Although these methods are commonly used to evaluate changes in local or regional economic conditions, they generally do not provide estimates that are directly applicable in BCA. For example, expenditures on fishing trips and related equipment are often used as an indicator of how much a water resource contributes to a local economy; however, these measures do not specifically capture changes in producer or consumer surplus, which are more appropriate measures of human welfare changes. Nevertheless, economic impact analyses can provide useful insights into the economic and equity implications of different actions, including how both positive and negative impacts are expected to be distributed across the affected community.

4.2. DATA COLLECTION TECHNIQUES FOR SOCIOCULTURAL AND ECONOMIC ASSESSMENTS

All the social science methods discussed in this chapter require one or more forms of data collection regarding the affected community. In many cases, they require primary data collection, which entails gathering original data directly from community members or stakeholders. In other cases, they require secondary data collection, which relies on existing sources of data. Several of the most commonly used methods for primary and secondary data collection are described below.

4.2.1. Primary Data Collection

For the purposes of this discussion, primary data collection techniques are grouped in the following four categories.

4.2.1.1. *Individual Interviews*

In individual interviews, answers are elicited from individuals one at a time either in person or over the phone (see, for example, U.S. EPA [2002]). Individual interviews can vary in many ways (such as format, question structure, and level of formality) depending on the desired

results. This technique allows for in-depth analysis of topics of interest, such as a thorough description of the experiences and emotions tied to the recreational services provided by an aquatic ecosystem in the community. Speaking directly to individuals also allows for insights not garnered using other techniques. However, it is important to note that information gathered through an individual interview can be biased by a respondent's tendency to say what he or she thinks the interviewer wants to hear or by design flaws that can affect data quality. Adequate training of interviewers, pretesting of interview scripts, and a representative sample can limit these problems.

4.2.1.2. *Surveys*

Surveys are lists of predetermined questions presented to respondents in the form of a questionnaire. The survey may be physically handed to respondents, mailed, sent electronically, given in a group, or in some other way delivered to the respondent, the respondent typically interprets the items on the questionnaire without assistance from the researcher. Surveys can gather demographic information on the respondent as well as perceptions, opinions, values, and behaviors related to the ecosystem. This technique allows data to be gathered from a large number of respondents by a small number of researchers at a relatively low cost per response, providing more representative data than with other techniques. Surveys allow more complicated questions to be asked, such as those requiring repetitive questions used in rankings. The absence of interview bias and the anonymity of the respondent may provide more accurate information as long as the questionnaire is not flawed. The researcher has no control over how the respondent interprets the questions. The overall cost of surveys can be high, partially because of the need for the services of survey methodologists and other professionals adept at survey design and sampling. The entire process also can be time consuming, and there is always the potential of low response rates due to problems with the survey instrument design, delivery method, or the interest level of the population (for more information on surveys, see Dillman [1978]). In addition, if the views of those who complete the survey are systematically different from those who do not, response bias could affect the results.

4.2.1.3. *Group Deliberations*

Group interviews can be used to elicit community perceptions and to facilitate deliberations. They vary in the level of information provided to participants, the criteria by which group members are recruited, depth of the desired response, and the extent to which the group members interact. Group interviews allow information to be obtained from many people at one time and also allow individuals to modify their opinions based on feedback from other group members. This technique generally is not as time consuming as individual interviews. However, one or a few members of the group may dominate the conversation, not allowing the opinions of all group members to be expressed equally. Adequate training of group interview moderators can limit this problem. Consensus may be difficult or impossible to achieve in a group setting, although consensus is not always the goal.

4.2.1.4. *Observation*

Observation involves collecting data on the community through observing day-to-day activities and interactions rather than asking the community members directly, as researchers do during interviews (see U.S. EPA [2002]). This technique may provide unanticipated insights about the values and behavior of the community that may be useful in preparing interviews or surveys. It takes time to fully observe the community, and some behaviors are unobservable. Researchers may need insider knowledge (such as that elicited during interviews) to understand the motivations behind some behaviors.

4.2.2. Secondary Data Collection

A wide variety of secondary data sources also can be used to support and conduct socioeconomic assessments. Many forms of demographic and economic data are readily available through written and electronic sources, such as information available in town halls and libraries. Data collected by the Bureau of Census, which includes information on population, housing, and economic characteristics can be particularly useful for identifying and characterizing the potentially affected community. Data on property values and characteristics, recreational activities, and consumer expenditures and prices are available from a number of sources, and they can also provide useful insights into the behaviors, values, and preferences of community members. Geographic data, for example, information on buildings, roads, elevation,

and the location of affected populations in relation to the physical landscape and other populations, also can be useful for characterizing and better understanding the community. These data can be represented in maps, which provide visual representations of the layout of the community, and they can be spatially linked to other data sources (e.g., through geographic information systems [GIS] techniques) to support more advanced analyses of community characteristics, behaviors, and preferences. In addition, published research findings regarding the community (or similar communities) often are available in journals, books, and fact sheets, and they also can serve as important secondary sources of information (additional information can be found in U.S. EPA [2002]).

4.3. SUMMARY AND COMPARISON OF SOCIAL SCIENCE METHODS

In Section 4.1, we identified 22 of the more commonly used sociocultural and economic assessment methods. This section provides additional descriptions and comparisons of these methods. At the end of this chapter, more detailed one-page descriptions are provided for each of the 22 methods.

Table 4-3 distinguishes the sociocultural and economic methods according to the types of data collection techniques that are most integral and most commonly used to apply these methods. As this table shows, most of the methods (and all of the sociocultural methods) require primary data collection. Although not specifically shown in the table, all of the methods can use secondary data productively; however, in most cases these data play a less prominent role than primary data. For example, demographic and economic data sources are often used as a first step in developing surveys or in structuring the make-up of an advisory committee.

As shown in Table 4-3, the primary data collection process most commonly employed is a key variable by which to differentiate the sociocultural methods described here. The mental model approach is the only sociocultural method described in this report that relies on data collected through individual in-depth interviews to develop the mental modeling coding scheme. The majority of the methods—public meetings, Delphi methods, multiattribute trade-off analysis, multicriteria decision-making, focus groups, advisory committees, and value juries—employ group discussions and deliberations to collect primary data for analysis. The Delphi method employs both group deliberations and surveys. The remaining sociocultural methods—opinion and attitudinal surveys, referenda, affective images, narrative, and damage schedules—

TABLE 4-3

Summary and Comparison of Social Science Methods: Main Data Collection Techniques Used

	Primary Data Collection			Secondary Data Collection			
	Individual Interviews	Surveys	Group Deliberations	Demographic Data	Economic Data	Geographic Data	Published Research
Sociocultural Assessment Methods							
Mental Model Approaches	✔						
Public Meetings			✔				
Delphi Method		✔	✔				
Multiattribute Trade-off Analysis			✔				
Multicriteria Decision-Making			✔				
Focus Groups Interviews			✔				
Advisory Committees			✔				
Value Juries			✔				
Opinion and Attitudinal Surveys		✔					
Referenda		✔					
Affective Images		✔					
Narrative		✔					
Damage Schedules		✔					
Economic Assessment Methods							
Contingent Valuation	✔	✔					
Conjoint Analysis		✔					
Hedonic Property Value				✔	✔	✔	
Recreation Demand		✔				✔	
Averting Behavior		✔		✔	✔		
Market Models				✔	✔		
Replacement/Restoration Cost					✔		
Benefit Transfer							✔
Economic Impact Analysis				✔	✔		

all rely on survey data. Finally, because all the sociocultural methods described in this report rely on preferences elicited from stakeholders, observations of relevant behaviors on the part of community residents may provide an important reality check on responses elicited, as well as suggest areas for further investigation. Prospective users of these methods would do well to review the section describing these various primary data collection strategies when deciding which method or methods to employ.

Most of these sociocultural methods provide strategies researchers can use to collect and reduce attitudinal and behavioral data into a set of discrete analytic units, or codes. These codes, often bundled under descriptive headings such as "recreational values" or "economic values," can create structure and order out of the complex assemblage of concerns and comments received from community members. To some extent, they allow for interpersonal comparison and generalization in the same way as economic indicators or other conceptual units operate in economic models. However, the coding schemes often differ from those used in economic methods in that many of these methods are by and large data-driven. That is, the collection of attitudinal and behavioral data precedes the development of the scheme by which the data are parsed and organized.

All of the economic assessment methods are inherently analytic, and in contrast to many of the sociocultural methods, they typically use little, if any, deliberative processes. Instead, many of the economic methods, in particular the preference elicitation techniques such as contingent valuation and conjoint analysis, require collecting data through surveys or, in certain circumstances, personal interviews. Also in contrast to the sociocultural methods, most economic assessment methods require some secondary data collection. For example, the hedonic property value method requires data on housing prices, housing characteristics, and local conditions, most of which can be acquired through existing data sources. Another example is the benefit transfer method, which by definition uses secondary data from existing economic studies.

Table 4-4 rates each of the sociocultural and economics methods according to cost/complexity which refers to the costliness and/or complexity of the method, in terms of time, data, and specialized technical skills required to implement it. This dimension is rated on a 5-point scale ranging from very low to very high. It must be noted that these ratings are subjective (based on the consensus of the report's authors) and require generalizations. Many of the methods can vary significantly in cost/complexity, depending on the context in which they are

TABLE 4-4

Summary and Comparison of Social Science Methods: Cost/Complexity

	How Costly/Complex to Implement?				
	Very Low	Low	Moderate	High	Very High
Sociocultural Assessment Methods					
Mental Model Approaches			✔		
Public Meetings		✔			
Delphi Method		✔			
Multiattribute Trade-off Analysis					✔
Multicriteria Decision-Making				✔	
Focus Groups Interviews	✔				
Advisory Committees				✔	
Value Juries			✔		
Opinion and Attitudinal Surveys			✔		
Referenda		✔			
Affective Images			✔		
Narrative				✔	
Damage Schedules			✔		
Economic Assessment Methods					
Contingent Valuation				✔	
Conjoint Analysis					✔
Hedonic Property Value				✔	
Recreation Demand					✔
Averting Behavior		✔[a]			✔[b]
Market Models			✔		
Replacement/Restoration Cost		✔			
Benefit Transfer		✔			
Economic Impact Analysis		✔			

[a] Averting expenditure approach
[b] Household production approach

used and the level of resources devoted to applying the method. Nevertheless, these ratings are included here to provide the reader with a broad understanding of the relative advantages and disadvantages of the different methods. They are intended to help the reader gauge which methods might be applicable to his or her situation. More detailed descriptions and comparisons of the methods are provided below and in the descriptions at the end of this chapter. Additional references for the sociocultural assessment methods can be found in U.S. EPA (2002) and additional details on the economic assessment methods can be found in Mäler and Vincent (2005) and Champ et al. (2003).

4.4. MENTAL MODEL APPROACHES

Type	Sociocultural Assessment Method
Description	Mental model and other cognitive mapping approaches have been used in a variety of environmental management contexts. In contrast to opinion polls (Section 4.12), which require that respondents answer fixed questions, the protocols used in a mental model interview allow participants to express themselves in their own terms. All participants discuss a common set of issues but are given substantial flexibility to focus on those issues of greatest concern. The primary goal is to identify those factors that most influence how a person thinks about the issues at hand and why different people may agree or disagree about what matters most or about preferred options.
Advantages	The techniques of mental mapping are flexible and user-friendly, in that the interviewer follows a script but is allowed to vary from this to the extent that the participant wants to discuss some items in more detail. Models also can be revised easily to incorporate new ideas that develop over the course of discussions and can be adapted to reflect the views of individuals, groups, or communities at large. Results are transparent and easily lend themselves to visual communication (through drawings of personal perceptions).
Disadvantages	The flexibility of a mental map can also be a liability, in that the information obtained from participants can range widely and, thus, provide less help than expected in terms of the actual decisions facing policy makers. Mental models involve relatively small numbers of participants to provide a picture of how people think about a policy option and why: they provide neither a number (i.e., for valuation purposes) nor a quantitative comparison of alternatives. Mental models also require that the terms and language used by participants is carefully defined to ensure that models accurately reflect the views of those interviewed and misunderstandings do not occur. To our knowledge, the technique has not yet been used to study community preferences for water quality.

4.4. MENTAL MODEL APPROACHES cont.

Type	Sociocultural Assessment Method
Outcomes	The outcome of a mental model process is an improved understanding of the factors determining people's thinking about the issue. One example is an expert model, which loosely follows the form of an influence diagram showing how key management actions are linked to measures of system performance. The model provides a visual tool for showing which variables are considered to be relevant and how these variables are connected. The technique is compatible with either qualitative analyses (e.g., through visual use of arrows showing pathways that link variables) or quantitative analyses (e.g., where knowing the value of the variable at the tail would influence estimates of the variable at the head).
Example	Morgan et al. (2002) used a mental models approach to study public understanding of global climate change. Interviews revealed confusion about the meaning of basic terms (e.g., climate change, greenhouse effect) and misconceptions about the physical mechanisms underlying global climate change (such as a confusion between ozone depletion and climate change and a lack of emphasis on carbon dioxide emissions). Respondents' views on the likely effects of climate change were more accurate. Gregory et al. (2003) used mental model interviews to develop a formal expert model of the factors determining the impacts of various transmission rate structures for electricity and the influence of the regulatory process producing these effects; this work facilitated the development of proposals that were technically sound and widely accepted.
References	Gregory, R., B. Fischhoff, S. Thorne and G. Butte. 2003. A multi-channel stakeholder consultation process for transmission deregulation. Energ. Policy 31:1291-1299. Morgan, G., B. Fischhoff, A. Bostrom and C. Atman. 2002. Risk Communication: A Mental Models Approach. Cambridge University Press, New York, NY.

4.5. PUBLIC MEETINGS

Type	Sociocultural Assessment Method
Description	In this method, a forum of community members meets to discuss issues or make decisions. The gathering is often highly structured. Attendees are allotted a specific amount of time to speak and may even prepare their statements beforehand. Researchers observe meetings to gain insight on the community. A facilitator runs the meetings while a recorder takes notes.
Advantages	Data are collected from large numbers of people at one time and can be particularly enlightening in terms of intra- and intersegment perceptions and concerns. The open-ended format allows people to express an array of views and sentiments on a specific topic.
Disadvantages	Unequal contribution by individuals may lead to some ideas dominating over others, resulting in a discussion not reflective of the group's values as a whole. Mediation of large groups can be difficult. Comments often range outside the scope and deal with broader issues. Interpreting people's comments may be problematic.
Outcomes	Conducting public ("town hall") meetings can be used as a communication tool while also allowing community members to sense that they are part of the project. Meetings can inform different steps of a project, from conveying problems that need action to informing the public of decisions that have been made and gaining feedback. Transcripts of the meeting may be consulted even if the researcher is not in attendance at the meeting.
Example	McComas (2003) describes the responses of participants in a series of public meetings in upstate New York who were debating the expansion of an existing solid waste landfill and remediation of an adjacent waste site. These responses also are compared with those of nonattendees in terms of comparative changes in risk perceptions and the credibility ratings of experts.
References	Cole, R.L. and D.A. Caputo. 1984. The public hearing as an effective citizen participation mechanism: A case study of the general revenue sharing program. Am. Polit. Sci. Rev. 78:405-416. McComas, K.A. 2003. Public meetings and risk amplification: A longitudinal study. Risk Anal. 23(6):1257-1270.

4.6. DELPHI METHOD

Type	Sociocultural Assessment Method
Description	The Delphi method is a structured, iterative process using questionnaires (filled out individually by each group member) to elicit consensus on a topic from a group of knowledgeable experts or community members. Experts or stakeholders are encouraged to revise their recommendations based on summary responses from the rest of the group.
Advantages	Different views of the issue are incorporated, progressing toward an agreement that systematically addresses all opinions. Anonymity can be maintained to persuade all members of the group to express their opinions, thus eliminating some of the problems associated with face-to-face group meetings.
Disadvantages	Which experts or stakeholders to include is not always apparent and can vary depending on how the issue is defined. Consensus is not always possible. This method can be time consuming depending on the number of iterations. Some respondents may drop out before all iterations are complete, thus affecting the validity of the results.
Outcomes	This method produces organized data in the form of questionnaire responses from multiple respondents. A consensus on the issue is the ultimate goal of the Delphi method.
Example	A Delphi survey of expert opinion on reservoir fisheries was used to aid in river basin reservoir management of the water resources claimed by both Georgia and Alabama.
References	Taylor, J.G. and S.D. Ryder. 2003. Use of the Delphi method in resolving complex water resources issues. J. Am. Water Resour. Assoc. 39(1):183-189.

4.7. MULTIATTRIBUTE TRADE-OFF ANALYSIS (MATA)

Type	Sociocultural Assessment Method
Description	Multiattribute trade-off analysis (MATA) methods facilitate trade-offs across the different ecological, economic, health and safety, and social objectives associated with alternative actions. Applications of MATA differ from multicriteria decision-making (Section 4.8) in terms of the emphasis on values elicitation through a sequence of steps to help participants understand their objectives in the context of a management problem and to use this information in selecting a preferred action. These steps include structuring the problem, defining key objectives, developing performance measures (attributes) for these concerns, estimating the anticipated consequences and associated uncertainty of actions in terms of the objectives, and evaluating alternatives in terms of their ability to satisfy the expressed objectives.
Advantages	MATA techniques highlight the multiple values held by different stakeholder groups. They provide decision-makers with information on these varied perspectives and the likely sources of support for, or opposition to, a policy. They are transparent, facilitate the involvement of multiple participants through use of a level playing field, and are well supported by both theory and practice. In the context of community-based water quality choices, MATA methods can be used to facilitate structured dialogue and understanding among participants with diverse backgrounds.
Disadvantages	Use of MATA can force stakeholders to break an issue down into too many discrete elements and, thus, lose sight of how some elements are interrelated. Practitioners also need to be aware that the approach carries with it a specialized vocabulary and that more quantitative applications (i.e., a "full" MATA, as opposed to a partial MATA), therefore, carry the risk of alienating participants who are more comfortable with qualitative approaches to valuation.
Outcomes	Multiattribute methods can be used to provide quantitative measures of the value placed on an environmental action, or they can be used to help structure community objectives and management or policy alternatives. The focus is on developing insights about preferred options, rather than developing a number (e.g., for use in a benefit-cost analysis); often, this type of "value-focused" help in framing a choice and ranking options is what decision-makers need to make more informed decisions about different levels of water quality or other environmental choices.

4.7. MULTIATTRIBUTE TRADE-OFF ANALYSIS (MATA) cont.

Type	Sociocultural Assessment Method
Example	Borsuk et al. (2001) used decision analytic methods to model nutrient management problems in the Neuse River (North Carolina) as part of an effort to reduce undesirable environmental conditions in the lower river and estuary. The main focus of the study was to link scientific models, expressed in terms of biophysical variables such as dissolved oxygen, to the economic, social, and procedural concerns of stakeholders. Construction of a probabilistic model relates proposed management actions to stakeholder interests by showing anticipated changes in the conditional values of endpoints. Gregory and Keeney (1994) used the value-focusing aspects of multiattribute methods to provide insight to decision-makers about the environmental, economic, and social concerns of stakeholders in the context of a proposed mining development that would alter a relatively pristine forest environment. This information was then used to help create novel and widely accepted management alternatives. Keeney et al. (1996) describe the use of the fundamental values of decision-makers to guide long-term wastewater planning at Seattle Metro, a major utility district. Multiattribute value assessment methods were used to elicit the objectives of decision-makers and provided a basis for quantitative evaluation of alternatives based on identifying the key trade-offs.
References	Borsuk, M., R. Clemen, L. Maquire and K. Reckhow. 2001. Stakeholder values and scientific modeling in the Neuse River watershed. Group Decis. Negot. 10:355-373. Gregory, R. and R. Keeney. 1994. Creating policy alternatives using stakeholder values. Manage. Sci. 40:1035-1048. Keeney, R., T. McDaniels and V. Ridge-Cooney. 1996. Using values in planning wastewater facilities for metropolitan Seattle. J. Am. Water Resour. Assoc. 32:293-303. Ohlson, D., T. Berry, R. Gray, B. Blackwell and B. Hawkes. 2006. Multi-attribute evaluation of landscape-level fuel management to reduce wildfire risk. For. Pol. Econ. 8:824-837.

4.8. MULTICRITERIA DECISION-MAKING (MCDM)

Type	Sociocultural Assessment Method
Description	Multicriteria approaches have been developed to examine the performance of different alternatives when compared with multiple objectives. The aim is to incorporate the value judgments of those considered to be legitimate participants into the assessment of management options; economic objectives (such as efficiency) or ecological ones (such as sustainability) will be incorporated only to the extent that they matter to decision-makers in the specific decision context. The theoretical basis for multicriteria decision-making (MCDM) approaches is well established and similar to that of other multiattribute methods (such as multiattribute trade-off analysis, Section 4.7).
Advantages	The main advantage of MCDM (or other multiattribute) approaches, including well-known methods such as the analytical hierarchy process (AHP), is their ability to provide direct insight into the selection of preferred environmental management options in terms of the factors important to decision-makers. The basic techniques (e.g., use of ratio scales) are quite user-friendly, the general approach is transparent, and the logic can be clearly shown in either verbal or mathematical terms.
Disadvantages	The validity of an MCDM is only as good as the selection and definition of objectives (i.e., to what extent have analysts faithfully captured and described the concerns of decision-makers?) and the choice of relevant alternatives (e.g., involving the use of criteria to screen unrealistic options or those outside the mandate of the preference elicitation process). MCDM approaches also can be viewed by community participants as overly quantitative and reductionist.
Outcomes	By combining information on preferences and on probabilities, MCDM approaches assign a utility function to different outcomes so that decision-makers should prefer the alternative that shows the highest expected utility. MCDM approaches have been applied to environmental management contexts involving the choice among different strategies for dealing with environmental and economic risks under conditions of substantial uncertainty.
Example	Ananda and Herath (2003) used AHP methods as an aid to stakeholder involvement in developing forest management policies in Australia that could address the complexity and uncertainty associated with policy options. The use of AHP helped incorporate stakeholder preferences by making explicit some of the primary multidimensional gains and losses decision-makers faced.

4.8. MULTICRITERIA DECISION-MAKING (MCDM) cont.

Type	Sociocultural Assessment Method
References	Ananda, J. and G. Herath. 2003. The use of analytic hierarchy process to incorporate stakeholder preferences into regional forest planning. Forest Policy Econ. 5:13-26. Saaty, T. 1991. Multicriteria Decision-Making: The Analytic Hierarchy Process. RWS Publishers, Pittsburgh, PA.

4.9. FOCUS GROUP INTERVIEWS

Type	Sociocultural Assessment Method
Description	In this method, a small group of people (typically 7 to 12) discuss topics presented by a moderator. Multiple focus groups often are conducted on the same topic. The meeting structure is highly organized with the purpose of obtaining detailed information on the topic of interest. Once the topic of the focus group has been determined, community members are chosen based on predetermined criteria (such as members of a cultural subgroup or age range). Focus group questions are typically simple and open-ended; moderators use the same questions for each set of focus group interviews on the topic. A focus group moderator asks the questions during the interview and is responsible for ensuring that the group stays on task.
Advantages	Many aspects are controlled by the researcher, including the topics discussed and the members of the group. However, flexibility not provided in a structured questionnaire is present, allowing in-depth discussion of certain topics. Specifically, interactions and discussions among participants can reveal important social dynamics, issues, and preferences that might be missed with individual interviews or surveys.
Disadvantages	A researcher skilled in moderating focus group interviews is needed to monitor the meetings. Opinions are derived from only a small group of people who may not represent the opinions of the community. Even if the focus group is carefully chosen to represent the community, outspoken participants may dominate the meeting and not allow the views of all participants to be spoken. Focus group interviews require a large amount of effort and funds for planning, conducting the meetings, and analyzing the results.
Outcomes	Results from the focus group are used as an approximation of the opinions of the community. This method can be used to develop survey instruments or inform planning for other methods. Results of the focus group interviews are documented in notes and/or audio or videotapes of the meeting, making them available for future reference. If multiple focus groups are conducted, a report summarizing and combining the results from all meetings may be useful.
Example	Desvouges and Smith (1988) discuss the use of focus groups as an aid to communicating risks, including the exploration of risk perceptions and the design of risk-mitigation policies. They explore the use of focus groups in a study of the use of risk ladders to elicit the perceived risk from hazardous waste exposure.

4.9. FOCUS GROUP INTERVIEWS cont.

Type	Sociocultural Assessment Method
References	Desvousges, W. and V.C. Smith. 1988. Focus groups and risk communication: The "science" of listening to data. Risk Anal. 8:479-484. Krueger, R.A. 1994. Focus Groups: A Practical Guide for Applied Research. 2nd ed. Sage Publications, Thousand Oaks, CA.

4.10. ADVISORY COMMITTEES

Type	Sociocultural Assessment Method
Description	Advisory committees consist of a group of people chosen to guide a project on the behalf of another group, such as the community affected by the project. Members interact with one another, potentially modifying their own ideas based on the input from other group members. The composition of an advisory committee can be iterative, adding people after one or two sessions to fill identified gaps.
Advantages	Members of a well-chosen advisory committee can provide perspective on the community's position on an issue, such as whether the community is likely to accept or reject a water management decision. Committees that are truly representative, including members of the sponsoring agencies and scientists as well as community representatives, can be extremely helpful.
Disadvantages	Scheduling a time that all committee members are available to meet may be difficult, especially if the committee is made up of community leaders. Staying on topic and reaching a consensus can be problematic and time consuming. If the advisory committee does not represent all views or subgroups of the community, it may be necessary to employ additional methods to determine these other viewpoints.
Outcomes	Advisory committees may guide the entire project or specific elements of a project. For example, an advisory committee may help plan a public meeting, review a draft survey instrument, or recommend a management policy from a list of alternatives.
Example	Gregory and Wellman (2001) discuss the use of structured facts- and values-based elicitations from the members of a representative advisory committee (as well as community participants) as part of their description of a multiattribute methodology used at the Tillamook Bay national estuary program site. An evaluation workbook was developed that provided insight to decision-makers about the management choices favored by participants and the key gains and losses across objectives that led to these choices.
References	Gregory, R. and K. Wellman. 2001. Bringing stakeholder values into environmental policy choices: A community-based estuary case study. Ecol. Econ. 39:37-52. MacRae Jr., D. and D. Whittington. 1997. Expert Advice for Policy Choice Analysis and Discourse. Georgetown University Press, Washington, DC.

4.11. VALUE JURIES

Type	Sociocultural Assessment Method
Description	Value juries and so-called "science courts" are a relatively new approach to evaluating environmental services. Modeled after the widely recognized jury system, the approach seeks to allow participants the time and information needed to understand a complex environmental issue and to make informed judgments about proposed policy or regulatory actions. As in a court of law, stakeholders are given the opportunity to hear opposing views and often to question witnesses, either directly or through a representative (i.e., equivalent to a defense or prosecution lawyer).
Advantages	Value juries follow a familiar and widely respected element of our society; as a result, they tend to carry substantial legitimacy and support. The approach works well as a way to develop a more informed citizenry, particularly when the environmental issue is complex, and it can also facilitate dialogue between scientists or agency representatives and less technically trained community members. Output can be tailored to the specific policy needs of decision-makers, resulting either in rankings of alternative options or detailed information about the reasons why participants favor or oppose specified plans.
Disadvantages	The successful conduct of a citizen value jury requires that people are able to set aside the time (often 2 or 3 days) needed to engage in such deliberations and that funds are available to bring in the requisite experts. This is sometimes difficult, particularly since participation usually is voluntary and can be viewed as a time-consuming nuisance (in contrast to court cases, which are mandatory and broadly seen as a citizen responsibility). Also, the results of citizen juries typically take the form of recommendations and have no legal standing, which can frustrate participants in those cases where politicians or other decision-makers may override the jury's recommendation.
Outcomes	The usual outcome of a value jury is a decision to proceed or halt a proposed environmental action. In some cases, value juries also have been used to help set damage awards, for example, in the case of stakeholders harmed by pollution.
Example	Brown et al. (1995) set out the conditions and requirements for using value juries as an aid to making defensible resource management decisions. The approach has been used to study a variety of environmental problems, including land management and water conservation options in Colorado.
References	Brown, T., G. Peterson and B. Tonn. 1995. The values jury to aid natural resource decisions. Land Econ. 71:250-260.

4.12. OPINION AND ATTITUDINAL SURVEYS

Type	Sociocultural Assessment Method
Description	Opinion surveys can involve either verbal or written questionnaires. They have been widely used to report how people think about environmental and water quality risks and have received broad coverage in the popular press. Usually, opinions are provided about the relative importance of a potential ecological improvement or damage (e.g., in comparison with other environmental problems or other health, social, or economic issues) or the influence of components of environmental concerns rather than as quantitative responses. One application of attitudinal surveys is to study the perceptions of ecological risks, in which psychometric techniques make use of specified characteristics underlying participants' psychological responses to develop a profile of how participants think about an environmental risk.
Advantages	Opinion surveys can be relatively inexpensive to administer and the results are user-friendly and easily understood by a wide range of citizens. Opinion surveys also can be fine-tuned to address the specific policy questions of concern to decision-makers, and both the level of detail and the number of participants (which, in turn, has implications for the statistical validity of results) can be varied.
Disadvantages	Opinion survey results depend greatly on specific and often highly specialized aspects of how questions are asked in terms of concerns such as wording, order, and (intentional or unintentional) emotional cues. Results do not reflect detailed evaluative information and often are limited to a single dimension of a problem (e.g., costs, risks). Little time is provided for thinking through a more complex problem and, as a result, responses often are uninformed and colored by judgmental biases (e.g., anchoring and availability) or cues introduced by the interviewer or questionnaire. Because the opinions provided usually are those of an individual, little opportunity is provided for dialogue or discussion with peers.
Outcomes	Rankings of environmental or economic concerns associated with water quality, for example, may show how important a proposed action is compared to other alternatives or focus on the reasons why a proposed environmental action is supported or opposed. Psychometric techniques probe subjects' reasons for thinking a potential source of environmental change is either benign or worrisome and the implications for regulations or other management options.

4.12. OPINION AND ATTITUDINAL SURVEYS cont.

Type	Sociocultural Assessment Method
Example	McDaniels et al. (1997) examined lay and expert perceptions of the ecological risks associated with human activities that could adversely affect water resources. Psychometric techniques are used to characterize human health risks in terms of specified characteristics; these underlying factors, including benefits, knowledge, and controllability, explain a great deal of the variability in lay judgments about ecological risks and their perceptions of the need for regulation or specific actions.
References	McDaniels, T., L. Axelrod, N. Cavanagh, P. Slovic and R. Dunlap. 1997. Perception of ecological risk to water environments. Risk Anal. 17:341-352. Schuman, H. and S. Presser. 1996. Questions and Answers in Attitude Surveys. Sage Publications, Thousand Oaks, CA.

4.13. REFERENDA

Type	Sociocultural Assessment Method
Description	Many different types of referenda or voting procedures have been used to estimate values for water quality and other environmental services. In a typical case, the residents of an area are asked to vote for or against a proposed action that is described in terms of its anticipated benefits, costs, and risks. A vote in favor of the action means that the person values the initiative, for example, an improvement in water quality in a local river, at least as highly as the cost he or she is asked to sacrifice.
Advantages	Referenda are commonly used and are viewed as a familiar approach to valuation. The problem context can be described in some detail, alternative policies can be provided (e.g., people can be asked to vote yes or no for one option or they can be asked to vote for their favorite among many actions), and it is relatively easy to compare results across different time periods. In contrast to most survey techniques, referenda often involve large numbers of people, thus lending themselves easily to statistical analyses and having the potential to provide a genuinely representative point of view.
Disadvantages	As with other questionnaires, a referendum is subject to biased interpretation as the result of question order or wording or the presence of accompanying information (e.g., photos, intentionally leading descriptions). Because of the large numbers of people involved, referenda can be quite expensive to undertake. Referenda also can take many forms, from carefully structured approaches to more casual questions, so it can be difficult to interpret whether the results of a vote should be considered legitimate.
Outcomes	A common outcome is an understanding of the percentage of people who favor or are opposed to the described action(s).
Example	McDaniels (1996) used a structured referendum, based on the techniques of decision analysis, to examine the choice among three options for treating sewage from the mid-sized coastal city of Victoria, Canada. Based on the results of small-group discussions, all three options were described in terms of their anticipated impacts on environmental, health, aesthetic, and economic objectives. About 34,000 voters participated in the actual referendum, in which the status quo (no treatment) option was identified as the preferred risk management scheme.

4.13. REFERENDA cont.

Type	Sociocultural Assessment Method
References	Magelby, D. 1984. Direct Legislation. Johns Hopkins University Press, Baltimore, MD. McDaniels, T. 1996. The structured value referendum: Eliciting preferences for environmental policy alternatives. J. Policy Anal. Manage. 15:227-251. McDaniels, T. and K. Thomas. 1999. Eliciting preferences for land use alternatives: A structured value referendum with approval voting. J. Policy Anal. Manage. 18:264-280.

4.14. AFFECTIVE IMAGES

Type	Sociocultural Assessment Method
Description	The positive and negative images associated with policy options can be used to gain insights about why, and to what extent, people value different environmental and water quality actions. Questionnaires using these images are particularly helpful when people's perceptions reflect poorly understood fears, hopes, and worries that may correctly or incorrectly be associated with a proposed initiative.
Advantages	Images are easy for people to work with and it is not difficult to elicit responses. The approach is relatively inexpensive to implement and can readily yield useful information about some of the factors likely to influence community feelings about a proposed environmental management initiative.
Disadvantages	The ease of responding to affective images can lead to problems because the gut-level responses may easily be biased or they may refer to a broader set of issues and concerns than the ones supposedly under consideration. Thus, it may be difficult to tie the results of an image-based survey to the specific policy question or initiative under study.
Outcomes	The usual outcome of an image-based survey is a ranking of the various possible components that might underlie perceptions of the merit of an initiative. Such rankings, for example, on a 1 to 7 scale from "least" to "most," can provide a useful understanding of the affective and cognitive reactions that underlie responses to a proposed action.
Example	Slovic et al. (1991) used images associated with people's negative perception of nuclear risks to demonstrate how the siting of a nuclear repository could lead to negative economic and social impacts. The approach linked perceptions of risk, stigmatization, and the potential for socially amplified reactions to images of the site and to how participants' expressed psychological and attitudinal responses could affect behavioral variables such as employment, tourism, and retirement decisions.
References	Loewenstein, G., C. Hsee, E. Weber and N. Welch. 2001. Risk as feelings. Psychol. Bull. 127:267-286. Slovic, P., M. Layman, N. Kraus, J. Flynn, J. Chalmers and G. Gesell. 1991. Perceived risk, stigma, and the potential economic impacts of a high-level nuclear waste repository in Nevada. Risk Anal. 11:683-696.

4.15. NARRATIVE

Type	Sociocultural Assessment Method
Description	Narrative methods use the familiar act of telling stories as a way to provide a useful perspective on understanding community preferences for water quality or other environmental concerns. Often using the first person, narrative approaches set the decision context by telling about or quoting an individual's experience, often comparing past to current conditions, and then asking participants to either report their emotional response (e.g., after reading a selected passage) or to engage in a valuation exercise.
Advantages	The advantage of a narrative approach is that it is familiar and can help capture the more affective dimensions of an environmental valuation problem, thus having the potential to help decision-makers gain a more complete understanding of the relevant value dimensions. Stories also occupy a central place in many nonscientific and nonwestern cultures, so narratives can prove to be particularly effective when community stakeholders include aboriginal representatives (e.g., Native Americans) or participants from nonwestern cultures.
Disadvantages	Although there is a strong theoretical basis for including narratives as an approach to understanding community attitudes, there are few practical rules to help the analyst in setting up an effective or defensible narrative context. This is problematic because the down side of narration's ability to tap into emotions is its ability to bias; thus, different stories generally will lead to different evaluations, and frequently there is little normative basis for selecting a preferred narrative context. In addition, making a link between attitudes expressed using narrative approaches and policy-relevant values can be difficult.
Outcomes	The result of a narrative judgment can take the form of a ranking or rating attitudinal expression, which then can be linked to values through a paired comparison (Section 4.16) or willingness-to-pay or other judgment task. These attitudes and valuations are based on the context established as part of the narrative description of the problem and can be designed to emphasize different aspects of the management context.

4.15. NARRATIVE cont.

Type	Sociocultural Assessment Method
Example	Satterfield et al. (2000) used narrative techniques to examine participants' responses to proposed environmental policy changes involving trade-offs between hydroelectric power production and salmon populations in a river. Modified narrative story techniques were compared with more utilitarian descriptions of the problem, such as those that might be used as part of a contingent valuation context. Narrative techniques were shown to be better able to help participants consider relevant value information and apply this knowledge to a complex policy environment; the authors conclude that this is in part due to the ability of story-based methods to more fully capture the affective and emotional dimensions of many environmental policy contexts.
References	Satterfield, R., P. Slovic and R. Gregory. 2000. Narrative valuation in a policy judgment context. Ecol. Econ. 34:315-331. Shanahan, L., L. Pelstring and K. McComas. 1999. Using narratives to think about environmental attitude and behavior: An exploratory study. Soc. Natur. Resour. 12:409-419.

4.16. DAMAGE SCHEDULES

Type	Sociocultural Assessment Method
Description	Damage schedules use surveys that present respondents with a relatively simple judgmental mechanism of paired comparisons to provide estimates of the gains and losses and relative (not necessarily monetary) value of various nonmarket ecological services and/or natural resource damages. The resulting rating "schedules" are similar to those used by the courts in personal injury cases, for example, to establish the relative value of nonpecuniary losses associated with different injuries.
Advantages	Provides an accessible and easily understood mechanism for estimating the relative value of nonmarket environmental services or natural resource damages. The judgmental task of making paired comparisons of value is relatively easy and the parallel with standard "workmen's compensation" and other procedures lends legitimacy to the approach. The method does allow internally consistent judgments from selected participant groups to be linked to policy responses, incentives, and proposed compensation or mitigation options.
Disadvantages	The resulting damage schedule is limited to the specific resource losses, services, and/or policy options included in the analysis. Therefore, the results may be difficult to generalize to other losses, services, and policy options.
Outcomes	A schedule that provides a scale for the relative value of different resource losses, services, and policy responses based on structured input from community members.
Example	Chuenpagdee et al. (2001) used damage schedules to help determine the relative value of potential environmental and economic losses to important fisheries habitats in Thailand. Both expert and lay participants were asked to make paired-comparison judgments that, in turn, helped develop a schedule of sanctions, restrictions, and damage awards that provided a measure of the relative importance of different water-based environmental resources and provided input into feelings about proposed changes in their availability and quality.
References	Chuenpagdee, R., J. Knetsch and T. Brown. 2001. Environmental damage schedules: Community judgments of importance and assessments of losses. Land Econ. 77:1-10.

4.17. CONTINGENT VALUATION (CV)

Type	Economic Assessment Method
Description	Contingent valuation (CV) uses survey questions to elicit individuals' values, in monetary terms, for specified "commodities" (e.g., goods, services, or changes in conditions) that are typically not available for purchase in existing markets. To make up for the absence of an existing market, this method presents respondents with a hypothetical situation in which they have the opportunity to buy the commodity. CV surveys usually consist of three main parts: • a detailed description of the "commodity" and a hypothetical set of circumstances under which it could be purchased • questions to elicit the maximum amount individuals would be willing to pay for the commodity, and • questions about respondents' characteristics or opinions, which might influence or be related to their WTP (e.g., income, age, concern about stormwater runoff).
Advantages	The CV method is very flexible and can be adapted to estimate individuals' values, in monetary terms, for a wide variety of commodities. It is particularly useful for measuring values for "nonmarket commodities," such as improvements in environmental conditions, which are typically not available for individuals to purchase. It is also particularly useful for capturing nonuse values (i.e., values that are not associated with individuals' use of or interaction with the commodity). Compared with conjoint analysis (Section 4.18), it is also particularly useful for measuring values for commodities when one is interested in the value of the commodity as a whole, rather than values for different subcomponents of the commodity. It is also useful when the commodity to be valued is relatively unfamiliar to the respondent and, therefore, requires significant introduction and description.
Disadvantages	The values expressed through CV surveys are difficult to validate because they are based on hypothetical scenarios. The values may also be influenced by the way in which the survey is constructed and administered. WTP estimates can be biased (overstate or understate true WTP) if survey participants act strategically in their responses or if they inadvertently respond differently, depending on how the commodity or CV scenario is presented to them. These potential biases can best be avoided through careful, well-researched design and extensive pretesting of the survey instrument.

4.17. CONTINGENT VALUATION (CV) cont.

Type	Economic Assessment Method
Outcomes	CV survey data can be used to estimate how WTP for the defined commodity varies across the studied population and how it depends on characteristics of the population. Depending on how the survey is constructed, it also may provide information on how WTP varies with respect to different levels or features of the commodity. These values can be used to quantify (in monetary terms) and directly compare the benefits (and/or costs) of defined changes resulting from, for example, watershed management policies.
Example	In one of the pioneering applications of the CV method, Smith and Desvousges (1986) administered a survey to a random sample of adults in southwestern Pennsylvania and elicited their WTP for three defined changes in water quality in the Monongahela River: (1) preventing water quality from falling to below-boatable levels, (2) improving water quality from boatable to fishable levels, and (3) improving water quality from fishable to swimmable levels. Their analysis provides average WTP estimates for each type of change, for both users and nonusers of the water resource.
References	Bateman, I.J., R.T. Carson, B. Day et al. 2002. Economic Valuation with Stated Preference Techniques: A Manual. Edward Elgar, Ltd., Northampton, MA. Mitchell, R.C. and R.T. Carson. 1989. Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future, Washington, DC. Smith, V.K. and W.H. Desvousges. 1986. Measuring Water Quality Benefits. Kluwer-Nijhoff, Boston, MA.

4.18. CONJOINT ANALYSIS

Type	Economic Assessment Method
Description	Conjoint analysis uses surveys to estimate the relative importance and value that individuals associate with different attributes of a commodity. For this method, a commodity is defined strictly in terms of its main components—a list of attributes. For example, a house would be described strictly according to its features, such as its age, size, number of rooms, and distance to local amenities. A conjoint survey presents respondents with commodities that differ only in the levels of each attribute that are present (e.g., a 15-year-old house that has six rooms and is 2 miles from a school or a 50-year-old house that has eight rooms and is 3 miles from a school). It asks respondents to compare and state their preferences for the described commodities. It then uses the survey responses to infer preferences and values for the separate attributes of the commodity. Like contingent valuation (Section 4.17), it can be used to estimate dollar values for commodities and/or attributes that are typically not available in existing markets, such as the various environmental changes resulting from a watershed management policy.
Advantages	The conjoint analysis method is very flexible and can be adapted to estimate individuals' values for a wide variety of commodities and attributes. It can be used to estimate the relative importance of and trade-offs individuals are willing to make among different attributes of a commodity. Consequently, it is particularly useful for measuring preferences for commodities that have multiple attributes and for nonmarket commodities. Conjoint surveys usually present respondents with a series of commodity choices; therefore, they can be used to collect extensive preference information from each respondent. In principle, they also can be used to estimate values for commodities or attributes that include nonuse values.
Disadvantages	The values expressed through conjoint surveys are difficult to validate because they are based on comparisons of hypothetical commodities. Designing an appropriate conjoint instrument typically requires specialized technical expertise and extensive pretesting of the instrument. Because conjoint surveys ask respondents to compare commodities with multiple dimensions (attributes), they are less appropriate when the individual attributes being evaluated are themselves complex and difficult to describe to respondents. Estimating monetary values based on conjoint survey data also requires specialized technical expertise.

4.18. CONJOINT ANALYSIS cont.

Type	Economic Assessment Method
Outcomes	Conjoint data can provide estimates of WTP and individuals' rates of trade-off for a wide variety of attributes and commodities, and it can be used to estimate how these values and trade-offs depend on characteristics of the population. These estimates can be used to quantify and directly compare the benefits (and/or costs) of multiple changes resulting from, for example, watershed management policies.
Example	Conjoint methods have been used to estimate values for regional changes in several dimensions of water quality (Magat et al., 2000; Viscusi et al., 2004). Using a computer-based instrument, respondents from across the country were asked to compare communities (the "commodity") that differed with respect to the following attributes: (1) cost of living, (2) percentage of waters safe for fishing, (3) percentage of waters safe for swimming, and (4) percentage of waters that support aquatic life. Analysis of the survey data provided WTP estimates for percentage changes in each of the water quality attributes.
References	Bateman, I.J., R.T. Carson, B. Day et al. 2002. Economic Valuation with Stated Preference Techniques: A Manual. Edward Elgar, Ltd., Northampton, MA. Louviere, J., D. Hensker and J. Swait. 2000. Stated Choice Methods: Analysis and Application. Cambridge University Press, New York, NY. Magat, W.A., J. Huber, W.K. Viscusi and J. Bell. 2000. An iterative choice approach to valuing clean lakes, rivers, and streams. J. Risk Uncertainty. 21(1):7-43. Viscusi, W.K., J. Huber and J. Bell. 2004. The value of regional water quality improvements. Discussion Paper No. 477. The Harvard John M. Olin Discussion Paper Series.

4.19. HEDONIC PROPERTY VALUE

Type	Economic Assessment Method
Description	The hedonic property value method uses data on housing prices and attributes of properties to decompose prices and estimate separate values for each of the property attributes. These attributes typically include structural characteristics (e.g., lot size, square footage, number of rooms), but they can also include various neighborhood and local amenity or environmental characteristics.
Advantages	The hedonic property value method uses data resulting from human behaviors in existing, well-established markets rather than from hypothetical market scenarios. It can be used to estimate households' WTP for small changes in a wide variety of local conditions (including environmental conditions) as long as these conditions differ to some extent across the properties used in the analysis, can be measured in quantitative terms, and can be observed or perceived by home buyers.
Disadvantages	This method requires extensive and rather specialized data, which may not be available for the area or issue of interest. Moreover, conducting the data analysis and estimating appropriate monetary values requires specialized technical expertise. For example, this method provides a set of marginal WTP coefficients on each explanatory variable (i.e., the marginal WTP for a unit increase in water quality improvement) which is not trivial to take and estimate a total WTP for a community contemplating a large change in water quality. It cannot be used to estimate nonuse values because these values are not reflected in (i.e., capitalized into) property values.
Outcomes	Hedonic property value analyses can provide estimates of individuals' WTP for changes in local conditions, including the level of environmental quality and the provision of local public services, amenities, and disamenities. These estimates can be used to quantify and directly compare the benefits (and/or costs) of multiple changes resulting from, for example, watershed management policies.
Example	The hedonic method has been applied in several studies to estimate values for changes in local water quality conditions. Using local housing prices and attribute data for properties near specific water bodies, these studies have found that prices are positively related to water quality measures, such as the clarity (visual depth) of the water. The measured effect of water quality on housing prices provides an estimate of local households' average WTP for improvements in water quality.

4.19. HEDONIC PROPERTY VALUE cont.

Type	Economic Assessment Method
References	Boyle, K.J., P.J. Poor and L. Taylor. 1999. Estimating the demand for protecting freshwater lakes from eutrophication. Am. J. Agri. Econ. 81(November):1118-1122. Leggett, C. and N. Bockstael. 2000. Evidence of the effects of water quality on residential land prices. J. Environ. Econ. Manage. 39(2):121-144. Palmquist, R.B. 2005. Property value models. In: Handbook of Environmental Economics, Vol. 2: Valuing Environmental Changes. K. Mäler and J.R. Vincent, Eds. Elsevier, New York, NY. p. 763-820.

4.20. RECREATION DEMAND

Type	Economic Assessment Method
Description	Recreation demand methods use data on observed recreation behaviors to estimate individuals' demand and values for specific recreational resources. They also are used to estimate how demand and values are affected by the characteristics of the available resources (including environmental quality) and of the studied population. In these models, the price of recreation is measured as the dollar value of time and other spending required to travel to the resource.
Advantages	Values from recreation demand methods are based on actual human behavior rather than stated behaviors from a hypothetical context. They are useful for measuring values for recreational services from natural resources and for measuring how these values depend on the environmental quality and other characteristics of the resources.
Disadvantages	This class of methods often requires extensive and rather specialized data. Data on human behavior and characteristics must usually be collected through surveys and then matched with other data on the characteristics of the recreational resources. Moreover, conducting the data analysis and estimating appropriate monetary values requires specialized technical expertise. Models that include all of the relevant recreation choices (i.e., whether, where, when, and how often to recreate) can be particularly complex to estimate. Linking recreation demand WTPs to water quality levels can also be complex; WTP estimates must range across the water quality levels and researchers must have enough data to control for other variables. Recreation demand methods can be used to estimate only those values associated with recreational activities; therefore, for example, it cannot be used to estimate nonuse values. Estimated values often are very sensitive to the modeling assumptions, such as the assumed dollar cost assigned to travel time.
Outcomes	Recreation demand methods can be used to estimate the value individuals' receive from having access to specific recreational resources (i.e., recreation sites). They also can provide estimates of how these values are affected by changes in the characteristic of the resources (including environmental quality) and by the characteristics of the individual as well. These estimates can be used to quantify and directly compare the recreation-related benefits (and/or losses) of changes to recreational resources resulting from, for example, watershed management policies.

4.20. RECREATION DEMAND cont.

Type	Economic Assessment Method
Example	Recreation demand modeling has been applied in several studies to estimate recreation-based values for changes in water quality conditions. Using a variety of survey methods to collect data on recreation behaviors and personal characteristics, and combining with data on water quality conditions at potential recreation sites, many studies have found an association between recreation choices and water quality. Based on individuals' observed trade-offs between time of travel to recreation sites (cost) and experiencing better water quality (benefits), these studies estimate the value associated with better water quality. For example, Parsons and Hauber (1998) estimated a recreation site choice model for freshwater anglers in Maine, and using this model, they estimated benefits to anglers of cleaning all Maine lakes to meet EPA standards.
References	Parsons, G.R. and B. Hauber. 1998. Spatial boundaries and choice set definition in a random utility model of recreation demand. Land Econ. 74(1):32-48. Phaneuf, D.J. and V.K. Smith. 2005. Recreation demand models. In: Handbook of Environmental Economics, Vol. 2: Valuing Environmental Changes. K. Mäler and J.R. Vincent, Eds. Elsevier, New York, NY. p. 671-762.

4.21. AVERTING BEHAVIOR

Type	Economic Assessment Method
Description	To protect themselves from environmental risks, individuals often engage in behaviors to reduce their exposures. Averting behavior methods study these behaviors to measure individuals' values for reducing these risks. Simpler versions of these methods measure how much is spent on these behaviors and how these expenditures vary with respect to external conditions (averting expenditure methods). In certain cases, observing how much individuals reduce their averting expenditures in response to an improvement in the quality of their tap water may not be a good estimate of their WTP to improve their tap water (e.g., if WTP includes pain and suffering or change in productivity losses). More complex versions also measure the extent to which these behaviors reduce individuals' risks (household production methods).
Advantages	Values estimated with these methods are based on actual human behavior rather than stated behaviors in a hypothetical context. They are particularly useful for measuring values for reducing potentially harmful environmental exposures to humans. The simpler averting expenditure methods can be relatively easy and inexpensive to implement because they mainly require information on how much individuals spend on these behaviors (e.g., bottled water purchases) in relation to environmental conditions, whereas the more complex behavior methods provide more exact measures of WTP because they include estimates of how these behaviors affect exposures and risk.
Disadvantages	Although relatively inexpensive, the simpler averting expenditure methods do not provide very accurate estimates of WTP to reduce risks. The more complex averting behavior methods provide more accurate estimates of WTP; however, they require more extensive and specialized data and more complex analysis methods to estimate WTP. Averting behavior methods are useful in situations where individuals actively engage in the behaviors and it is possible to measure the dollar cost of these behaviors. Also, if these behaviors produce other benefits (e.g., bottled water provides better tasting as well as safer water), then it is much more difficult to use these methods to specifically isolate values for reducing harmful exposures. Finally, values based on these methods assume that subjects have a reasonably good understanding of what is being averted. If risks are not well understood, then averting behaviors may not give a good indication of value.

4.21. AVERTING BEHAVIOR cont.

Type	Economic Assessment Method
Outcomes	Averting behavior methods can provide estimates of the value individuals place on reducing potentially harmful or damaging environmental exposures, including damages to health or property. They also can provide estimates of how these values are affected by personal characteristics. These estimates can be used to quantify and directly compare the benefits (and/or losses) of changes in environmental exposures resulting from, for example, watershed management policies.
Example	Averting expenditure methods have been used widely to estimate losses that could be avoided by preventing drinking water contamination. For example, Collins and Steinback (1993) surveyed almost 900 households in rural West Virginia with wells that tested positive for bacteria and other contaminants. They estimated average costs for filtering/treating or using alternative sources of water ($42 in 2004 dollars). This value is best interpreted as a lower-bound estimate of the average household's value for eliminating the observed contamination. Unfortunately, no applications of the more complex household production methods are reported in the literature estimating values for reduced water contamination.
References	Abdalla, C.W., B.R. Roach and D.J. Epp. 1992. Valuing environmental quality changes using averting expenditures: An application to groundwater contamination. Land Econ. 68:163-169. Collins, A.R. and S. Steinbeck. 1993. Rural household response to water contamination in West Virginia. Water Res. Bull. 29:199-209. Dickie, M. and S. Gerking. 1991. Valuing reduced morbidity: A household production approach. South. Econ. J. 57(3):690-702.

4.22. MARKET MODELS

Type	Economic Assessment Method
Description	This method measures changes in consumer surplus and producer surplus in markets affected by specific policies or changes in environmental conditions. When these policies or changes in environmental conditions directly affect production costs or the demand for specific market goods/services, then producers and consumers in the market experience gains or losses. This method estimates these gains and losses by modeling the market (i.e., price and quantity) adjustments that occur as a result of such a change.
Advantages	This method uses observed behaviors in actual markets to infer values for things that are not exchanged in markets (e.g., environmental quality changes). It is particularly useful when the nonmarket changes to be evaluated are strongly linked to an existing market, either because they directly affect the production costs or the demand for the market good or service. The method can be applied using existing data on prices and quantities in the affected market. Once the market model is established, measuring consumer and producer surplus changes is relatively straightforward.
Disadvantages	The method can be used only to estimate gains or losses that are experienced through the modeled market. Estimating the supply and/or demand relationships in the market and how they are affected by changes in environmental conditions can require specialized technical expertise. The method is considerably more complicated if the market to be modeled is not competitive or is affected by external price or quantity controls.
Outcomes	The method provides estimates of consumer surplus and/or producer surplus changes in an affected market. These dollar estimates can be directly compared or added to other benefits or cost estimates resulting from, for example, watershed management policies.
Example	Anderson (1989) modeled the market for Virginia hard-shell blue crabs using available market data for the period 1960 to 1987 and also estimated the effect of changes in seagrass habitat on supply conditions. Using this model, he estimated the changes in producer surplus for commercial crabbers and changes in consumer surplus for consumers of blue crabs that would result from policies to restore seagrass habitat.
References	Anderson, E. 1989. Economic benefits of habitat restoration: Seagrass and the virginia hard-shell blue crab fishery. N. Am. J. Fish. Manage. 9:140-149.

4.23. REPLACEMENT/RESTORATION COST

Type	Economic Assessment Method
Description	This method estimates losses associated with environmental degradation as the costs of replacing, restoring, and/or repairing damaged ecosystems or physical property. Correspondingly, it measures gains from environmental improvements as the replacement/restoration costs that would be avoided.
Advantages	The method requires less data, resources, and specialized expertise than most other economic valuation methods. The method is most appropriate when there is a high likelihood that the assumed replacement/restoration activities will occur as a result of damage. If individuals are willing to incur the expenses to repair the damages, it implies the value they associate with the damage is equal to or greater than these expenses (otherwise they would not voluntarily incur the expense). In other words, it implies that the replacement/restoration costs are a lower-bound estimate of actual losses.
Disadvantages	The method often requires strong assumptions about the types of changes humans would make as a result of environmental degradation. In particular, it assumes that specific restoration/replacement activities would occur in response to the degradation (e.g., flood-damaged properties would be repaired or replaced). If it is not actually known whether these activities are likely to occur, then the method is less appropriate because the costs of the activities will provide little information about individuals' values or preferences.
Outcomes	The method typically estimates the number of relevant units that are damaged (e.g., acres of wetland or number of homes) and the average cost of replacing or restoring the unit based on available market prices. The product of these two components provides an estimate of total damages.
Example	Ragan et al. (2000) used this method to estimate the benefits of reducing the salinity in the water supply in the Arkansas Valley of Colorado. The benefits were measured as the avoided costs to households of repairing and replacing appliances that are damaged by high salinity levels.
References	Ragan, G.E., R.A. Young and C.J. Makela. 2000. New evidence on the economic benefits of controlling salinity in domestic water supplies. Water Resour. Res. 34(4):1087-1095.

4.24. BENEFIT TRANSFER

Type	Economic Assessment Method
Description	This method relies on results from existing economic studies to estimate the benefits of improving environmental conditions and/or ecosystem services. It adapts and transfers value estimates from the location or context of the existing studies and applies these estimates to the policy location or context of interest.
Advantages	This method generally requires little if any primary data collection; therefore, it is relatively inexpensive to apply. It does not require the same level of technical expertise that is typically required for conducting original stated or revealed preference analyses. It generally is most appropriate for providing rough or first-cut benefits estimates when time and resources are limited. It also is most appropriate when value estimates are available in the literature, are of good quality, and measure values for changes and contexts that are similar to the policy changes and context of interest.
Disadvantages	Benefit transfers rely entirely on what is available in the existing literature, and they are directly limited by the quality and accuracy of the existing results. They also are limited by the amount of relevant data and information reported in the existing studies. They are less reliable and appropriate when there are significant differences between the context of the existing studies and the policy context of interest. Values based on benefit transfer also may be viewed as less acceptable by community members, if the estimate that is used is derived from elsewhere and is transferred to their situation.
Outcomes	Most benefit transfers use information from existing studies to estimate an average "unit value" (e.g., value per fishing day, per acre of wetland, per health effect avoided). These unit values are then multiplied by corresponding estimates of the number of units that change as a result of the policy to estimate the aggregated benefits of the policy.
Example	Morgan and Owens (2001) used results from an earlier study (Bockstael et al., 1989) to estimate the aggregate benefits of observed improvements in Chesapeake Bay water quality. Bockstael et al. previously used revealed and stated preference methods to estimate average WTP per person (beach users, boaters, and bass fishers) for a 20% improvement in Bay water quality. Morgan and Owens rescaled these estimates to apply to a 60% improvement and multiplied them by updated estimates of the number of beach users, boaters, and bass fishers.

4.24. BENEFIT TRANSFER cont.

Type	Economic Assessment Method
References	Bockstael, N.E., K.E. McConnell and I.E. Strand. 1989. Measuring the benefits of improvements in water quality: The Chesapeake Bay. Mar. Res. Econ. 6:1-18. Brander, L., R. Florax and J. Vermaat. 2006. The empirics of wetland valuation: A comprehensive summary and a meta-analysis of the literature. Environ. Resour. Econ. 33(2):223-250. Morgan, C. and N. Owens. 2001. Benefits of water quality policies: The Chesapeake Bay. Ecol. Econ. 39(2):271-84. Rosenberger, R. and J. Loomis. 2003. Benefit transfer. In: A Primer in Nonmarket Valuation, P. Champ, K. Boyle and T. Brown, Eds. Kluwer Academic Publishers, Norwell, MA.

4.25. ECONOMIC IMPACT ANALYSIS

Type	Economic Assessment Method
Description	This method is designed to measure policy-related changes in specific economic indicators, such as changes in expenditures and sales, employment levels, incomes, and tax revenues. It rarely has anything to do with preferences or welfare as interpreted in economics; rather, this method measures indicators such as expenditures/sales, profits, and employment in sectors of the economy that are directly related to the resource. Economic impact models vary in geographic scope (e.g., local, state, and/or region) and the number of different economic sectors included; however, they are usually based on assumed "input-output" (I/O) relationships between the selected sectors. They begin by measuring direct effects (i.e., changes in the economic indicators for the sector most directly affected by the program or policy). They then use the assumed I/O structure to measure indirect effects (i.e., changes in economic indicators for other sectors, in particular those that buy from or sell to the directly affected sector). They also measure induced effects (i.e., changes in the economic indicators that result from changes in income and, thus, expenditures) by households.
Advantages	The data and analytical requirements for this method are typically low compared with other methods. The resulting estimates are easy to communicate and interpret.
Disadvantages	The economic indicators used in this method are often not conceptually valid measures of preferences or human welfare. For example, expenditures/sales provide a gross measure of economic activity, which does not account for the direct or indirect costs associated with the activity. These methods also usually do not measure how the economic indicators are related to the extent or quality of the resource. Moreover, the I/O structures used in these models are usually quite rigid and do not account for changes in market prices or how these price changes are likely to affect market transactions. For these reasons, economic impact models are generally not used in BCA.
Outcomes	Aggregate measures of changes in economic activity related to a specific program or policy, or aggregate measures of economic activity in sectors directly related to a natural resource.
Example	The Greeley-Polhemus Group (2001) conducted a study for the Maryland Department of Natural Resources that estimated expenditures on recreational activities and commercial values of coastal properties for the coastal bays in Worcester County, MD.

4.25. ECONOMIC IMPACT ANALYSIS cont.

Type	Economic Assessment Method
References	The Greeley-Polhemus Group, Inc. 2001. An Assessment of the Economic Value of the Coastal Bays' Natural Resources to the Economy of Worcester County, Maryland. Final Report. Prepared for the Maryland Department of Natural Resources.

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