Valuation of nontimber resources: an overview

B. Condon and W.A. White

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Natural Resources Canada
Canadian Forest Service

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The Canadian Forest Service's Northwest Region is responsible for fulfilling the federal role in forestry research, regional development, and technology transfer in Alberta, Saskatchewan, Manitoba, and the Northwest Territories. The main objectives are research and regional development in support of improved forest management for the economic, social, and environmental benefit of all Canadians. The Northwest Region also has responsibility for the implementation of federal–provincial forestry agreements within its three provinces and territory.

Regional activities are directed from the Northern Forestry Centre in Edmonton, Alberta, and there are district offices in Prince Albert, Saskatchewan, and Winnipeg, Manitoba. The Northwest Region is one of six regions and two national forestry institutes of the Canadian Forest Service, which has its headquarters in Ottawa, Ontario.

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ABSTRACT

This report provides a review of how economics can assist in the management of the forest resource by providing useful information on the value and measurement of nontimber resources such as recreation and preservation. Value is defined in the context of economic analysis; benefit–cost analysis, a tool used for land use trade-off decisions, is examined; the use values, nonuse values, and environmental control services are reviewed; and the importance of valuing nontimber resources is examined. The last section reviews the theoretical models (Contingent Valuation Method, Travel Cost Method, and the Discrete Choice Travel Cost Model) used in nontimber valuation and assesses their effectiveness.

RÉSUMÉ

Ce rapport explique comment on peut appliquer les principes d'économie pour gérer les forêts en fournissant de l'information qualitative et quantitative sur leur valeur « non ligneuse », notamment leur valeur récréative et naturelle. Le concept de valeur y est défini dans un contexte d'analyse économique. Les auteurs examinent l'étude avantages-coûts en tant qu'instrument de décision en matière d'aménagement du territoire, et ils étudient les valeurs d'utilisation et de non utilisation, les services de contrôle écologique, de même que l'importance de calculer la valeur des ressources forestières non ligneuses. La dernière section fait une revue et une évaluation de l'efficacité des modèles théoriques (Contingent Valuation Method, Travel Cost Method, Discrete Choice Travel Cost Model) utilisés dans le calcul de la valeur non ligneuse des forêts.

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The exclusion of certain manufactured products does not necessarily imply disapproval nor does the mention of other products necessarily imply endorsement by Natural Resources Canada.

INTRODUCTION

Forests supply a diverse combination of market and nonmarket goods and services. This can often create a complex management problem for the use of the forest resource. The values associated with conventional forest products such as lumber and pulp and paper products are derived directly from the market system. On the other hand, there are many benefits from the forest resource that are not derived through the market system and are more difficult to measure, such as the value of a day spent hunting, fishing, or birding, or, perhaps even more difficult to measure, the value of the role that forests play in regulating weather patterns.

The benefits from the forest resource, other than the timber benefits, are collectively known as the nontimber resources of the forest. The nontimber resources of the forest supply both goods and services. Nontimber goods include wildlife, wildlife habitat, and wilderness areas, while nontimber services include the services that emanate from the nontimber goods. These services include activities such as hunting, fishing, and camping. Generally, it is the services that the forest supplies that are the focus of nontimber valuation. Due to the increased pressures on forest resources, the increased demand for nontimber resources, and society's strong desire to preserve our natural heritage, it is becoming increasingly important to evaluate these nontimber benefits.

Forest land managers on Crown lands must manage forests not only for timber and the wood products, but also for other uses such as wildlife and recreation. Although under no legal obligation, private land managers are also encouraged to manage for nontimber resources. The key to success for managers is recognizing the interdependencies in production among uneven-aged timber stands, wildlife habitat, watershed maintenance, and forest recreation (Bowes and Krutilla 1989). The difficulty lies in the selection of a management program that will maximize the benefits from timber and other multiple-use services. This forest management program will depend on the relative values of wood production, nontimber resources, and existing regulatory requirements.

ECONOMIC VALUATION

Economic Value

The term 'value' has many interpretations. In this report, use of the term is confined to the context used in economic analysis. In monetary terms, economic value refers to the amount an individual is willing to exchange for a good from a set of resources, or the minimum amount an individual would accept in exchange for the good (Adamowicz 1991). Economic value is the combination of the ability to pay, the value assigned to the desired end, the perceived efficacy of the good as an instrument to that end, and the availability, perceived efficacy, and price of alternatives (Peterson et al. 1990). Value not only depends on short-run preferences but on the long-run institutional context (i.e., the rules and conventions that govern society) (Bromley 1982). The basic premise of economic value is that the value of a commodity is not intrinsic but depends on the preference systems held by individuals (Brown 1984). Economic value is not constant, but varies among individuals and changes with time.

In many cases, the value of nontimber resources cannot be captured through their market prices, either because there is no market price associated with a resource, as in the case of viewing wildlife, or the price does not reflect its economic value, such as license fees paid for hunting. This can also be true of timber resources. This creates a problem as market prices, which represent measures of resource value, function as rationing devices. Therefore, to make informed decisions about resource allocation some effort must be made to supplement the market value information. The theoretical models developed for benefit estimation attempt to determine the full economic value because expenditures often underestimate the value of nontimber goods and services.

Consumer surplus is a useful measure to determine the maximum amount of money an individual would pay above what has already been paid to receive the benefits from the good. It is the difference between the maximum amount that a person is willing to pay for a good (its value) and the price of a good. There are four measures of consumer surplus: compensating variation, compensating surplus, equivalent variation, and equivalent surplus.

The compensating measures are the amount of compensation, paid or received, that would make an individual as well off as before a change (Boadway and Bruce 1984). The equivalent measures are the amount of compensation, paid or received, that would make an individual as well off as he or she would be after the change. In other words, a compensating measure is the amount of money an individual would accept in compensation for a decline in a nontimber service, whereas an equivalent measure is the amount of money an individual would pay to avoid the decline. For example, an individual might accept $100 as compensation for losing a forest recreation area (compensating measure) or he or she might be willing to pay $100 to ensure that the area is preserved (equivalent measure).[1]

In policy analysis, it is necessary to aggregate individuals' values to evaluate the socially optimal allocation of resources. Theoretically, a social welfare function (SWF) provides a means of comparing allocations while taking into account individual variations in preferences, income, and other factors. The SWF weighs and aggregates individuals' well-being or utility. It can be illustrated through using the economic concepts of the production possibility frontier (PPF) and the social indifference curve (SIC).

The PPF refers to how the production of one good can be traded off for the production of another, whereas the SIC represents a constant level of society's utility for various combinations of the two goods. The point of tangency between the highest SIC and the PPF represents the socially optimal allocation of resources (Fig. 1). This point is known as the Pareto optimum, as it is the point at which an individual cannot be made better off without making another worse off. This criterion, unfortunately, only has limited use in policy as few projects offer a gain to some individuals without losses to others. Further, the Pareto criterion ignores income distribution and equity concerns; it assumes $1 is the same for the rich as it is for the poor. Therefore, the criterion favors the status quo as the range of choices critically depends on the initial distribution.[2]

A compensation principle was introduced by Kaldor (1939) that stated that if the gainers of the project or policy could compensate the losers, a net welfare gain could result from the policy change. Although, as compensation is hypothetical and is never actually paid, some questions are raised as to the distributional consequences of the policy change. If compensation were actually paid, there would be no need for the principle as no one would be worse off as a result of the policy change, and the Pareto criterion would be sufficient. Arrow (1951) argued that it is impossible to aggregate individual preferences into a SWF without restrictive assumptions.

Although there are some underlying theoretical shortcomings with the Pareto criterion, benefit–cost analysis, a variant of the Pareto criterion with compensation, is often used as a tool in economic analysis.

Benefit–Cost Analysis

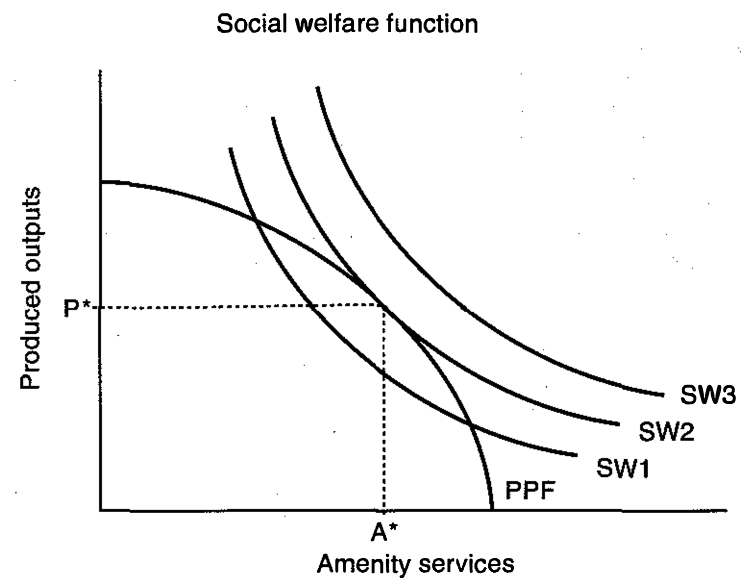
Benefit–cost analysis is a variant of the Pareto criterion with compensation. It is an economic tool that measures the welfare gains and losses to society by aggregating the monetary values of the benefits and costs involved. It is a useful tool in assessing the economic feasibility of given projects, ranking projects, and optimizing their scales or sizes (Veeman 1986). It allows policy makers to determine if resources are being used in their highest value.

In the past, benefit–cost analysis has underestimated the true scarcity value of nontimber resources as it failed to account for the potential loss of nontimber resources associated with development decisions. Quantifying the values associated with the nontimber resources allows both the timber and nontimber services of the forest to be evaluated on the common basis of monetary units.

A benefit–cost analysis should be taken from a social perspective based on social returns, costs,

1 For a more concise discussion of consumer surplus, and the measures of consumer surplus, refer to Boadway and Bruce (1984), Hartwick and Olewiler (1986), and Pearse (1990).

2 For further information on Pareto optimality and aggregating individuals' preferences, refer to Arrow (1951) and Boadway and Bruce (1984).



Any combination of produced outputs and amenity services lying on or within the production possibility frontier (PPF) are attainable. The curves SW1-SW3 represent social indifference curves in ascending order. SW3 is not attainable because it lies above the PPF. SW1 is attainable, but the allocation does not maximize social welfare. The point of tangency between the SW2 and the PPF at P* and A* represents the socially optimal allocation of resources or the Pareto optimum defined here.

Figure 1. The socially optimal allocation of resources.

and discount rates, not a private perspective. A social perspective would include an estimation of economic activity that is linked to the primary activity to account for the regional effects of income distribution and include values associated with nontimber services. Social discount rates are generally lower than private discount rates. Discounting is the process of making benefits and costs occurring at different points in time commensurable, and the discount rate reflects the diminished value now of the benefits and costs not expected to occur until some future time.

The present value of a perpetual flow of forest resources can be calculated by dividing the benefits received by the discount rate. For example, if birding in a certain area was expected to return $10,000 per year and the social discount rate was 5%, the present value of birding would be $200,000. There has been some controversy over choosing a social discount rate when it comes to the preservation of nontimber resources, as any positive discount rate puts less importance on the future.

Choosing an appropriate accounting stance is important in benefit–cost analysis (Veeman 1986). Will the analysis be looked at from a local, provincial, national, or international level? The choice of an accounting stance has a large impact on the quantity of benefits derived. In the case of wildlife preservation or of scientific values held within the forest resource, where the benefits of preservation are not limited to a province or even the country, an international accounting stance would greatly increase the benefits versus the costs.

Prices included in benefit–cost analyses must be corrected to reflect the true societal scarcity values or opportunity costs. Market prices often do not reflect the true value of nontimber resources to society. Entrance fees paid for access to park areas rarely reflect the full value of the park experience. Timber prices or stumpage, too, might not reflect the full value of timber. For example, timber prices might not accurately capture the environmental costs associated with logging and processing.

Secondary benefits should not be used to justify projects in benefit–cost analyses, as in a fully employed economy, these benefits represent a transfer of economic activity, not a net gain (Veeman 1986). Secondary benefits are those benefits that are generated by economic activity that is linked forwardly (processing and distributing industries) and backwardly (input supply industries) to the primary activity. Although secondary benefits are important in examining the impacts on regional income distribution, they do not result in efficiency gains unless the resources would be unemployed throughout the length of the project.

A number of benefit–cost analyses have been done on forestry land use trade-off issues. For example, analyses have been done on the benefits of wilderness preservation and species habitat preservation versus the economic costs (Boyle and Bishop 1987; Bowker and Stoll 1988; Gunton 1991; Rubin et al. 1991; Lockwood et al. 1993). The benefits and costs included in these analyses vary. The benefits of wilderness preservation could include: the maintenance of recreational and tourism opportunities; reduced damage to roads caused by logging trucks; and, the preservation of the land (Lockwood et al. 1993). The costs of wilderness preservation could include: the loss of revenues from the timber; lost jobs; potentially higher timber prices; and, the loss of recreation and tourism opportunities that can result from improved access created by roads built by logging companies. The results of a benefit–cost analysis are dependent on the benefits and costs included, the discount rate, and on the assumptions within the model. Analysis should be undertaken to determine the sensitivity of the results to these variables.[3]

Types of Values

The benefits from nontimber resources can be divided into use values, nonuse values, and environmental control services (Adamowicz 1992). Use values are values in which users receive benefits directly or indirectly. Some users value nontimber resources directly through consumptive uses such as hunting or fishing, while others benefit indirectly through nonconsumptive uses such as wildlife photography or birding.

It was recognized by Krutilla (1967) that a significant proportion of the value of a resource was being ignored when only use values were considered. The nonuse values became known as preservation values, which were categorized into existence, bequest, and option values.

Existence values are the values placed on nontimber resources, such as wildlife, by people who find it important knowing that there is wildlife within a forest even though they might never see it. Bequest value is the importance individuals place on preserving nontimber resources for future generations. It reflects the importance placed on passing on a diverse and relatively unspoiled natural environment. Option value is the value an individual places on preserving an area, and, even though the individual might never use the area, he or she is willing to pay to preserve it (Nautiyal 1988). It arises from a combination of the individual's uncertainty about future demand for the site and its future availability (Cicchetti and Freeman 1971). Option value is in excess of the expected values that would be generated by a user if he or she did visit the area.

Nonuse values are more difficult to measure than use values because demand is not related to economic activity within a region. It is much easier to estimate the value of a popular recreation site than the value of a threatened species. Many studies have shown, however, that nonuse values, which accrue to nontimber resources, are substantial and have been greatly underestimated. In many cases, use values account for a small proportion of the total benefits associated with the timber resource. This was evident in a study done on the preservation values on the Grand Canyon in which less than 0.5% was attributed to user values (Schulze et al. 1983). Although this is an extreme case, other studies that have used more conservative measures have shown that not including nonuse values could effectively underestimate total benefits by 25% (Asafu-Adjaye et al. 1989).

Forest resources also play a role in water quality and quantity, erosion control, climate control, flood control, and wildlife habitat. These are the environmental control services of a forest (Adamowicz

[3] Benefit–cost analysis is among one of the methods used to evaluate land use trade-offs. Other methods include biophysical analysis (McHarg 1969; Hills et al. 1970), economic impact assessment (Davis 1990; Natural Resources Management Program 1990) and multiple-objective analysis (Hill and Werczberger 1978; McAllister 1980). Gunton (1992) provides a comprehensive review of the advantages and disadvantages of these methods.

1992). The impact of changes in the environmental control services will affect the quality and quantity of use and nonuse values. For example, improving water quality could enhance fish populations and changes in wildlife habitat can affect hunting and wildlife viewing values.

Importance of Economic Valuation

Economic valuation of the nontimber resource is important for a number of reasons. First, estimating values for nontimber resources allows both priced and unpriced goods and services to be included in resource allocation decisions, which in turn allows the trade-offs in managing for these resources to be examined. This is useful in economic models that incorporate nontimber values into forest rotation decisions (Hartman 1976; Calish et al. 1978; Englin 1990). Accounting for nontimber values in analysis could shorten or lengthen the optimal forest rotation. Generally, nontimber services are represented by an amenity function that includes a variety of activities. If the amenity function is increasing over time, the optimal timber rotation is lengthened, whereas if the amenity function is decreasing over time, the rotation period is shortened. Although incorporating nontimber values into rotation decisions explicitly allows the benefits to be accounted for, difficulties arise when land bases have multiple uses where some amenity values are increasing over time while others are decreasing over time. Complementary and competing values must be accessed, and in some cases, management decisions have to be made on a single amenity value.

The second reason it is important to place a monetary value on nontimber resources is to determine compensation in cases where loss or damage of an environmental asset has resulted from negligence on the part of an individual or firm (Adamowicz 1991). Valuation techniques such as travel cost and contingent valuation models have been used in court cases in Canada and the United States and have been accepted by the United States Water Resources Council (1979, 1983) and the United States Department of Interior (1986) as acceptable methods for valuing nontimber goods and services.

Third, while technological change can expand the production possibilities for goods, it is unlikely to increase the natural services of the environment. The loss of unique natural environments is often irreversible, and, once the areas are lost, the future benefits are destroyed. Technological change and substitution among inputs that have played important roles in the production process of other commodities are generally incapable of supplementing the flow of nontimber benefits from the forest resource (Howe 1979).

The fourth reason is the shift in society's preferences toward amenity services, which has led to an increase in demand for nontimber goods and services. This shift in demand has also been attributed to an increase in income, leisure time, population, education, and mobility in society that have allowed more people to enjoy nontimber resources (Nautiyal 1988). Interest in nonuse services is also increasing. This is evident by the increased interest in maintaining old growth forests and species diversity, regardless of whether these areas or species are ever actually seen.

Valuation of nontimber resources also allows the identification of the regional distribution of these services and the regional economic impacts. Individuals incur costs while using the nontimber resources of the forests, and although this is different from measures of value, such expenditures are important from a regional economic standpoint.

The sixth reason it is important to assign monetary values to nontimber resources is that, although timber values can be included in national income accounting, the services provided by nontimber resources are not included in national accounts. Although national accounts treat buildings and equipment as productive capital, the depletion of natural resources does not appear in national accounts. Countries could erode their soils, hunt their wildlife to extinction, and deplete their forest stocks below sustainable levels, yet this loss of natural capital would not appear in national accounts (Repetto 1989). The stock from which a flow of renewable resources emanates could be irreversibly damaged, impairing sustainable consumption in the future. Gross national product (GNP) is one of the most common indicators of welfare, yet it is imperfect because growth could be illusory if it is based on ecologically and environmentally unsustainable practices. If GNP is to be a more accurate measure of welfare, the national accounting procedures should account for the changes in the natural resource base.

There are three issues associated with managing nontimber resources to be examined. First, does the demand for maintaining and enhancing nontimber resources justify the expenditure of Crown funds? Second, who is responsible for maintaining and enhancing nontimber resources? Third, if nontimber goods should be priced, how should this be done?

Demand

The first issue is whether demand justifies the expenditure necessary for maintaining and enhancing nontimber resources. This implicitly involves the accurate estimation of nontimber benefits and costs. A number of methods have been developed to estimate the values associated with nontimber goods and services; however, the reliability of the values have been questioned.

A number of methods have been developed to test valuation estimates for their reliability. One method is to compare the values from different benefit estimation techniques (Bishop and Heberlein 1979; Sellar et al. 1985). This method of validation has been criticized because the values are not validated against any true value and evidence of correlation between them does not necessarily prove the validity of one or both techniques (Adamowicz 1988b).

Another method of testing the reliability of the estimates is to compare willingness to pay values from contingent valuation techniques to actual monetary exchanges in simulated market situations (Bishop and Heberlein 1986; Dickie et al. 1987; Kealy et al. 1988). Bishop and Heberlein (1986) show no statistically significant differences between actual monetary outlays and the hypothetical market; however, large standard errors were associated with both methods and the analysis was based on sample averages (Adamowicz 1988a). Kealy et al. (1988) and Dickie et al. (1987) show large discrepancies between hypothetical and simulated markets. Reliability has also been tested by subjecting the same individual to various methods of benefit estimation in a repeated sampling process (Adamowicz 1988a; Loomis 1989).

Lastly, Monte Carlo experiments can be used to test the accuracy of the valuation estimates by incorporating the 'truth' into computer models that then generate data (Caulkins et al. 1985; Kling 1988; Common and McKenney 1994). The results of the studies are varied; some authors claim estimates are reliable, while others claim they are not.

In order to make informed land-use allocation decisions, managers need information on the demand for nontimber goods and services. Although the reliability of the estimates has been questioned (in many cases, the estimates have been characterized by large standard errors), these techniques appear to be the best available tools to estimate demand. Research should be directed at minimizing the variability of estimates through survey design, and the estimates obtained should be tested for their reliability.

Who is Responsible?

The next issue that arises is who should be responsible for maintaining and enhancing nontimber goods and services. A seemingly efficient solution would be to ensure that those who benefit from the timber resource pay the costs. For example, forest companies that use timber to make forest products would pay to return the forest to a state where it could provide the same nontimber services as it did before the harvest. Hunters, recreationists, and others who benefit from wildlife, scenic beauty, and other nontimber benefits could also be asked to pay to ensure the continued flow of these services. Citizens who never use the forest but nevertheless benefit by its existence also bear a responsibility in maintaining the flow of services the forest provides. The Crown, as owner of the resource and a steward of public interest, could also be seen as responsible for the maintenance of the forest.

The question of responsibility is complicated by the public-good nature of nontimber resources. Public goods are goods that are nonexcludable and nonrival. Nonexcludability occurs when once a good is provided to one person, it is then provided to others because they cannot be excluded. Nonrivalry occurs when the consumption of a good by one person does not prevent the good from being consumed by another. An example of a public good is a panoramic view; consumption remains unaffected by others' enjoyment of the same view (although crowding might affect enjoyment). The very nature of public goods makes it difficult to determine who benefits.

The forest industry's responsibility depends on the type of tenure under which it operates. In Alberta, tenure types include forest management agreements (FMAs), quota certificates, timber licenses, commercial timber permits, and local timber permits. Property rights, enveloped within these tenures, provide little incentive to manage for any other resource except timber. For example, no revenue is generated to the firm from an increased wildlife density. The primary alternative to the property-right system is government regulation. As the FMA holder is on Crown land, society's norms and values can be imposed through regulation.

Such regulation will impose costs on the firm, including administration costs, opportunity costs, and actual logging costs (Benson and Niccolucci 1985). Higher administration costs result from the development of plans associated with nontimber resources (i.e., logging plans for integrated resource management). Opportunity costs are the costs involved in not harvesting certain areas due to concerns for wildlife habitat, forest recreation, and erosion control. Actual logging costs could include strategic placing of roads and cut blocks to protect sensitive areas, changing the rotation length to optimize nontimber resources, or more expensive logging systems to prevent soil erosion.

As an alternative or in conjunction with government regulation, tax incentives, and grants could be used to provide incentives for forest companies to manage for nontimber resources.

From the discussion above, it is unclear as to who is responsible for maintaining and enhancing nontimber goods and services. As the majority of forested land in Canada is publicly owned, society, ultimately, should have the right to decide how the forest should be used. The forest resource, however, can no longer supply all our needs at little cost. The increased scarcity of the timber resource and increased demand from logging companies and environmental groups as well as the general public, have created some heated exchanges. If society feels that increasingly more lands should be preserved and taken out of timber production, then society will have to absorb the costs.

Pricing

If forests were privately owned, any profit-maximizing owner would be free to price access and determine the price that would maximize net revenue. In the long run, they would invest in a given site until the optimal quantity and quality was reached. When access is not priced though, this optimization is not possible. There is a cost involved in preserving and managing forests for multiple use, a growing concern over the rationing of natural resources, and the ability to cover the costs involved in providing outdoor recreational opportunities.

In cases such as outdoor recreation, pricing policies might work well in managing nontimber resources. Pricing policies are important not only for economic efficiency, but also for equity in distribution of income, fairness in distribution of fixed costs among users, conservation of natural resources, and protection of environmental quality. Pricing works well to disperse recreationists to alleviate crowding, protect sensitive areas, and generate revenue. It is efficient (although perhaps not equitable) in such a way that the users who value the area the highest will retain the use, whereas those who do not value the area as highly will move elsewhere. Pricing can provide appropriate signals to consumers and producers to ensure the land is managed to provide the maximum economic value.

Other methods of rationing can be used to disperse users, such as first-come, first-serve or lottery mechanisms, but these methods are not as efficient because they do not generate the highest value.

The implementation of pricing access to forest lands brings up some issues. First, the cost of collection is often higher than the value of fees, and fee revenues are often not significantly related to the costs. As well, there are equity considerations involved in pricing access to natural areas because some individuals might be excluded. Third, efficient pricing of public goods requires separate prices for each consumer, with the sum of these prices equal to the additional value from the public good. As individuals value amenity services differently, no single price will adequately capture the value.

If pricing policies are to be implemented to ensure those who benefit from the resource pay the costs, the optimal pricing policy must be determined. User fees and various taxes are options, but cases have to be looked at individually. In the case of water-quality enhancement at a recreational site, for example, a sales tax might be preferred, as well as a tax on the residents, to ensure all those who benefit from the resource pay the costs involved.

Summary

Although determining the demand for nontimber resources with precision is difficult due to the constraints within the theoretical models for benefit estimation, the difficulties of quantifying nonuse values, and the public good nature of nontimber resources, it is generally accepted that the values associated with these resources are significant. Future research should focus on accurately capturing these values, testing the reliability of these estimates, and incorporating the estimates into policy analysis.

The second issue discussed was who should be responsible for the costs of maintaining or enhancing nontimber resources. This problem arises from the lack of property rights associated with nontimber resources. More clearly defined markets would allow identification of those who benefit. Obviously, as in the case of nonuse values, this is not technically feasible, and other methods must be used to identify those who benefit.

Last, the issue of pricing was discussed. Although pricing in some cases is technically unfeasible as a result of the public-good nature of the resource, in some cases it can work well to provide revenue for the maintenance of the nontimber resource.

THEORETICAL MODELS FOR BENEFIT ESTIMATION

The objective of benefit estimation is to determine the value, in monetary terms, of the impact of a change in the quality and quantity of a good or service that does not have a market price. Two approaches are used to measure nontimber values: the direct and indirect methods. The direct method involves the use of surveys to determine consumers' willingness to pay (WTP) for a good with no market price. The most common form of the direct method is the contingent valuation method (CVM). The indirect method involves observing the actual behavior of individuals to determine the valuation of nonmarket goods. The basic travel cost method and modifications of this model are examined.

The Contingent Valuation Method

The contingent valuation method elicits responses from participants concerning the price they would be willing to pay to avoid losing an area or experience. Here, WTP is defined as the amount of money an individual would pay to obtain the change and still be as well off as before the change. The CVM is based on establishing a hypothetical market situation and asking individuals to reveal extramarket values contingent upon the existence of this market. This can be done by on-site interviews, telephone surveys, or mail questionnaires. Access to nontimber resources is often available at a low or nominal price, and the CVM provides a means of discovering a price that the individual would pay if a market system did exist. In other words, it provides a means of capturing the consumer surplus. Two assumptions are implicit in this model: consumers have the ability to assign accurate values to nontimber resources; and the values can be captured in the hypothetical markets developed.

The CVM must establish base line conditions with respect to the availability of nontimber resources, and explicitly describe the institutional and structural framework that regulates access and use (Randall 1987). It must thoroughly characterize the changes that will result from policy alterations and, through the creation of a hypothetical market, it must attempt to capture the participants' WTP accurately. As well, it must outline the conditions for provision of the environmental improvement and the method of payment. The quality of the results depends on the characteristics developed within the contingent market.

The CVM has some notable advantages. It can be easily administered and is essentially free of restrictive assumptions (Phillips and Adamowicz 1983). It is particularly useful for valuing a single component such as hunting because it separates out the values of the component from the total value. The CVM also distinguishes among private, public, option, and existence values.

Techniques in the Contingent Valuation Method

There are various techniques involved in administering the contingent valuation survey. The four most common techniques are iterative bidding, payment cards, open-ended questioning, and the dichotomous-choice approach.

The iterative bidding technique begins with an interviewer developing the market conditions under which the item is to be valued. The interviewer then asks whether the interviewee will accept an initial bid, and then, depending on the response from the interviewee, the interviewer increases or decreases the bid until an acceptable value is found (Boyle and Bishop 1988). This results in a final bid that can be used as a measure of value. Some studies have shown that this technique involves a starting-point bias in which discrepancies arise in the reported value of an item depending on the starting point (Boyle et al. 1985; Samples 1985).

The payment card technique involves cards that display a range of dollar values starting from zero and increasing at fixed intervals (Boyle and Bishop 1988). In addition to these values, the cards help to obtain estimates of what respondents from the preceding year paid for public services (Boyle and Bishop 1988). The interviewer describes the hypothetical market situation and the item to be valued as in the iterative bidding technique, but also obtains information on the respondents' incomes. Each respondent is then shown a payment card corresponding to income category and is asked to pick a value for the item while considering household income and the information on the card. The value obtained is final and no bidding takes place.

Open-ended questioning involves asking an individual the maximum amount he or she is willing to pay. This effectively eliminates a starting-point bias. The reliability of this approach has been questioned because individuals might be unable to determine an accurate value for goods or services that they have never had to value.

The dichotomous-choice technique involves asking respondents whether they are willing to accept or reject a monetary value. Only a yes or no response is required. The advantage of this method is that the respondent is not faced with the complexities of the iterative bidding and payment card techniques. The technique is therefore comparatively simple for respondents because they do not have to come up with exact values for which payment is not customary. The dichotomous technique is simple to administer as no interviewer is required and the starting-point bias is eliminated.

The dichotomous-choice approach is gaining popularity. It is generally preferred to open-ended questioning as a result of the difficulty associated with placing accurate values on nonmarket resources. As well, it resembles a real market situation. An individual is faced with a price and, based on this price, makes a purchasing decision. A study done on recreational boating using the CVM found that open-ended questions resulted in 23% of the respondents unable to provide accurate answers, whereas only 9.2% of the respondents could not provide accurate answers when asked dichotomous-choice questions (Sellar et al. 1985).

Shortcomings of the Contingent Valuation Method

There are a number of disadvantages associated with the CVM. Individuals might not accept the market developed or they simply might not have well-developed beliefs about how they would behave in real markets for environmental assets. Individuals can deliberately overstate their WTP to ensure that the good or service is preserved (this occurs frequently when it is anticipated that the costs will be incurred by the government). Individuals can also understate their true WTP for a good, believing that they have little impact on the aggregate valuation, and by understating its value, can receive the benefits without actually paying. This behavior results in the true value of the resource being underestimated. Although this behavior is apparent when WTP questions are open-ended, the dichotomous-choice approach is effective in reducing this type of strategic behavior.

Individuals can also have aversions to a particular method of payment such as entrance fees, tax payments, or general price increases. This is known as vehicle bias. In these cases, an individual's WTP will be understated. Vehicle bias can be avoided by choosing methods of payment that are unlikely to create protest bids. Payments into public trust funds are often used as neutral payment vehicles.

Although it is likely that strategic behavior exists to some extent in some forms of the CVM, research suggests that the effect of these biases is small (Cummings et al. 1986; Mitchell and Carson 1989).

One of the most problematic issues with the CVM is that there are discrepancies in values obtained, depending on whether the question elicits WTP values or willingness to accept values. A willingness to accept (WTA) value is defined as the amount of money that would have to be paid to an individual to forego the change and leave the person as well off as if the change had occurred. Economic theory suggests that these two measures should be similar; however, empirical studies show that WTA values can be three to four times higher than WTP values. The difference in the estimates obtained between WTP and WTAhas, in part, been attributed to an income effect that restricts WTP but not WTA. Hanemann (1989) suggests that the difference between WTP and WTA depends not only on an income effect, but also on the degree of substitutability between the goods being valued and the other goods' utility function. He suggested that by holding income constant, the smaller the substitution effect and the greater the disparity between WTP and WTA. Macnab and Adamowicz (1990) tested Hanemann's hypothesis empirically and their results showed little support for the substitute hypothesis. They argued that the difference between WTP and WTA is not explained by traditional economic theory and that all benefit estimation studies involve some degree of measurement error.

Other issues surrounding the CVM include the existence of an embedding effect and eliciting responses that reflect moral satisfaction rather than economic value (Kahneman and Knetsch 1992). The embedding effect occurs when WTP for a good varies depending on whether the good is valued on its own or as part of an inclusive group of goods. Kahneman and Knetsch (1992) showed that WTP for narrowly defined goods is close to that of more inclusive categories. The moral satisfaction issue arises when WTP to prevent the loss of a public good is affected by moral considerations. In this case, responses would not reflect the true economic value associated with the good. These issues are important and must be considered when developing contingent valuation surveys and analyzing the responses.

Summary of the Contingent Valuation Method

The CVM is a flexible tool and is the only method capable of estimating nonuse values. Studies have revealed that the CVM is consistent with preferences revealed by actual choices and it is systematically related to individual demographic characteristics and the availability of substitutes and complements (Randall et al. 1983). The CVM has been found to be consistent with the estimates obtained using actual market data (Bishop and Heberlein 1979; Bishop et al. 1988; Kealy et al. 1988). Although incentives for accurate valuation of a public good in contingent valuation surveys might not be as strong as in a private-goods market, incentives are not absent (Randall 1987). The CVM might not completely capture the magnitude of valuation for nontimber resources, but it does effectively signal the direction of these values.

The challenge facing the CVM is in its ability to capture nonuse values. Nonuse values cannot be easily compared to actual market data or other benefit estimation techniques. Research should focus on attempting to capture these values accurately.

The Travel Cost Method

The travel cost method (TCM) was first developed in 1947 by Harold Hotelling[4], who proposed using travel cost as a surrogate for price to estimate demand. The method is based on the premise that even when no entry fee is paid to use a recreational site, visitors pay an implicit price for the attributes or services of the site. This implicit price is the cost of travel to the site, including both transportation and time costs. Individuals from different origins face varying travel costs and therefore will visit the site at different rates. From this information, a demand curve can be inferred to estimate the value of a recreation visit above expenditures. The advantage of this approach is that it is based on actual behavior; therefore, the values obtained are not based on intentions or attitudes. Individuals report the distance traveled and their travel costs.

The distance traveled to a site not only involves a monetary cost, but a time cost. Ignoring time costs can overestimate the effect of a price change on

[4] Hotelling, H. 1947. Letter to the director, National Park Service, U.S. Department of Interior. Quoted *in* Outdoor Recreation Resources Review Committee Report 24, Economic Studies of Outdoor Recreation. Washington, D.C. 1962.

visits, underestimate the number of visits to the site, and, therefore, underestimate the benefits attributed to the site. Most travel-cost analyses use some proportion of the wage rate as a proxy for the cost of travel time. Time costs, in most cases, are assumed to be one-quarter to one-half of the wage rate; however, large statistical differences arise depending on which value is used. Wilman (1980) argues that time values will likely differ across individuals, trips, and sites for the same individual, and be given by some nonlinear function of the wage rate.

Although the distance traveled involves a time and monetary cost, it is possible that the time spent traveling could also represent an enjoyable part of the trip, such as when viewing wildlife from a vehicle. It is therefore important to estimate the utility or disutility associated with traveling to a site. The challenge is estimating the time cost associated with travel and determining what proportion of the trip represents a benefit.

In travel-cost analysis, an appropriate functional form must be determined. Most analyses have used linear, semilog, or double-log functional forms. Estimates of consumer surplus are random variables and alternative functional forms affect its statistical properties. A study done on the differences between a linear demand curve and a semilog form found almost a fourfold difference among estimates of consumer surplus (Ziemer et al. 1980). Kling (1989) found the choice of functional form resulted in the variation of welfare measurements from 4% to 107%. As well, Adamowicz, Fletcher, and Graham-Tomasi (1989) found different functional forms resulted in substantial differences in the variances and means. They argued that if two forms are similar in overall fit, the one with the smaller variance associated with welfare measures should be selected.

Shortcomings of the Travel Cost Method

The TCM has a number of restrictive assumptions. It can only estimate use values because it is necessary to travel in order to estimate values. This method cannot, for example, estimate the value of 'backyard birding'. Fees such as admission or license fees must be viewed by the participant in the same way as a travel cost (Phillips and Adamowicz 1983). As well, the basic TCM assumes that intraseasonal effects, tastes, preferences, and income levels at varying distances to sites are constant. Further, the basic TCM is only applicable to single-destination trips; therefore, only the marginal travel costs associated with the site should be included to prevent overvaluation (Mendelsohn and Brown 1983).

Another restrictive assumption is that the length of time spent on site must be held constant; however, many of the estimated travel cost demand curves do not hold visit length constant. These demand curves might not therefore provide useful information to managers facing decisions involving capacity or use (Wilman 1987). The TCM also assumes weak complementarity in that it requires a market purchase to be associated with an environmental good. For example, the benefits from an environmental improvement such as a water quality enhancement project must be able to be measured by the increased demand for water-based recreational activities.

Modifications of the Travel Cost Method

As the basic TCM is unable to value quality changes and the presence of substitute sites, modified travel cost models, such as the hedonic TCM and discrete choice models have been developed to take into account these variables.

The Hedonic Travel Cost Method

While the basic TCM is useful in valuing recreation sites and activities, the hedonic travel cost (HTC) method is useful in valuing recreational quality or site characteristics. For example, the basic TCM can value a trip to Banff National Park, whereas the HTC model can estimate the value of the opportunity to see a grizzly bear.

The HTC method assumes that individuals are willing to pay more to travel to a site that they consider to have higher-quality characteristics. Output is viewed as a function of the inputs used, and the value of the output depends on the mix and characteristics of the inputs. Heterogenous sites are treated as a bundle of characteristics and it is assumed that the individual will maximize utility subject to travel costs, user fees, travel time, and the desirable characteristics of the site.

The HTC model is estimated in two stages. In the first stage, the implicit prices of the characteristics are estimated using a time variable and a distance variable to account for varying speeds to sites (Brown and Mendelsohn 1984). For each residence zone, travel cost is regressed on the characteristics of each site. In the second stage, the number of trips and the level of characteristics are estimated for each individual.

The HTC method treats the choices of characteristics of a site by recreationists explicitly. By traveling farther to a site or extending a visit an additional day, the recreationist implicitly makes a purchase of the desired characteristic attributed to the site. The value of an additional day of an activity can be determined by estimating the change in expenditure for an additional day and then using the data to estimate the marginal value and a demand schedule for the activity (Phillips and Adamowicz 1983). For example, the demand for a higher level of fish density can be calculated by regressing the level of fish density purchased on price.

This method is flexible and easy to use. Fairly reliable data can be obtained and quality characteristics can be incorporated, creating a realistic market situation. As well, the HTC method is more relevant than other methods to policy makers, because public agencies have direct control over the characteristics of the site. This method is therefore useful in obtaining information on the value of improving site quality.

Although the HTC method seems to have gained better recognition than the basic TCM, it has some disadvantages. It assumes individuals within a zone have the same wage rate and travel the same distance to the site (Smith and Kaoru 1987). Variations in either of these variables can affect behavior. For example, if a individual has a lower wage rate, he or she might have an incentive to choose lower-cost sites.

It is also difficult to identify a full set of demand equations in the hedonic travel cost model because all the relevant characteristics must be included in the model and accurately measured (Maler 1974). Further, the HTC model assumes that only one site can be used per quantity, and characteristic levels are not linearly additive across quantity units (Wilman 1988). This assumption is restrictive with respect to some forms of recreation where quality characteristics are linearly additive across quantity units within a time frame. In the case of hunting, fishing, or birding, the amount of time spent on the site can effectively double the level of characteristic obtained.

In summary, the HTC model is useful when visit levels remain fixed as the site choice changes, allowing the marginal WTP for a characteristic and its marginal cost to be aggregated over visits (Wilman 1988). The travel cost method works better, however, under conditions where the site choice remains fixed because the visit level changes, allowing the marginal cost of a characteristic to be used as an exogenous shift variable affecting demand and supply curves for visits.

The Discrete Choice Travel Cost Model

The HTC model is useful in valuing site characteristics and determining the value of quality changes; however, it does not explicitly treat site substitution or the fact that some individuals will exit and enter as site quality varies. Discrete choice models (DCM) have been developed to incorporate explicitly substitute sites, quality effects, and site entry and exit that influence an individual's choice (Caulkins et al. 1986). The individual chooses from among a finite set of alternatives that are mutually exclusive, and utility is derived directly from the consumption of activities and indirectly from the characteristics of those activities (Stynes and Peterson 1984).

The DCM is consistent with the concept of utility as a function of site attributes and socioeconomic characteristics, and it has the ability to model complex behavioral processes (Adamowicz 1991). Some of the assumptions of the basic travel cost method have been relaxed, but a decision-making process is imposed on the user. Decisions must be made regarding the choice of the activity and the choice of a site. As well, the decision to take a trip and undertake an activity is made one trip at a time; therefore, there is no carryover from one trip to the next, and habit and intraseasonal factors are eliminated (Adamowicz 1988a). A sequential choice model has been developed in which choices of trips are made one trip at a time rather than at one point in the season (Adamowicz, Jennings, and Coyne 1989).

The DCM is estimated in stages. In the first stage, the probability of participation in an activity is estimated, and, in the second stage, the probability of choosing a particular site given the characteristics of that site is estimated. A logit model is often used to analyze the data obtained. This model assumes that the individual chooses to visit the recreational site that maximizes utility based on the attributes of the site (Kling 1988). The model predicts how trips will be reallocated after a quality change; however, it cannot predict how the total number of trips will change as a result of the quality change. Kling (1988) proposed using a separate participation equation to predict the total number of trips an individual would take after the quality improvement. The dependent variable is the total number of trips per season, and the independent variables are income and a measure of the utility obtained from taking one trip to each site. This equation can then be used to calculate per-season welfare estimates.

Summary

Although modifications on the basic TCM deal with some of the restrictive assumptions, they require substantial data and objective descriptions of site characteristics. They are more sensitive to the absence of demand shift variables and measurement errors in the variables included, and therefore require higher quality and more extensive data than the basic TCM (Mendelsohn and Brown 1983). Determining which method to use will depend on the availability of data and the objectives of the study.

The TCM is a useful tool in benefit estimation and has the advantage of being based on actual behavior. Although the restrictive assumptions associated with the TCM have constrained its use in the past, the TCM is becoming applicable to more situations in recreation analysis through the use of more sophisticated econometric analysis and advances in modeling.

CONCLUSIONS

The need for information on the value of nontimber goods and services is growing as the demand increases for forest resources. Estimating the values associated with nontimber resources is difficult due to the absence of market prices, the lack of knowledge of who is benefiting, and what benefits are involved. Economic valuation is an important tool in estimating demand for nontimber goods and services. Although there are still some issues surrounding the reliability of the estimates obtained from benefit estimation techniques, many recent advances in survey design and modeling have increased the reliability of the estimates.

Future research should focus on improving the reliability of the valuation estimates and ensuring the estimates obtained are useful to managers and policy makers. Integrating multiple uses on land bases requires that the values of the nontimber goods and services are accounted for in land-use allocation decisions.

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