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The Economic Value of Water Recreation in Minnesota

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Abstract

In recent years, increased demands for water for competing uses created a need for establishing a systematic water resource management policy. Knowledge of the value of benefits of water in its various uses is necessary for allocation decisions because this resource is in the public domain. This paper discusses several non-market methods of imputing the economic value of water, particularly recreational water use. Using Minnesota Department of Natural Resources (DNR) data, two alternative techniques for measuring value are evaluated and compared. These methods are used to provide empirical estimates of the recreational value that people place on Minnesota's water resources. Minnesota has 1986 annual water-based recreational expenditures in excess of $862 million. In addition, over $377 million represents non-market benefits which might otherwise be ignored. Failure to consider the non-market benefits substantially undervalues the recreational use of water when comparing water's value to industrial or agricultural uses. Finally, the implications of these estimates for water management policy are discussed.

Introduction

Minnesota, the land of 10,000 lakes, is known for its abundant supply of fresh, sparkling water. However, in recent years increased demand for water for recreation, and for industrial and economic development uses underlines the importance of establishing a systematic water resource management policy. Allocation decisions for resources in the public domain, like water, require non-market methods of valuation as opposed to values arising out of ordinary market transactions.

This paper considers the economic valuation of water, with particular attention paid to recreational use. Alternative techniques for measuring values are discussed and compared. Several methods are used to provide empirical estimates of the recreational value that people place on Minnesota's water resources. Finally, consideration is given to how these estimates might be used for making policy decisions.

Valuation of products and commodities in private markets generally do not pose measurement problems. Goods are sold at competitive prices, which serve as signals for efficient resource allocation. These prices multiplied by the volume of sales determine sales revenues, which represent the market value of a particular activity and its relative importance in terms of income and employment generation within the state.

Common property resources, or lands and waters held in public trust such as state and national forests and parks, county lands, etc., generally do not have markets and these resources cannot be priced or their value to society assessed directly. These resources need to be valued quantitatively, because they are demanded by individuals and groups and because, correspondingly, other goods and alternatives are foregone. According to Schmid (1) an exchange ratio exists when public resources are being utilized, and this represents an "implicit" price of a public or "free" good.

The recreational use of water is thought of as a free good because the entry prices charged for access (e.g., park sticker) to recreational water use are usually negligible in relation to the value derived from this common property resource. Because recreational water use is not valued or priced like other goods and services, and because things that are measurable are often viewed as more important, assessing the value of recreational water use is critically important for efficient water management decisions.

Two types of economic benefits, or user values, can be derived from the recreational use of water resources. One benefit, an economic impact, answers the question, "What is the economic impact from the expenditures of recreational users of the water resource?" The other benefit, consumer surplus of the recreational experience, answers the question, "How much do participants value the recreational experience above what they must pay (i.e., the consumer surplus)?" Although these two economic benefits are distinct, they are both very important in making efficient water management decisions (see Rockland (2)).

Legislators often support water recreation projects with a goal of generating the greatest employment and income stimulus or economic impact. Water recreation enthusiasts make purchases of goods and services in the local area and affect industries directly; and, these expenditures stimulate purchases from other industries that supply the directly impacted firms. These direct and

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indirect expenditures create income and wages paid by the directly and indirectly affected businesses, and these incomes from the household sector are used to purchase more goods and services creating an induced impact in the region. When direct, indirect and induced effects on income and employment are summed, the total economic impact of publicly-spent water recreation dollars can be calculated and compared between regions. (For an example, see 3.)

Although economic impacts of publicly expended funds for water-related recreational activities are important to local legislators in the impacted area, government agencies, which must make allocation decisions between particular regions, will often be more interested in the consumer surplus of enhanced recreational opportunities to users of various recreation projects around the state of Minnesota. The remainder of the paper is devoted to this latter type of user value.

Because many of Minnesota's water resources are in the public domain and private markets are not in existence to measure the consumer surplus values of these resources, non-market methods of valuation are required. These techniques must determine the consumer surplus value of benefits from recreational use which can be compared to costs of provision so that resource allocation decisions can be made by public agencies in a benefit-cost framework.

Methods and Sources

Two methods are often used to value these non-market consumer surplus recreational benefits: the travel cost method (TCM) and the contingent valuation method (CVM). Both methods are used to estimate the value of economic benefits in the context of benefit-cost analysis.

The travel-cost demand estimation procedure was suggested by Harold Hotelling (4) and was refined and implemented by Clawson and Knetsch (5) and others. The basis for the travel-cost approach according to Rowe (6) is the recognition that the use of recreational services at a particular site requires the user to incur not only expenditures for entry fees and equipment, but also the expenses associated with traveling to the site. The cost, or price, to an individual of using services at the site will vary according to the travel time and expenses incurred in getting to the site. Moreover, the farther away users are from the site, the greater the implicit price of using the site. Information on distances and travel costs for a cross-section of users is used to construct demand curves for a single site, and consumer surplus is then calculated from the demand curves.

The CVM relies upon a survey response to a hypothetical question. A surveyor might ask a user how much he or she values purer (in various increments) water compared to presently polluted water and then use the responses to determine the incremental benefits of purer water (see, for example, 7). These could be compared, within the benefit-cost framework, to the cost of purifying water in order to make resource allocation decisions. Some economists have criticized this approach because of its highly hypothetical setting for making a valuation choice, while other economists defend it as the only method of evaluating environmental changes before they have actually been made (see 8 for review of these positions).

In addition to valuing changes in a resource, CVM can be used to assess the value of an existing resource by asking the individual directly about his or her willingness to pay or to sell access to the resource. If the resource is owned by the individual, then willingness to sell (or be compensated for giving up access to it) is relevant. Willingness to sell or receive compensation for access will generally tend to overestimate the true value of the resource since the respondent is thinking in terms of receiving recompense. For publicly owned resources, however, willingness to pay for access is expected to result in a more conservative estimate of the value of access to the resource. In the context of recreational water use, the CVM can, and will, be used to assess a conservative estimate of water recreational value.

As already suggested, economists have various ways of measuring the economic value of public goods. Assuming that the recreational use of water in Minnesota is a public good, in this section actual estimates of the value of Minnesota waters will be provided, by region, using the theoretical methods which have been outlined. The plan will be to begin by presenting the estimates of recreational values in various tables and then to discuss the meaning and policy significance of these numbers.

The value of recreation to participants involves two separate economic values: 1) the market value of recreation, which is measured by expenditures, and 2) the non-market value, which is estimated here by consumer surplus. A study of acid rain in Minnesota (9) suggested that user option and existence values (which are also components of non-market value) are, on average, 60 percent of the consumer surplus participation values for users of lakes. In addition, similar existence and option values could be considered for non-users. This would certainly imply that consumer surplus participation values presented underestimate total non-market recreational value of Minnesota waters.

In the various tables two economic values, expenditures and consumer surplus, have been estimated on a per day basis. While some work was done using smaller geographic areas (e.g., for counties and 13 regions see (10)), all the tables have been prepared for the five regions that were the primary geographic focus of the Water Allocation Project (11).

Also, statistical tests determined that differences between regions in per day values (i.e., for expenditures and for consumer surplus) were insignificant, in part because of inadequate sample sizes for several counties [The F-test mean square ratios of 1.305 for expenditures

(per day) and 1.343 for consumer surplus (per day) were less than the 1 percent probability value of 2.64]. Nonetheless, tables were prepared by region because of large differences in use (days). Similar statistical tests led to the conclusion that there were no statistically significant differences in per day values between water-based recreational activities such as fishing, swimming and boating [The F-test mean square ratios of 1.10 for expenditures (per day) and 0.34 for consumer surplus (per day) were less than the corresponding 1 percent probability value of 2.80]. Consequently, the tables have been prepared for all water-based activities, rather than separately for major activities like fishing and boating.

The expenditure and consumer surplus estimates are based on survey data. Two separate surveys were conducted in order to prepare the estimates, one of residents, in 1985-86, and the other of residents and non-residents, in 1978. In the 1978 survey, non-residents were sampled on a systematic random basis as they entered the state. They were asked to keep detailed trip records in a diary and return it by mail. A similar telephone survey, in this case a geographically stratified sample, was conducted for residents. A total of 5,000 trips were included in these surveys, and these together provide a complete sample coverage of those who recreated in Minnesota in 1978.

The 1985-86 survey was conducted by telephone and of residents only. Respondents were asked questions about the most recent trip taken by the household. It was conducted over a 12 month period so as to collect information on all forms of recreation, even though most of the water-based recreation occurred during the summer. This survey asked a contingent valuation question for trips (i.e., when the respondent stayed away from home overnight) but not for non-trips. Since the ratio of CVM consumer surplus to expenditures was found to be statistically constant (44%) for resident trips, this regularity was used to estimate (CVM) consumer surplus for resident non-trips and also for non-residents.

The Minnesota Department of Natural Resource weighted each survey so that the total days for each area reflected the total amount of recreation (days) in 1986. The weighted individual surveys were combined to counties for the travel cost estimation and later to regions to prepare Tables 1 through 3. Finally, only those surveys which involved water-based recreation were used in the compilation process.

Each survey provided information about recreational expenditures by location and activity, which could be used directly. Consumer surplus values were found by both methods, contingent valuation and travel cost. Unfortunately, the 1978 survey did not have a contingent valuation question while the 1985-86 survey did. On the other hand, the latter survey did not allow for travel-cost estimation because it was only conducted for residents. Consequently, a decision was made to rely on the latest survey and the contingent valuation approach, for reasons noted. However, the travel-cost method was used to substantiate the contingent valuation results.

Results

All consumer surplus values presented in Table 1 are based on the contingent valuation approach. In addition, travel cost estimates of consumer surplus (per day) were prepared, using the 1978 survey, in order to confirm the contingent valuation consumer surplus values in Table 1. Details of the travel cost methodology and estimation process are presented in (10). Contingent valuation and travel cost consumer surplus (per day) estimates for trips are compared in Table 2.

While the original travel cost estimates were in miles, those in Table 2 have been transformed into dollars so as to facilitate comparison with the contingent valuation consumer surplus estimates. In fact, alternative travel

Table 1. Expenditures and Consumer Surpluses for Water-Related Recreation†

Economic Region	Total			Daily Average	
	Recreation	Expense	Consumer Surplus‡	Expense	Consumer Surplus‡
	Million days	- - - - - - - Million $ - - - - - -		- - - - - - - - $ - - - - - - - -	
West	11.54	127.6	59.1	11.06	5.12
Northeast	30.37	503.3	203.6	16.57	6.70
Central	11.40	81.1	37.5	7.12	3.29
Metro	33.74	100.9	57.1	2.99	1.69
Southeast	8.43	49.4	20.2	5.86	2.40
Total (State)	**95.48**	**862.3**	**377.4**	**(9.03)**	**(3.95)**

† Totals are based on compilations of Department of Natural Resource surveys of residents only (1985-1986) and residents and non-residents (1978) for both day and overnight trips.

‡ Consumer surplus values were determined by using the contingent valuation method.

Table 2. Comparison of Consumer Surplus Values by Contingent Valuation and Travel Cost Methods (Resident and Non-Resident Overnight Trips)†

Economic Region	Contingent Valuation Method	Travel Cost Method (Consumer surplus per day)‡			
		Distance‡	Mileage Rate $0.0264	$0.05	$0.10
	$	miles	$		
West	11.55	121.2	3.20	6.06	12.12
Northeast	8.79	343.0	9.05	17.15	34.30
Central	7.99	328.9	8.68	16.45	32.89
Metro	13.22	964.5	25.46	48.23	96.45
Southeast	7.81	236.5	6.24	11.83	23.65
Statewide	**9.36**	**354.7**	**9.36**	**17.73**	**35.47**

† Daily contingent valuation values represent a weighted average, based on number of recreation days, of overnight trips.

‡ Travel cost consumer surplus values for the five regions are based on a weighted average (based on recration days) of travel cost estimates found for 13 regions (see (10)).

cost estimates have been prepared for different assumptions of dollars per mile. Generally, the estimates arrived at using the two methods, contingent valuation and travel cost, show similar relative values for the regions. For example, both show the Metro region to have the largest consumer surplus per day. In fact, there were no significant differences in the contingent valuation consumer surplus values (per day) between regions.

Likewise, an F-test was conducted for the travel cost consumer surplus (per day) values to determine if significant geographic differences existed. The resulting F-value of 0.51 was well below the corresponding 1 percent probability value of 3.08.

While the relative consumer surplus values per day are compatible for the two methods using original ways of estimating them (see first two columns of Table 2), they are calculated in dollars for the contingent valuation and miles for travel cost method. Both methods can be reconciled to yield the same state average consumer surplus per day ($9.36), but this requires assuming a cost per mile of $.0264. If higher values are used (e.g., $.05 and $.10 in Table 2), the travel cost method yields consumer surplus values which are greater than the contingent valuation values in Table 2. One explanation may be that users, when asked to value their experience by the contingent valuation question on the survey, may have

Table 3. Expenditures, Consumer Surplus and Water Acres Aggregated by Region (Residents and Non-Residents)

Economic Region	Fishable Water†	Total Expense	Total Consumer Surplus	Total Recreation	Average Per Acre Expense	Average Per Acre Consumer Surplus	Average Per Acre Recreation
	thousand acres	million $	million $	million days	$		days
West	237	127.6	59.1	11.54	538.4	249.2	48.7
Northeast	1,584	503.3	203.6	30.37	317.8	128.6	19.2
Central	225	81.1	37.5	11.40	360.3	166.6	50.6
Metro	62	100.9	57.1	33.74	1,629.8	921.7	545.0
Southeast	167	49.4	20.2	8.43	295.8	121.1	50.5
Total (State)	2,275	862.3	377.4	95.48	(379.1)	(165.9)	42.0

†Based on Minnesota Division of Game and Fish Data (12).

underestimated or behaved strategically. That is, if users believe their answers may be the basis for setting fees, they will give a conservative value. Thus, the contingent valuation results, which are being presented and discussed in this report, are, in fact, more conservative estimates of consumer surplus than similar travel cost estimates.

Another way of presenting the recreational economic values would be to determine the expenditure and consumer surplus per acre of water for each region. In Table 3 the total acres of fishable water in each region (12), as determined by compiling county acreage data from DNR records, is given along with the total (resident and non-resident) expenditures, consumer surplus, and recreation days from Table 1. Dividing the values by lake acreage gives an indication of the differences between regions in the values per acre. Such per acre values might also be useful for policy decisions that would involve adding or subtracting lake acreage to a region.

The Northeast region has almost 70 percent of the state's fishable water acres and, consequently, it has the greatest total expenditures and consumer surplus values in the state. On the other hand, when expenditure and consumer surplus values are found per acre, the Metro region value is the greatest in the state. The limited availability of water for recreational use in the Metro region, relative to other regions, and relative to demand in the metropolitan area, results in a greater value per acre. This same reasoning also explains why the Metro region has the greatest daily consumer surplus and expenditure values. In fact, there is a distinct positive correlation between the per acre values in Table 3 and the corresponding per day contingent values found in Table 1.

Discussion

The results presented could be useful for making policy issues. Consider, for example, using benefit-cost analysis to evaluate creating a new water-based recreation lake. The analysis of such a policy decision first requires that an estimate of usage be made, perhaps from a feasibility study or a demand forecasting model. Another, more naive, approach would be to estimate usage (recreation days) based on the days per acre indicated in Table 3. Once usage is determined (in days), these values are multiplied by daily expenditure and consumer surplus values in the tables to estimate benefits derived from a new lake.

If the federal government were doing the benefit-cost analysis of this scenario, it would not consider expenditures to be a benefit since such expenditures do not increase the Gross National Product. Rather, any increase in expenditures in Minnesota would be considered a transfer from some other part of the country, not a gain. Using a similar logic, if the State of Minnesota were doing the benefit-cost analysis, it would consider non-resident expenditures a benefit since these represent a net gain to the state product. The State might also include resident expenditures as a benefit, but only to the extent such gains represent a transfer of resident expenditures into the state that had previously been spent outside the state.

To continue the benefit-cost analysis of creating a new lake, consumer surplus values for both residents and non-residents would be considered benefits by the federal government. While the state might also consider both to be benefits, it could also use only resident consumer surplus values if it took a more parochial view of the analysis.

Any analysis of gains or losses in recreation resources, such as the creating-a-lake scenario, would be done assuming no substitution. That is, to calculate benefits, based on the gain in days from a 100 acre lake, it is assumed that the gain is not offset by less recreation at existing sites. To the extent such substitution takes place, it would lessen the effects that have been suggested. While this may be an interesting topic for further research, it could not be analyzed given the aggregated nature of the data available.

In terms of economic development, Table 3 is useful for evaluating alternative sites for development within the state. For example, consider a proposal for an industrial use of water which would eliminate 100 acres of water for recreation. According to Table 3, the value of such a loss of recreational water would be much greater in the Metro area than the other regions. This suggests that the state should consider policies that encourage outstate industrial development since the loss in water based recreation would be less if future development occurs outside the Metro region. Of course, gains in each region from the proposed industrial development might also vary, but this could be analyzed using the regional economic impact models. However, the differences in recreation (per acre) indicated by Table 3 are greater than the differences in economic impacts between regions (see 3). Therefore, the policy conclusion that industrial development, which adversely impacts recreation, is best encouraged outside the Metro region still is valid.

The economic value of water for recreation is substantial in Minnesota. For example, the Northeast region has annual water based recreational expenditures in excess of $500 million. In addition over $200 million (about 44%) represents non-market benefits which might otherwise be ignored.

The key contribution of these estimates is the determination of consumer surplus, since valuing these non-market benefits is easily overlooked. While expenditures are more than twice as large as consumer surplus, failure to consider the latter definitely undervalues the recreational use of water *vis-a-vis* the agricultural and industrial use of water. Altogether, the

results provide a rich source of information regarding the economic value of Minnesota waters for recreation. These values should be used in making public decisions regarding the future of water in Minnesota.

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