

HANDBOOK FOR ESTIMATING THE ECONOMIC VALUE OF CHANGES IN FISH AND WILDLIFE-RELATED RESOURCES

May 1996



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Attached for your reference is the subject document, prepared by the Economics Group, Technical Service Center, in cooperation with Environmental and Planning Coordination staff in the Program Analysis Office. The handbook was prepared in response to periodic inquiries received from Reclamation study managers regarding the monetary value of various environmental enhancement actions; in particular, a section on non-use value is included.

Please contact Bob Hamilton at (303) 236-8080, extension 526, if you have questions or comments concerning this handbook or if you want additional copies.

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**HANDBOOK FOR ESTIMATING THE ECONOMIC VALUE OF
CHANGES IN FISH AND WILDLIFE-RELATED RESOURCES**

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May 1996

Preface

This handbook is intended to convey the economic concepts related to valuing fish and wildlife and their habitat. Often these resources are enhanced (or in some cases degraded) through actions of Reclamation and other agencies and these changes need to be considered in the evaluation process. This handbook is intended to provide guidance to that effect with the intended audience being those who are not economists, but may need to have a brief understanding of these economic issues when making decisions affecting public resources.

This is intended to be a general guide, but not providing detailed information necessary to be able to perform all the techniques described. Numerous publications exist which describe these techniques and this publication is not intended to be a replacement for those.

The contents of this document emphasize the concepts necessary to understand nonmarket valuation techniques. After the introduction is a brief discussion of economic theory. This section includes the economic concepts underlying economic valuations of public resources. For the reader who finds this discussion of economics to be brief, economic theory is provided in greater detail in the appendix. Following the section on economic theory are two sections discussing techniques for determining both use and nonuse economic values for fish and wildlife resources. Included in these sections are tables showing sample economic values for resources, having used the techniques described.

The pages in this document are divided into two columns. The wider column is intended to be the main text of the document, with the narrow column providing summaries of the material to help the reader find components more easily. Key words are in *italics* when they are presented and defined the first time, with the intention that this will help the reader locate the definitions for these concepts.

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INTRODUCTION

INTRODUCTION

This handbook is designed to help determine economic valuations for changes in fish and wildlife resources due to government activities or decisions. For example, actions by the Bureau of Reclamation may affect wetlands, stream-flow, land use, water temperature, or other environmental parameters. Habitat changes often cause impacts to fish and wildlife populations, affecting economic values of the public. Often agencies are interested in determining economic values of fish and wildlife effects for comparison to either habitat improvement costs or the value of other competing economic objectives.

The economic values provided by fish and wildlife include those derived from knowing the resource continues to exist (nonuse values) in addition to value from using the resource (use values). Often, economic studies are limited to measuring effects on consumptive outdoor recreation activities such as hunting or fishing, but other economic values may be relevant, particularly in the case of threatened or endangered species. This handbook summarizes common techniques used to determine the full range of economic values for fish and wildlife-related resources provided, managed, or impacted by government actions. Brief overviews of the techniques are provided after first addressing the underlying basic economic theory.

Why do we need economic analysis? Why bother?

Many of our natural resources create benefits for other reasons than providing traditional economic profits to our society. However, when we make decisions about using or changing the resources, these decisions are usually contemplated with economic values as one of the primary factors in the decision process. In order to compare impacts to resources of different levels of importance, it is

This handbook describes how economists value natural amenities and enhancements as a result of government actions.

Resources provide values to society through use or by knowing the resource exists. Values beyond traditional economic valuation techniques are a special interest of this handbook.

Economic choices affect our decision process when choosing how to use resources. As a society, we need to have knowledge of economic values to achieve optimal decisions.

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necessary to establish an economic value for all the resources in question. Without such a value, these resources would not be considered worth preserving in an economic decision framework if alternative uses existed.

Valuing public resources and other amenities, why is this difficult?

Many resources are not sold in private markets due to characteristics of the goods and have little or no market value. Therefore, the market value may not reflect the true social value.

Society values many goods that are not sold in a market place and therefore have no price. These *nonmarket goods* are either public goods (provided or preserved by government action) or do not have sufficient property rights to create marketability. Even for goods that could be provided by private markets, externalities and other characteristics may lead to non-optimal levels of use not reflecting true social values.

Nonmarket goods have economic value even though these values may be difficult to determine.

Do these goods still have economic value?

Even if goods are not sold in traditional ways and do not have a market price, they provide economic values to society. Economic theory recognizes that value received from goods and services are based on what individuals consider important whether or not these are exchanged in any market.

Resources without market values provide benefits to society and have values.

Society has shown that resources not having market values still provide benefits similar to market goods because they increase the well-being of our society. Goods have economic value as long as individuals are willing to trade other goods with economic value for them. Economists measure these values in terms that are recognized by society, using dollars to measure them.

Economic values of all resources lead to optimal management decisions.

While we may not directly associate wildlife habitat or other amenities with dollar values in the same way we think about the value of goods such as groceries or tickets to sporting events, we need to

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determine values for comparison purposes when making management decisions concerning use of these resources.

Is there justification for determining economic values for resources not priced in the market?

Since the 1950s government agencies have supported decisions that determine economic values for natural resources. At that time, an inter-agency committee on water resources published a report commonly referred to as "The Green Book", (Inter-Agency Committee on Water Resources 1958) providing for economic analysis related to water projects comparing benefits and costs. In 1962, the concept of nonmarket valuation was further developed by the publication commonly referred to as "Principles and Standards" by the Water Resources Council, published in U.S. Senate Document 97 (U.S. Water Resources Council 1962). This document indicated that economic values should include nonmarket recreation benefits in addition to more traditional benefits and costs.

Additional development of nonmarket economic valuations continued with revisions of the Principles and Standards by Water Resources Council. The latest revision, published in 1983 and referred to as "Principles and Guidelines," recognized the contingent valuation method, travel cost method, and unit day value method for use by federal agencies (U.S. Water Resources Council 1983). These methods will be discussed later in this document. The "Principles and Guidelines" also clearly described the "willingness to pay" principle underlying national economic development benefits.

Other agencies also added to the development of nonmarket economic valuation. For example, the Forest Service included standards in the *Forest and Rangeland Renewable Resources Planning Act* (1974). In 1976, the Bureau of Land Management

Government decisions have upheld the concept of nonmarket valuation. Many of these decisions have provided standards for determining values.

Development of nonmarket valuation standards has continued with the 1983 revision of "Principles and Guidelines." This document suggests three methods of valuing resources, which are discussed later in this handbook.

Numerous agencies have supported developments in valuation techniques since the 1950's, including the Forest Service and the

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Bureau of Land Management.

In addition to Federal Agencies, nonmarket valuation techniques have been supported by a U.S. Court decision. Also, a panel of laureate economists supported aspects of nonmarket valuations.

One additional point to be considered is the impact on downstream users. Benefits can be substantial for these off-site changes in water quality.

published the *Federal Land Policy and Management Act*.

The contingent valuation method has been validated for use in valuing natural resource damages in federal court with the decision of *Ohio v. U.S. Department of the Interior* (U.S. Court of Appeals 1989). Recently, contingent valuation was reviewed by a panel of laureate economists who determined that it produced estimates reliable enough for administrative and judicial determinations (NOAA 1993).

It should be mentioned that, while this handbook is focused on nonmarket valuations, habitat changes can have broader implications. Agency actions can affect water quality at the site (and local fish and wildlife) and also affect downstream users, off-site. These off-site benefits should be considered when an economic analysis is performed. For example, these downstream users can be municipal, industrial and agricultural users.

ECONOMIC THEORY OF NONMARKET VALUES

ECONOMIC THEORY OF NONMARKET VALUES

The following is a brief discussion of the economic concepts related to economic valuation methods. A more detailed discussion of economic theory underlying the valuation techniques is available in the appendix for the interested readers.

Goods are usually traded in markets. Each person tries to maximize their own well-being through market transactions, willing to pay more for goods considered to have higher values. Each individual maximizes a personal level of value for each dollar spent. Economists theoretically call this personal level of value "*utility*," a concept which is not observable. Therefore, levels of "*utility*" cannot be measured or levels compared between individuals.

In a perfectly competitive market, each good is available at a given price to all customers even though some individuals may be willing to pay more. Also, individuals are often willing to pay more for the first unit of a good with each subsequent purchase possessing less value because it provides less enjoyment. If the seller could charge a price equal to the willingness to pay for each individual sale, greater profits could be earned. If this were possible, then the seller is said to "perfectly discriminate" among all purchasers.

What is net willingness to pay?

In competitive markets, perfect discrimination is not possible and a common price is charged for all sales at a given moment in time. The lost profits, those that could have been earned under "perfect discrimination" of price, are then a benefit to the consumer, referred to as *net willingness to pay*.

Individuals maximize personal level of value, called *utility*, by trading goods, creating a market for much of the economic activity.

The price of a good is the same for all customers in a perfectly competitive market. However, some customers would be willing to pay a higher price. The difference is net *willingness to pay*.

ECONOMIC THEORY OF NONMARKET VALUES

Net willingness to pay and producers' profits measure economic efficiency. Market imperfections, such as monopolies, reduce economic efficiency by reducing total value.

Public goods exist because private ownership is not efficient. Society has a difficult time determining values for these goods, referred to as *nonmarket goods*.

Values for nonmarket goods can be divided into *use values* and *nonuse values*.

Researchers have determined estimates of use values for many activities.

Economists recognize this net willingness to pay, along with the producers' profit, as the measure of economic efficiency. Economic efficiency is maximized with competitive markets, and is reduced whenever imperfect markets occur, such as monopolies. When the producer finds a way to capture some of the consumers' net willingness to pay, the producer would earn additional profit at the expense of the consumer, but economic efficiency would be reduced because the producer's profit increases at rates less than the decrease in consumers' net willingness to pay.

What are nonmarket goods?

Some goods cannot be privately owned in an efficient manner and are provided by the public sector. These goods are not sold in any market at their true value, but still provide substantial benefits to society. Because they are not priced, their economic value is more difficult to determine. These goods are referred to as *nonmarket goods*.

Separating use and nonuse values

Total economic value for nonmarket goods can be broken into use and nonuse values. *Use values*, as the name implies, occur because the resource is being used in some way. *Nonuse values*, also referred to as passive use values, occur without the holders of these values expecting to use them.

Use values are derived from activities making use of resources including fish and wildlife (hunting and fishing), land resources (hiking and skiing) and water resources (boating and rafting). There have been hundreds of studies providing use values for wildlife and habitat resources. Examples of these studies can be found in Walsh et al. (1988).

ECONOMIC THEORY OF NONMARKET VALUES

Consumptive and nonconsumptive components of use values

Use values can be further divided into consumptive and nonconsumptive components. *Consumptive use* refers to activities, such as hunting and fishing, that consume the resource. *Nonconsumptive use* recognizes that the recreationist can use the resource without actually removing it from its environment. Common nonconsumptive uses include wildlife photography, bird watching, and wildlife feeding. The term "nonconsumptive" reflects the nature of the activity and should not be confused with the consumption of goods used by the recreationist. Bird watchers, for example, who purchase (consume) binoculars, cameras, and other gear are still nonconsumptive users in regard to wildlife.

Some species provide both consumptive and nonconsumptive uses; for example, birds (such as ducks) could be both hunted and observed. Endangered species, however, usually provide only nonconsumptive use due to low population levels, if they provide any use at all. Often endangered species provide only nonuse values to society.

Nonuse values

Nonuse value recognizes that the public benefits from the preservation of the resource even when it is not used. People hold positive benefits from knowing that the amenity continues to exist, in the potential availability for future use, and with preservation for future generations. Research has shown that these values exist in substantial amounts (Brookshire et al. 1983; Walsh et al. 1987, Walsh et al. 1994). In some examples, nonuse values have represented from 70 to 95 percent of the total value for wildlife and wilderness areas (Loomis 1991, Walsh et al. 1987). Substantial nonuse values are likely to exist when resources are unique and when

Activities which provide use values can be further sub-divided into *consumptive* and *non-consumptive* uses.

Different species of fish and wildlife provide different components of use. Endangered species usually provide only nonuse values.

Nonuse values exist because people receive benefits from knowing species and resources exist even if they will never use them. Often, the nonuse values for a species is larger than the use values.

ECONOMIC THEORY OF NONMARKET VALUES

Nonuse values are substantial for unique types of resources.

Determining values for species and habitat often are called for when activity exists which require a policy decision affecting these resources. Valuing a change in habitat is often the technique for valuing the species which use the habitat.

Nonuse values exist for many types of resources in addition to threatened and endangered species.

loss would be irreversible, for resources such as endangered species, wetlands, and the Grand Canyon.

Measuring total values (use and nonuse) often are called for when actions occur that change species habitat. Projects that restore or re-establish habitat such as wetlands recovery, usually lead to changes in populations of species. Determining economic values for habitat also include values for the species involved. Also, determining economic values for one or more species implies values for the habitat. The same can be said for changes which reduce habitat or populations of species. Researchers often cannot or do not separate the implied effect on habitat when valuing species. For example, many studies which value a certain species, ask respondents to express values for changes in the habitat.

Examples of nonuse values in this handbook are related to threatened and endangered species. However, nonuse values are also applied to many resources not listed and using listed species as examples is not meant to imply that nonuse values only apply to these species which are mentioned.

MEASUREMENT TECHNIQUES FOR USE VALUES

MEASUREMENT TECHNIQUES FOR USE VALUES

Many methods have been developed for the purpose of measuring the use values of environmental amenities. Three methods have been recommended by the federal government for measuring use values, these being the *contingent valuation method (CVM)*, *travel cost method (TCM)*, and *unit day value method*. These three are designed to reflect user net willingness to pay (current economic guidelines, the "Principles and Guidelines," describe each method in some detail). In addition, values can be determined using existing models with a method known as benefit transfer. Other methods also have been used but are less desirable due to certain characteristics. These less acceptable methods are also discussed.

Contingent valuation method

Contingent valuation method (CVM) is a direct survey approach for estimating values. This technique can be used to value the current level of the resource or activity such as fishing, motorboating, and camping. It is especially useful when values need to consider hypothetical conditions or changes in quality, or projects not yet built.

This method is based on the assumption that attitudes and values can accurately and consistently be measured upon request and assumes that tastes and preferences are stable over time. This technique expands on the more traditional view of economic valuation that required an actual observed monetary expenditure in order to recognize an individual's willingness to pay.

Areas of continuing development for CVM

Because the CVM is not based on actual behavior, researchers have been concerned with possible biases related to the questionnaire design

Use value can be measured by the *contingent valuation method*, *travel cost method*, and *unit day value method*. Also, *benefit transfer* can provide values when other methods are not available. Other methods are less desirable as they are not supported by economic theory.

Contingent valuation is one method used to estimate nonmarket benefits. It uses a survey methodology to determine willingness to pay by individuals.

Researchers have expressed concern that lack of direct observation of

MEASUREMENT TECHNIQUES FOR USE VALUES

expenditures could lead to biased answers.

However, concern that respondents provide false answers on questionnaires is generally unwarranted. CVM values compare with results achieved by other techniques.

Studies have shown that CVM results are stable over time.

Descriptions of the good in question provide the basis for the valuation process. Respondents then state whether this good is worth the amount they are asked to pay.

and consumer behavior. Much of the current research has developed techniques for designing the questionnaires to overcome potential problems.

One such bias suggests that respondents could answer questionnaires incorrectly to influence the results of the study. While this is a valid concern, comparisons of results with those of other methods have shown that this is not usually a problem, with properly designed studies. Researchers have compared CVM results with results from other methods such as the travel cost method and simulated markets. These tests have shown that the values estimated by the CVM are consistently close to the comparable values (Carson et al. 1996). Unfortunately, comparisons of values from different techniques are only applicable to use values, as the CVM is the only technique available for estimating nonuse values.

Also, the CVM has been shown to be reliable over time, indicating stability in the determined values. Researchers have re-surveyed respondents valuing the same resource after an extended amount of time. These studies indicated consistency as the re-survey results were similar to the original values (Loomis 1989, 1990).

What is the general design of a questionnaire?

A survey begins with a description of the current and proposed quantity and quality of the resource in words and graphics. For the quantity of the resource being valued, the questionnaire must specify a payment method which would be imposed on the respondent. The proposal must clearly state what resource would be received if payment is made and what happens if payment is not paid. Currently, the referendum format is a popular way to state the willingness to pay question and is similar to voting on a bond issue. A referendum question is similar to the following: "Would you vote in favor of program ABC if

MEASUREMENT TECHNIQUES FOR USE VALUES

it cost your household \$X per year in higher federal taxes?" The referendum question technique was supported by a panel of laureate economists who were convened to determine the appropriateness of the CVM (NOAA 1993).

The sample needs to represent the overall characteristics of the population within the described region. Major economic and social characteristics of the sample, such as income, education levels, and gender distributions, are assumed to match the population of the area it represents. Data collected through the referendum approach is assumed to have a logit distribution, and analysis requires estimating the results with this in mind.

One additional concern, when conducting surveys of the public for use with the CVM (or any other technique requiring a survey, such as TCM) is that approval from the Office of Management and Budget (OMB) is necessary under the 1980 Paperwork Reduction Act. This approval is necessary when 10 or more persons are solicited. The approval process requires up to 120 days and can increase the cost and length of time required for the study. Additional information can be obtained from the Information Collection Handbook provided by OMB.

Travel cost Method

A second technique for valuing nonmarket goods is the *travel cost method (TCM)* which gathers information about the user's preferences by observing the user's visitation behavior. TCM is a good method for estimating values for resources currently being used, such as reservoir and recreational facilities. It is not a good technique as the CVM for estimating projects not yet built. Because the TCM observes actual behavior, it has been used in hundreds of studies. However, the TCM may estimate larger values than the CVM because it estimates the

The technique has been approved by a panel of laureate economists.

As in other scientific studies, a random sample needs to reflect the characteristics of the population from which it was drawn.

Use of the CVM requires approval from OMB as it is a technique requesting information from the public.

A second method is the travel cost method which obtains nonmarket values through observed behavior. For most recreational activities, travel cost is the largest expense required for participation. This technique has been used in numerous studies.

MEASUREMENT TECHNIQUES FOR USE VALUES

The TCM may give higher values for the same site when compared to the CVM because they may be measuring different goods.

The TCM acquires data through questionnaires and other sources. Numerous variables are used to estimate the value of the resource.

Travel cost method assumes that travel cost becomes a proxy for the price of the resource in question.

Other expenses also affect participation and are recognized in the valuation process.

TCM data usually includes only participants. Also,

value of a trip, which can include several activities while the CVM tends to value resources used for a limited number of activities. For example, a recreation site can provide substantial fishing, motorboating, and developed camping, all of which occur on the same trip and would be measured using the TCM. A study of the same site, using the CVM may value only resources supporting the one activity being considered by the research, such as the fishing component which can estimate a smaller value.

Often, data used in estimating the TCM are gathered with a questionnaire but can be acquired through other means. Data usually includes travel cost information, travel time and distance, length of time of the trip, length of time on-site, information on substitute sites, and site quality characteristics. Travel cost method provides good estimates of values for current conditions, but is difficult to use for anticipated changes or hypothetical conditions.

The TCM is based on the assumption that the cost to travel to the site is the largest cost of participation and can proxy for the price. It is based on the premise that increased cost of travel to a recreational site affects demand (use) in the same way as would a change in price, if price existed.

In addition to the travel costs, variables affecting recreational decisions include license and entrance fees plus on-site costs. The value received by the participant also is affected by the quality or attractiveness of the site. These variables affect the economic value of the site and are usually included in the valuation process. Additional variables to consider include the decision to recreate, site selection, trip frequency, length of stay, and site substitutability.

The TCM measures economic benefits for participants at recreation sites. Because

MEASUREMENT TECHNIQUES FOR USE VALUES

nonparticipants are not included in the sample data and trips are measured in integers rather than continuous values, advanced econometric methods are used to analyze the sample. Discrete values (integer values) are usually considered by modeling discrete distributions. Instead of using ordinary least squares, count data models (Poisson or negative binomial distributions) are assumed to represent the sample distribution. Statistical techniques also require modeling for truncated samples, recognizing that only participants are in the sample (nonparticipants are excluded from the sample). Without truncated modeling, the demand function would overestimate the economic value due to an upward bias on the estimated price coefficient.

Table 1 provides an estimate of recreation values determined by either the TCM or CVM technique. This table is a summary of 20 years of research in the field of recreation economics and shows a mean and range for different activity types. Variation in economic values can be due to a number of factors including site quality differences, location of the site, and variations in techniques.

Unit day value

Unit day values are based on expert judgement providing estimates of the willingness to pay for an average user at the recreation site. The original values were based on surveys of entrance fees at private recreation areas in 1962 and need to be adapted for new sites. "Principles and Guidelines" provides estimates of values for different types of resources and uses. These values are adjustable, within a limited range, for changes in quality.

The unit day value method was developed in the early 1960's because determining recreation values was difficult. This method was developed as a means of providing recreation values for project benefit/cost analyses and projecting values for sites

trips are not a continuous variable. Advanced econometric techniques are required for analysis of the data collected.

Table 1 provides estimates of use values using either TCM or CVM.

Unit day value utilizes information from past studies to determine values for other sites. Values are derived from a predetermined list of values published in "Principles and Guidelines".

Unit day values were developed because of the need to value new recreation sites prior to their completion.

MEASUREMENT TECHNIQUES FOR USE VALUES

Unit day value needs to be used with caution as the values are generalized and used only when another technique is not available.

not yet built (Loomis 1992). With improved methods such as travel cost and contingent valuation, unit day value method should be used with caution. Using the unit day value method can lead to sizable error in the estimated economic benefits for many activities that do not meet the assumptions of average conditions. Errors are also caused by aging of the unit values guidelines, lack of detail when specifying the activity, and failing to consider quality differences between sites. This method should only be used when other options are not available.

Table 1: Net Values per Recreation Day for Activities from Selected TCM and CVM Studies in the United States, From 1968 to 1988
(Converted to 1995 Dollars Using the Consumer Price Index)¹

ACTIVITY	\$/DAY PER PERSON	NUMBER OF STUDIES	RANGE OF VALUES
Camping	\$ 26.09	18	\$ 11.17 - 47.18
Hiking	38.91	6	21.24 - 75.46
Picnicking	23.19	7	9.53 - 63.13
Wilderness	32.89	15	11.79 - 143.68
Nonconsumptive fish and wildlife ²	29.70	14	7.13 - 51.46
Sightseeing/offroad driving	27.15	6	13.97 - 43.05
Cold water fishing	40.97	39	① 13.62 - 159.71
Warm water fishing	31.51	23	10.99 - 80.34
Big-game hunting	60.84	56	26.79 - 192.54
Small-game hunting	41.24	10	25.31 - 70.36
Nonmotor boating ³	65.14	11	13.87 - 247.92
Motorized boating ³	42.23	5	11.18 - 92.82
Winter sports ³	38.13	12	15.24 - 90.17

1. SOURCE: Walsh et al. 1988.

2. Nonconsumptive fish and wildlife include values associated with viewing and photographing.

3. While boating and winter sports are not directly valuing wildlife, these values are included as representative of examples of benefits that could change from changes in fish and wildlife habitat.

MEASUREMENT TECHNIQUES FOR USE VALUES

Table 2 provides estimates of values determined through use of the unit day value guidelines. The average value was determined by finding the median of the range of values.

Table 2 estimates values using unit day value guidelines.

Table 2: Net Values for a Recreation Day Using Unit Day Values
(Converted to 1995 Dollars Using the Consumer Price Index)¹

ACTIVITY	AVERAGE VALUE PER DAY	RANGE OF VALUES
GENERAL RECREATION (camping, hiking, picnicking, etc.)	\$ 5.04	\$ 2.55 - 7.64
FISHING AND HUNTING (of normal quality)	5.59	3.66 - 7.64
SPECIALIZED ACTIVITIES (big game hunting, wilderness activities, white water boating, marine activities, specialized nature photography)	20.08	10.35 - 30.24
SPECIALIZED FISHING AND HUNTING	23.78	17.83 - 30.24

¹ Unit day values estimated from average point values, calculated from "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies," March 10, 1983.

MEASUREMENT TECHNIQUES FOR USE VALUES

Table 3 compares TCM and CVM values with unit day values.

Table 3 provides a comparison of the values shown on Table 1 and Table 2. These values are adjusted to 1995 dollars for comparison and show that unit day values provide lower estimates than the TCM and CVM techniques.

Table 3: Comparison of Values from TCM and CVM Versus Unit Day Values
(Converted to 1995 Dollars Using the Consumer Price Index)

ACTIVITY	TCM/CVM ¹ \$/DAY PER PERSON	UNIT ² DAY VALUE	DIFFERENCE ³
Camping	\$ 26.09	\$ 5.04	\$ 21.01
Hiking	38.91	5.04	33.87
Picnicking	23.19	5.04	18.15
Wilderness	32.89	20.08	12.81
Nonconsumptive fish and wildlife	29.70	20.08	9.62
Sightseeing/offroad driving	27.15	20.08	7.07
Cold water fishing	40.97	23.78	17.19
Warm water fishing	31.51	23.78	7.73
Big-game hunting	60.84	23.78	37.06
Small-game hunting	41.24	5.59	35.65
Nonmotor boating	65.14	20.08	45.06
Motorized boating	42.23	20.08	22.15
Winter sports	38.13	20.08	18.05

1. Values from Walsh et al. 1988 adjusted to 1995 prices (Table 1).

2. Average values from Table 2.

3. Difference is determined by subtracting the second column from the first.

MEASUREMENT TECHNIQUES FOR USE VALUES

Benefit Transfer

Benefit transfer is a technique utilizing existing nonmarket values from other methods. The researcher transfers values from previous studies to the study or site in question. A researcher may use this technique if lack of time and funding preclude use of original research such as CVM or TCM. This technique provides adequate values if the attributes and characteristics of the economic values from the transferring studies are adequately matched to the site in question.

In its simplest form, benefit transfer can be similar to a sophisticated unit day value procedure. However, it can provide better results than a unit day approach because benefit transfer utilizes more current research, reflecting up-dated procedures for determining economic values, and the transfer technique is often more rigorous.

A researcher must be concerned with several issues when transferring values. The models and data from previous studies need to relate closely to the applied amenities. For instance, the activities need to be similar; trout fishing studies may be necessary for transfer to trout fishing sites. Sensitivity to regional differences need to be considered. Site quality is an important variable affecting economic values, and should be considered. Not considering these issues will result in values that do not represent the amenities in question.

When using benefit transfer, the researcher needs to test the responsiveness of the resulting value to changes in conditions as a type of sensitivity analysis, such as determining how a range of conditions affect the estimated value. The researcher needs to consider what are the important variables used in the analysis and whether the variables meet theoretical conditions. Important variables can include site quality, substitute resources, treatment of

When other techniques are not feasible, sometimes the researcher can use a technique called benefit transfer. This method utilizes demand functions from other studies for transferring values.

Benefit transfer is more rigorous than the unit day value method as it utilizes more information from previous results.

Benefit transfer requires matching prior studies to the new site for more accurate results.

The researcher needs to test the results to determine whether they are sensitive to changing conditions. If not, then the researcher should reconsider the estimated values.

MEASUREMENT TECHNIQUES FOR USE VALUES

Several sources of data are available for use in benefit transfer analysis.

The gross expenditure method is less preferred because it is likely to provide results not representing true economic values.

The gross expenditure method fails to consider the impact of other factors such as other sites on the value of the resource.

The acquisition cost can understate the value of the resource and may value

time and monetary cost, the sophistication of the study design, the type of willingness to pay question, the method of valuation, the data collection method, the type of activity, time on site, location, socioeconomic values, sample size, response rate, and year of the research.

Sources for data used in a benefit transfer study can include studies from government agencies, published research, university working papers and student dissertations. For an example of this technique, see Walsh et al. (1992).

Less preferred methods.

Several methods sometimes used but less preferred for economic valuation because they do not follow economic theory and subsequently do not provide valid measures of net economic benefits (net willingness to pay). The first is the gross expenditure method. As the name indicates, what is measured is the total spent by consumers participating in the activity or using the resource. For example, this could be the amount spent by the recreationist for gear, licenses, travel, and other items.

Measuring just the amount expended fails to consider that the resource may be much more valuable than the level of expenditure and ignores the net willingness to pay received by the resource user. This method fails to recognize tradeoffs among resources (whether substitutes are available) which can affect the value. It does not consider the possibility that some expenditures may be related to more than this one resource (users can visit several sites on one trip).

Acquisition cost approach

Another method which sometimes is used but not supported by economic theory uses the cost of acquiring or constructing the facilities at a site, and

MEASUREMENT TECHNIQUES FOR USE VALUES

could include restoring or re-establishing areas such as wetlands. What is measured is the amount of expenditures for development of the resources rather than the value of the amenity. This technique is sometimes used when no other values are available and is based on the assumption that the resource must be worth at least the amount society has decided to budget.

However, defense of this technique includes the concern that in some cases, an approximation is needed for a site. Knowing the value of other similar resources could at least provide an approximation of the minimum economic value determined by society for this type of acquisition or restoration.

For example, using expenditures resulting from development of a lake site may only measure the cost of the improvements rather than the value of the lake itself. This amount represents a value likely to be related to one use of the resource but may fail to consider other "values" that are not represented by that expenditure.

something different than what is intended.

However, this technique is sometimes used when an approximation is needed.

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

Contingent valuation is the only method approved in "Principles and Guidelines" for determining nonuse values. However, benefit transfer method can also be used as can *hedonic pricing*.

Substantial nonuse values exist for fish and wildlife resources. However, little work has been done to test the reliability of results. This has led to questions concerning values received to date.

A large segment of society values goods even when they do not use those goods. They have a sense of responsibility toward preserving the existence of species, an empathy for animals, and a sense of responsibility for human activities that affect habitat.

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

Currently, the only direct method available for measuring nonuse values is the previously described contingent valuation method. However, two other techniques, the benefit transfer method and hedonic pricing, could also be used to estimate economic values. Benefit transfer method is the same process as discussed in the **Measurement Techniques for Use Values** section and will not be discussed further in this section. *Hedonic pricing method* can be used to measure nonuse values but for most situations adequate data are not available. A brief description of the hedonic pricing method follows a discussion of contingent valuation issues that relate to non-use values.

Research has shown that substantial nonuse values exist for fish and wildlife resources. Since the only direct method for estimating nonuse values is with the contingent valuation, results cannot be validated by comparison with results achieved with other methods, as with use values. In recent years, validity of nonuse values has become an important issue leading to new developments improving estimating procedures.

Why are there existence values?

Many people have strong feelings toward the existence of natural resources -- whether old-growth forests, wild rivers, salmon or spotted owls -- even though they may never observe or use the resources in any way. People have altruistic feelings and a sense of environmental responsibility toward seeing that the existence of these resources continues. They have sympathy and empathy for animals and feelings of responsibility for loss of habitat due to human economic activities (Randall and Stoll 1983). Economic valuation recognizes that the existence of

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

these amenities is important to members of society (Bishop and Welsh 1992).

Positive economic values can exist for species or natural resources even if individuals were not aware of this existence prior to learning about them in a survey. Critics may argue that this is an example of the failure of the CVM. Proponents of CVM counter that this can be an example of the process by which consumers determine preferences. Consumers determine which goods and services to purchase within budget constraints and seek information to determine what choices to make. Consumers do not make the effort to learn about goods that are unavailable. Once a new product becomes available, consumers acquire additional information about the new product (Bishop and Welsh 1992).

In the same way, respondents to a contingent valuation survey may not be aware of the amenity prior to the survey, but upon learning about it decide it has value to them. Lack of knowledge prior to the survey only means that there was no choice previously, not that the resource fails to have positive values. Once society is aware of the resource, then determining the value with the available information is important.

Doesn't summing the total values for resource amenities result in an unbelievably large number?

It has been argued that if all the nonmarket values for amenities are added together the total will be an implausibly large amount. The argument then suggests that these values are not true economic values but some highly inflated number. However, this argument also could be applied to the millions of market goods. While these values are substantial, individuals choose among the nearly infinite number of choices to allocate their limited resources (Bishop and Welsh 1992).

Individuals can have positive values for goods they became aware of only recently. This applies to nonmarket goods as well as market goods.

Consumers do not typically gather information on amenities that are unavailable. When a good becomes available, effort is then expended to find out about it.

Large economic values for nonuse resources, such as endangered species, represent the cumulative positive values of thousands of members of society and indirectly reflect the scarce nature of the resources.

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

Government agencies and court decisions have held that nonuse values represent the views of society.

Large values reflect the scarcity of the species and represent the existence value for thousands of individuals in society.

Goods that are scarce have large marginal values, including endangered species. If recovery of endangered species occurs, values per individual in the species would fall substantially.

What property rights hold for existence of species?

Recently, existence values have been considered by courts when considering damages or setting public policy. Courts have held that excluding nonuse values results in too narrow a view. Ohio vs USDI (U.S. Court of Appeals 1989) concluded nonuse values should be included in damage assessments.

Aren't nonuse values very large for each individual in some species?

For species that have small populations, dividing the estimated value for the species by the number of individuals results in a large value per individual. These values appear large because humans have a tendency to think of the value per unit in terms of use values or market values (Bishop and Welsh 1992). We may think of salmon in dollars per pound when it is sold as a private good. However, with existence values, one fish may represent the existence value from thousands of persons, each individual's value added together.

Large values can also be thought of as representing the small size (scarcity) of the population and status of the species, and how close it is to extinction (Randall and Stoll 1983). Scarcity causes high prices in market goods (such as diamonds). Recovering populations would lead to rapidly decreasing values per individual. Failure to recognize the large individual values when the population of the species is near extinction fails to consider the benefits provided by the public goods portion of the species, leading to suboptimal levels of the good.

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

Validity of contingent valuation

Most economists accept the existence of nonuse values as a valid economic concept. However, some economists express dissension related to measurement techniques for determining these values. Economists who express disagreement with the values feel that the CVM does not reflect values representing society, suggesting that the results lack validity.

Validity refers to the ability of the study to correctly measure the theoretical concept being investigated. If the predicted values vary in a systematic way, the estimate not only lacks validity, but also is biased.

Arguments have been presented suggesting bias in different directions. One argument suggests that the researcher can bias the description of the good being valued, leading to an upward bias, as respondents bid higher than their true willingness to pay. Often, the researcher is hired to determine a value for the resource in question and needs to be careful not to misrepresent the good. Both positive and negative points need to be expressed in the description of the good.

Other researchers argue that the estimated willingness to pay in contingent valuation studies are biased downward because researchers approach the design of the study in a conservative fashion, making an effort to avoid overestimating willingness to pay. This argument suggests that researchers are concerned with avoiding any upward bias and deliberately make choices that push their estimates downward. This approach deliberately lowers the estimated value, systematically departing it from a true estimate, intentionally introducing bias (Bishop et al. 1996).

Nonmarket values are generally accepted as economic values. However, any dissension that occurs is usually due to measuring techniques.

Validity occurs when systematic bias is absent.

Bias occurs due to many reasons. Researchers can bias results upward with improper study designs.

Also, results can be biased downward when conservative approaches are overemphasized.

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

Validity is enhanced through proper design and structure of the questionnaire prior to the collection of data. Proper design is necessary to convince the respondent that the proposal is feasible. Otherwise, the respondent may not provide accurate responses.

Communication is essential in the study. Prior testing of the questionnaire leads to greater confidence in the results.

The researcher needs to understand acceptable methods of survey execution, including follow-up on non-response and issues related to analysis.

Table 4 provides estimates of nonuse values for

Validity can be affected in numerous ways. Design and execution of the study affects the validity of the study. A contingent valuation questionnaire must inform the respondent adequately so that an individual understands the issue in question. The respondent must be able to understand the payment method and accept this payment method as feasible and just. The information presented must convince the respondent that the project is feasible. The mechanism for payment is an especially sensitive item in the study as it is usually a method of taxation, payment into a special fund, or an increase in the cost of a product purchased by the respondent. If the respondent does not believe the payment mechanism, then the respondent will not believe the integrity of the study and fail to provide the necessary responses. Also, the study must convey how and when the resource in question will be provided in a way acceptable to respondents.

Prior to executing the survey, the researcher seeks responses from the public (prior to the actual survey) through mechanisms such as focus groups, pretests, and pilot studies. The researcher must determine how the respondent interpreted the questions and redesign of the questionnaire as responses are received. Providing evidence of these activities shows that public response and proper communication is being achieved (Mitchell and Carson 1989).

Validity is affected by how the study is conducted and how the results are analyzed. The researcher needs to follow acceptable methods of executing the study. Proper sampling technique is required and follow-up on why people do not respond may be necessary. Statistical analysis needs to be conducted with a thorough understanding of the econometric issues affecting the data sets.

Table 4 shows estimated nonuse values from studies valuing selected endangered or threatened

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

species. Because these are values for endangered and threatened species, they represent only nonuse values, as most endangered and threatened species have population levels not large enough to provide substantial use values.

endangered and threatened species.

Table 4: Economic Nonuse Values Estimated Using Contingent Valuation Method: Nonuse Values for 16 Threatened and Endangered Species and Their Habitat¹
(Converted to 1995 Dollars Using the Consumer Price Index)

SPECIES	AVERAGE VALUE ²
Atlantic salmon	\$ 7.63
Arctic grayling/cutthroat trout	10.06
Bald eagle	26.01
Bighorn sheep	11.15
Blue whale	41.78
Gray wolf	71.00
Grizzly bear	35.96
Humpback whale	73.20
Monk seal	20.22
Red-cockaded woodpecker	15.56
Pacific salmon and steelhead	31.29
Sea otter	28.32
Northern spotted owl	92.65
Squawfish	8.42
Striped shiner	6.04
Whooping crane	33.07

1. Since some of these species (salmon) could have some use value in addition to nonuse value, these values may represent total value in those cases.
2. Source: Loomis and White 1995.

MEASUREMENT TECHNIQUES FOR NONUSE VALUES

Values vary due to different study implementation methods, level of habitat changes proposed in the study, and impact on the species.

These values vary in magnitude because they are from many different studies, none of which implement the method in exactly the same way. More current studies may have used more sophisticated techniques, utilizing the experience of earlier research. The level of restoration of the species' habitat, the level of certainty of preservation, and impact on other species affect the values estimated. Also, values between species will vary. In spite of these differences, these values provide insight into how society views preservation of these natural resources.

The values are appropriate for comparative purposes, comparing costs of projects with benefits. Nonuse values add a component in the benefits calculation while costs could include loss of power, reduced diversion of irrigation water, or money necessary to pay for the project.

Hedonic Pricing Method

Hedonic method determines the values of resources included in the price of market goods. This technique requires extensive data and often is not considered due to the lack of appropriate data.

Hedonic pricing method is an acceptable technique for estimating non-use values but is not described in "Principles and Guidelines". This method is seldom used due to lack of data. Hedonic pricing uses market prices for a good to price attributes bundled with that good, including amenities in question. Market goods include housing, labor, or automobile markets. Housing markets are used most often in hedonic pricing, due to the availability of housing sales prices. Sales prices are affected by attributes including the size of the house, location, landscaping, age, school district, and various environmental amenities. These amenities could include levels of pollution, measurement of recreational shoreline, or distance to a lake.

The price of the good is unbundled using econometric techniques. A two stage estimation is

Economists assume that these environmental amenities affect the price of the house along with the other attributes. Unbundling, or separating, the value of each attribute is accomplished through use of

SUMMARY

econometrics techniques. The resulting coefficient provides the value of that attribute toward the total value. The result from a regression usually provides a "first stage" estimation of a total function and a "second stage" equation is required to determine the marginal value or price for a given quantity of the attribute. Interpretation of the results can be difficult as estimations are often non-linear functions, the coefficients do not reflect marginal dollar amounts across the range of the function. In spite of interpretation problems, this technique probably would be used more frequently if adequate data were available.

Two examples of hedonic pricing used housing prices to value aesthetic attributes, including proximity to lakes are presented. The first example estimated the impact on housing prices caused by proximity to lakes and water quality in those lakes in Orange County, Florida (Feather 1992). Real estate sales data were used to estimate the values in this study. The results showed that as the distance from a lake increased, the values near water diminished. The results also showed a positive correlation between water quality and property values.

A second study also looked at the value of the proximity of property to a lake near Austin, Texas (Lansford, Jr. and Jones 1995). This second study also used housing sales prices along with known attributes such as square feet of the house, construction quality, school district location, and distance to the lake along with approximately 25 other attributes. The results showed, on average, that 22 percent of the sales price of the house was attributable to the aesthetics of proximity to the lake, but the marginal value of this amenity decreased rapidly with increasing distance. For an average size house, moving from a water front home to 150 feet from the lake reduced the price by around \$96,000.

usually necessary to determine the marginal value for each attribute.

Two examples of hedonic pricing are discussed. These use real estate prices to value proximity to lakes and value water quality. The first study looked at homes in Florida.

The second study considered real estate values for homes near Austin, Texas. The study showed that proximity to a lake increased property values. The results also showed that, as property moved farther from the lake-front, the decreasing value was larger for real estate closer to the lake.

SUMMARY

SUMMARY

This handbook is designed to help determine economic valuations for changes in fish and wildlife habitat due to government activities or decisions. Valuing these resources requires recognition that traditional economic valuation techniques (market prices) are not adequate. A researcher needs to use additional techniques to identify and quantify values that contribute to the well-being of our society. Economists believe that these values need to be represented in economic terms when managerial decisions are made.

Many government agencies have supported the efforts to value nonmarket goods in recent years. These agencies have issued reports which follow the development of nonmarket valuation in economic theory. Currently, the "Principles and Guidelines" provide guidance for determining economic values and recognizes "the willingness to pay" principle which underlies the nonmarket valuation technique.

Economists determine economic efficiency through measurement of net willingness to pay and producer profit. These values represent the "net" value to consumers and producers, above the transaction costs. Efficiency is increased if the sum of these values is increased. Efficiency is maximized under purely competitive markets. Unfortunately, many goods are not provided in purely competitive markets, leading to inefficient allocations of goods in our society.

Public goods are one area of inefficient allocations. Certain resources provide public goods to society. Under a "market only" analysis, these goods typically would not be available, as there are no prices representing their value to society. Therefore, other techniques are necessary to measure their nonmarket values.

Total value for nonmarket goods can be divided into use and nonuse values. Techniques for estimating use values include the contingent valuation method, the travel cost method, and unit day value method. This handbook also discussed other techniques sometimes used and suggests why these are less preferred. Also, a benefit transfer technique was discussed. This technique applies results from other studies to provide estimates of value when a more thorough technique is not feasible. This handbook also shows estimates of values found using the techniques discussed.

SUMMARY

Non-use value estimations are usually limited to using the contingent valuation method. This technique is the only method available for estimating these values under most situations. Benefit transfer technique can also be used to transfer values from previous studies when direct estimation is not possible. Hedonic pricing method was also discussed as a method for estimating non-use values. While this technique can estimate these values, for most situations, data are not available for this technique to be effective.

Appendix: Review of Economics

What is economics?

Economic theory is based on the idea that resources are scarce and insufficient to satisfy all human wants. Individuals compete for these scarce resources, often through markets, buying and selling at market-determined prices. In addition to limited resources, people have limited budgets and limited time further complicating the choice process. The study of economics considers how these choices are made and how they cause resources to be allocated. Therefore, one definition of economics is the study of choices involving scarce resources.

How do economists study the transactions of these scarce resources?

Economies are composed of millions of transactions buying and selling a large number of goods and services by millions of consumers. These numerous transactions create a complicated system that is difficult to analyze. In order for economists to study economic systems, models are built which are less complex than the actual economy. Successful economic models are able to capture the essence of the economy while still being simple enough to verify and understand.

Who controls the transactions in our economy?

Our economy is based on the premise that most transactions occur through individuals without any governmental control. Markets are simply transactions occurring between individuals. Each person trying to maximize one's own well-being is what creates efficient, optimal markets. This assumes that each individual tries to achieve as much value as possible for each dollar spent. Individuals achieve optimal markets without a large centrally organized structure other than laws providing the groundwork.

Economics is the study of allocating limited resources within our monetary constraints.

Economists study economic systems through simplified models of our economy.

Private markets determine our supply of goods and their prices. These markets are simply trades between individuals.

Consumers maximize their well-being through choices. Economists refer to this individual well-being as *utility*. Consumers try to choose goods to obtain as much "utility" as possible, more desirable goods having more utility.

Consumers have budget constraints when maximizing utility. Prices also affect the decision process. Consumers buy goods only when the value of the last unit purchased exceeds the cost of that unit.

How is optimal choice measured by economists?

Economists believe that people mentally rank goods from least to most desirable in some manner. This ranking may not be a conscience thought, but occurs through comparisons of goods as we purchase these goods. By choosing between purchases, consumers create a level of well-being for themselves, which has been labeled *utility* by economists. Each individual tries to maximize this utility. More desirable goods offer more utility than do less desirable goods. One way that economists determine the ranking of the utility of goods is by observing the behavior of individuals in society. While economists can determine a lot about consumer preferences, levels of utility (well-being) are not directly measurable or comparable between individuals.

How are these measures of consumer well-being utilized by economists?

Economists assume each person achieves the highest level of utility (well-being) possible within the constraint of a budget (one's level of income); the larger the budget, the greater the utility. Each person has a budget constraining one's choice and therefore, one's maximum utility, achieving the greatest level of utility within that constraint. Besides our budget constraint, prices of goods affect our choices. Economists assume that, for most goods and services, the first unit of a good or service purchased provides the most utility. Each subsequent unit then adds a little less to our utility level until finally the amount of utility received from the next unit is not enough to compensate for the cost.

For example, if we are hungry, we could stop at a fast food place and buy hamburgers. The first one really hits the spot, and maybe a second. At some point, we would decide we are full and not

Appendix: Review of Economics

purchase any more as each subsequent burger does not provide enough enjoyment to offset its price. On the other hand, if we were at an "all you can eat" restaurant, we may go back for an additional helping. In this case, the price of the next serving is zero, so we would be more tempted to at least go for another bite, if not the whole serving.

Consumers really don't make these comparisons of utility when goods are purchased, do they?

Consumers compare the price for each good purchased and mentally (and possibly sub-consciously) consider how much utility (well-being) it provides. This comparison causes consumers to purchase more of one good, giving greater enjoyment, than another good. The quantity purchased for each good reflects the level of utility we get from each good in relation to its price. In theory, this means that the amount of utility received from the last unit of each good will be equal for all goods per each dollar spent. As prices change, if the price of a good goes down, people have a tendency to buy more of that good relative to the quantity of other goods, giving up some of other goods to provide money necessary to increase the quantity of the first good.

Consumers do not always behave rationally from the perspective of economic theory. For example, uncertainty toward future employment possibilities may cause the consumer to choose goods other than those that maximize their long-term utility. A consumer may include others in one's household when making decisions. A consumer may choose differently if it affects others in the family. A consumer could be faced with lack of divisibility such that one can purchase only certain quantities.

Another factor includes consideration of how goods are packaged. For example, we may wish to

Consumers generally do not try to consciously measure their utility when making decisions. Maximizing utility occurs automatically when one tries to achieve the highest level of enjoyment possible, given prices of goods. Individuals balance purchases among goods so that the level of enjoyment is the same for each dollar of expenditure.

Economics recognizes that decisions are not perfect. However, decisions by consumers match economic theory fairly closely.

Appendix: Review of Economics

purchase an automobile with certain characteristics or options which are only available on a model more expensive than we want to buy. However, economic theory assumes that these issues are insignificant enough so that theory reflects our general decision process.

What is supply and demand?

Demand is the measure of the maximum price for each unit of a good that a consumer would pay and reflects an individual's willingness to pay.

Demand is the measurement of the marginal (or incremental) value a consumer is willing to pay for each unit of a good. As was stated previously, each additional unit of a good purchased has less value to the consumer than the previous units. Demand is the recognition of this declining value for each additional unit. Demand is also the measure of the quantity that would be purchased at each price level. Demand is shown in Figure 1, showing the quantity demanded at each price level (the downward sloping line). At higher prices, less will be purchased, and at lower prices more purchased.

Supply function measures the cost of production for each unit and the minimum price acceptable to the producer for that unit.

Supply measures the quantity that would be offered for a given price and is based on the cost production to the manufacturer. It is assumed that, for most production processes, cost of production per unit is constant or is increasing, leading to a flat or rising supply function. (While initial levels of production create falling marginal costs, firms will expand beyond this volume of production whenever possible). The point where demand and supply intersect is called the equilibrium point, which determines the selling price and quantity for the good in a free market. People buy goods as long as the value equals or exceeds the price and producers will produce goods as long as the price is greater than or equal to the cost of the last unit produced.

Where supply and demand intersect is the equilibrium point, identifying the selling price and quantity.

Appendix: Review of Economics

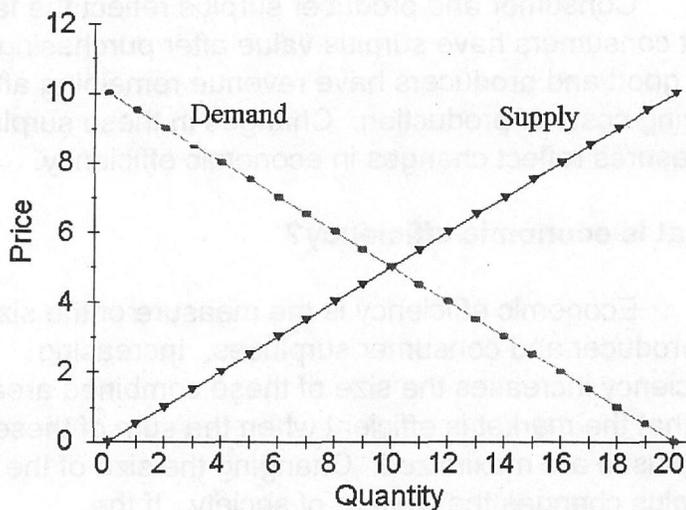


Figure 1

How is economic value measured?

At quantities less than the equilibrium quantity, the consumer is willing to pay more for each unit of the good than the market price and the cost of production is less than the market price. For the consumer, the difference in value between the selling price and the price the consumer would pay is surplus value for each unit. It is also represented as the area under the demand curve and above the price line. *Consumer surplus* and *net willingness to pay* are equivalent measures.

A *producer's surplus* is also recognized by economists. Producer surplus is the area below the price line and above the supply curve. Producers sell each unit of the good at the market price, but the cost of production for some units may be less, leading to a surplus for the producer, creating the producer surplus. For producers with constant cost of production, this area does not exist and the producer surplus is zero.

Economists measure the surplus value attributed to consumers and producers. Measuring this surplus value provides economic value (net benefits for that good). These are called *consumer surplus* and *producer surplus*.

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Changes in the total surplus value determines changes in economic value to society.

Economic efficiency is the sum of the consumer and producer surpluses. The market is efficient when these achieve maximum value. Arbitrary manipulation of the market affects one or both of these surpluses, reducing total welfare to society.

Economic efficiency occurs only when markets are purely competitive. Monopolies, and other market structures affect efficiency. Also, some goods and services do not reach equilibrium because some costs to society (pollution, etc.) are not reflected by market demand and supply. This market failure affects economic efficiency.

Consumer and producer surplus reflect the fact that consumers have surplus value after purchasing the good and producers have revenue remaining after paying costs of production. Changes in these surplus measures reflect changes in economic efficiency.

What is economic efficiency?

Economic efficiency is the measure of the size of producer and consumer surpluses. Increasing efficiency increases the size of these combined areas so that the market is efficient when the sum of these surpluses are maximized. Changing the size of the surplus changes the welfare of society. If the producer increases the price of the good away from the equilibrium price, then producer welfare would be increased. However, consumer surplus would decrease and total welfare of society decreases because consumer surplus decreases faster than producer surplus increases. Welfare to society also would decrease as total surplus decreases when price moves from market equilibrium.

Does market efficiency always occur in free markets?

Market efficiency occurs when purely competitive markets exist with no regulation. For many goods, however, the market is not efficient for any number of reasons. Other market structures, such as monopolies, do not have the same market forces to achieve market efficiency and do not maximize society's benefits. The monopolist prices goods to capture as much of the consumer surplus as possible to increase profits, reducing the benefit to the consumer. Other problems also lead to inefficient markets. These can include market failures such as pollution (externalities). Society incurs the cost of the pollution, but the producer receives the benefit. Public goods also affect market equilibrium as these are *nonmarket goods*. Without a market, a demand

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curve is difficult to determine, as is measurement of consumer surplus. A proxy for the market price needs to be found in order to find economic value and optimal levels of these goods.

What are nonmarket goods?

Some goods add value to our lives but are not sold in the market place. For instance, some goods cannot be privately owned as the owner could not exclude others from using the good. The classic example is national defense. If one purchases the good, then we all are protected. Therefore, if national defense was sold in the market, not all would pay the price, either because some would chose to not purchase the good or would know that others would buy it and protect everyone. As few would be interested in paying more than their fair share, then optimal levels would not be achieved. To be fair to all and provide optimal levels of public goods, goods of this nature are provided by the government and charged to everyone through taxes. Nonmarket goods exist because of lack of adequate property rights necessary for private ownership. Without property rights, discussed in the next section, economic value of a good cannot be protected by the owner.

Resources provided by Reclamation projects which are used for recreation and fish and wildlife habitat are also public goods. The consumer usually does not pay for the resources used. For example, there may be a fee for use, such as an entrance fee, but these fees generally are not large enough to pay the cost of providing the resource and are essentially provided free of charge.

Market failure and the property rights problem

Goods and services are bought and sold traditionally through private marketplace. These

Nonmarket goods occur because not all goods can be held privately and provide efficient benefits to society. Public goods are examples of nonmarket goods.

Many of the resources provided by Reclamation are public goods such as fish and wildlife habitat. These goods are essentially provided at minimal cost to the consumer.

Goods and services meet four characteristics to be

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private goods.

Characteristics of a private resource are the right to private use, right to exclude others from using, right to exchange for money, and right to enforce one's rights from encroachment.

Nonmarket goods exist because at least one of these rights do not hold. Public goods fail to hold these rights. Examples include many water resources and fisheries.

Other goods also fail to have property rights. These goods include clean air and clean water, affected by pollution.

Measuring economic values for nonmarket goods can be a necessary, but difficult process.

trades can take place because certain conditions are met allowing the buyers and sellers to identify characteristics of trade. Characteristics of private market goods include (1) the right to use the resource as a privately owned good, (2) the right to exclude others from using the property or receiving the benefits and costs, (3) the right to exchange the good for money or other considerations (right of voluntary transferability), and (4) the right to enforce one's rights from encroachment by others.

If at least one of these rights is missing, a good or resource will not be a private good. Public goods and resources are one type missing at least one of these characteristics as they can not be privately used, other users cannot be prevented from receiving benefits. Also, public goods usually cannot be exchanged, although water resources can sometimes be held for private use, once diverted from streams. Often included in public resources are common property goods such as fisheries and wildlife and their habitat. These goods cannot be exclusively held by individuals.

For other goods, such as clean water or clean air, property rights may not be well-defined. Pollution control is determined by government entities because it is difficult to achieve acceptable levels of pollution control in the marketplace. Producers of goods produce pollution, affecting water quality and air quality, but little of the cost is incurred by the producer. Those affected by the pollution do not have well-defined rights to prevent pollution.

Measuring the value of nonmarket goods

Nonmarket goods such as publicly provided resources are not priced in the market, but still have economic value. Since these goods have economic value, determining a demand curve and consumer

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surplus is important for recognizing their importance when economic decisions are being made.

Dividing total nonmarket value into its components, use and nonuse values.

Total nonmarket value can be separated into two components, use and nonuse values. *Use values*, as the name implies, exist because the resource is being used in some way. *Nonuse values*, also referred to as passive use values, occur without the holders of these values expecting to use them.

Use values are derived from activities such as hunting wildlife, fishing, or other activities by recreationists, including hiking and skiing. There have been hundreds of studies providing use values for wildlife and habitat resources.

Consumptive and nonconsumptive components of use values

Use values can be further divided into two components, consumptive and nonconsumptive uses. *Consumptive use* refers to activities, such as hunting and fishing, that consume the resource. *Nonconsumptive use* recognizes that the recreationist can use the resource without removing it from its environment. Common nonconsumptive uses include wildlife photography, bird watching, and wildlife feeding. The term "nonconsumptive" reflects the nature of the activity and should not be confused with the consumption of goods used by the recreationist. Bird watchers, for example, who purchase (consume) binoculars, cameras, and other gear are still nonconsumptive users if they only watch the wildlife.

Some species provide both consumptive and nonconsumptive uses; for example, birds could be both hunted and observed. Endangered species, however, usually provide only nonconsumptive use

Nonmarket value can be broken into use values and nonuse values.

Use values occur when people use the resources being valued.

The two types of use values are consumptive and nonconsumptive. Consumptive uses consume the resource while nonconsumptive users leave the resource for others.

Endangered species usually do not provide use values due to low levels of population of the species.

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Nonuse values recognize that society holds positive values knowing that the resource exists, or has the potential for use by current or future generations. Nonuse values are often a substantial part of total value for resources.

due to low population levels, if they provide any use values at all. Often endangered species provide only nonuse values.

Nonuse values

Nonuse value recognizes that the public benefits from the preservation of the resource without any use. People hold positive benefits from knowing that the amenity continues to exist, has the potential availability for future use, and is preserved for future generations. Research has shown that these values exist in substantial amounts (Brookshire et al. 1983; Walsh et al. 1987, Walsh et al. 1994). In some examples, nonuse values have represented from 70 to 95 percent of the total value for wildlife and wilderness areas (Loomis 1991, Walsh et al. 1987). The high nonuse values may be especially relevant for resources that are unique, have little substitutability, and losses would be irreversible, such as the Grand Canyon, old growth forests, and whooping cranes.

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