T 630.6
W5254

PROCEEDINGS 1967

WESTERN FARM ECONOMICS ASSOCIATION

Fortieth Annual Meeting
July 19-21, 1967
Las Cruces, New Mexico

RECREATIONAL VALUES OF WATER IN A NEW MEXICO RESERVOIR

by
Robert O. Coppedge*
New Mexico State University

Purpose of the Study

The specific problem of the study from which this paper is derived was to determine the economic value of water for recreation based on demand schedule analysis. The project was funded by the Water Resources Research Institute at New Mexico State University. The research project title was Recreational Values of Water in the Major Reservoirs of New Mexico. The changes in the value of water for recreation as the water level changes from early summer to late summer were also determined. The main hypothesis of this study was that the economic value of water for recreational purposes changes during the major recreational period of the year due to fluctuating water levels.

The Study Area

Two reservoirs were chosen for analysis, Elephant Butte Reservoir and Navajo Reservoir. Results from the Elephant Butte study only are the basis for this paper. Elephant Butte Reservoir is located in south-central New Mexico, in an area with a hot, dry climate. The nature of the reservoir is such that it is classified as a warm-water reservoir. The shoreline of the reservoir is gently sloping and in many places has sandy beaches. Vegetation in the area is mostly mesquite and salt-cedar, with little or no natural shade available. The reservoir is subjected to considerable fluctuation in water levels because of downstream irrigation requirements.

Methods and Procedures

To analyze the data obtained in a field survey of 518 recreationists during the summer of 1966, four procedures employing demand analysis were utilized. The differences among the procedures in this study and the results obtained are due mainly to independent and dependent variables. Procedures used are, for convenience, identified by a researcher's name, i.e., Anderson-Gray (3), Clawson (2), Brown, Singh, and Castle (1), and Lerner (4). The variables of each procedure are listed together for comparison.

Researcher	y-variable	x-variable
Anderson-Gray	cost per man-day	man-days
Clawson	cost per person	number of people per unit of population
Brown-Singh-Castle	cost per man-day*	days per unit of population
Lerner	cost per man-day	man-days per unit of population

* excluding depreciation costs, this variable was the independent variable in the Brown, Singh, and Castle procedure.

---

* Paper prepared when author was a graduate research assistant, Department of Agricultural Economics, New Mexico State University. Author presently is an Agricultural Economist with Natural Resource Economics Division, Economic Research Service, USDA.

In applying the four procedures, the effort was made to follow as closely as possible the variables as defined by the researchers involved. The Anderson-Gray technique was applied to the variables of the other procedures.

To determine the recreational value of water, the market demand equations were integrated and expanded to the population. The recreational use of water in acre-feet was calculated, making possible the calculation of a value of water for recreation per acre-foot.

Using the Anderson-Gray procedure, regression equations were computed, integrated, and expanded for early summer (before July 31) and late summer (after July 31). The value of water per acre-foot was calculated for each period as noted above. The decrease in the value of water per acre-foot decrease in water storage was also computed.

Results

The regression equation, coefficient of determination, population value, and the value of water for recreational purposes for each procedure are presented in Table 1.

Table 1. Regression Analysis, Value of the Population, and Value of Water per acre-foot by Procedure, Elephant Butte Reservoir, 1966

Procedure	Regression Equation	Coefficient of Determination	Value of the Population	Value per acre-foot
		per cent	dollars	dollars
Anderson-Gray	y=44.97-11.73 log x	93	16,825,808	416
Clawson	y=21.06-.0045 x	89	23,839,144	590
Brown-Singh-Castle	y=4.46-.00044 x	79	10,859,710	269
Lerner	y=6.67-.00025 x	81	43,038,473	1,065

The Brown, Singh, and Castle result has the lowest value of the four. One possible reason for this is that the dependent variable excludes depreciation costs (only variable costs are used). (1-p. 32) The observation should be made that the Brown, Singh, and Castle publication from which their variables were taken did not compute the total value of benefits. They calculated a "net economic value" which is the excess value generated by an increase in park fees. This value represents only a part of the area under the demand curve. (1-p. 28)

The highest result, obtained by the Lerner variables, was due partially to the fact that when accumulating the x-variables by zone, the lowest cost is included at the outer extremities of the demand schedule. In this instance, Zone 4 had the lowest cost, where in the other procedures Zone 4 had the highest or a higher relative cost, therefore, this zone for the Lerner procedure was located in this extreme position. The Zone 4 man-days per unit of population (x-variable) were low and including it after accumulating the other zones, instead of before, resulted in a higher relative sum of the x-variables as compared to the other procedures. This higher sum, together with the higher integers used to obtain the total and the

higher average, when incorporated into the procedure used to compute the regression equation, resulted in a higher integral of the equation.

The calculations based on early and late summer are presented in Table 2. As seen from this table, the value of water for recreational purposes increased from early to late summer. The primary reason for this increase is the decrease in consumptive use of water for recreation and the decrease in water storage on which to base the value per acre-foot. Recreational use of water is assumed to be equal to evaporation + seepage multiplied by minimum pool divided by average pool. This amount is the estimated consumption water use by recreationists. The value of the population decreased about four million dollars, and the water storage decreased 190,548 acre-feet. The decrease in the value of water for recreational purposes per acre-foot decrease in water storage was $21.67.

The decrease in the value of four million dollars of the recreational population at Elephant Butte is regarded as due mainly to water storage decreases. There are probably seasonal effects confounded in the values.

Table 2. Regression Analysis, Value of Water, and Average Pool for Early and Late Summer, Elephant Butte Reservoir, 1966[1/]

Item	Units	Before July 31	After July 31	Difference
Equation	---	y=40.96 -11.22 log x	y=42.49 -12.54 log x	---
Coefficient of Determination	per cent	91%	95%	---
Integral	dollars	21,794.65	13,343.05	-8,451.60
Value of Population	dollars	10,562,036.10	6,433,525.02	-4,128,511.08
Average pool[2/]	acre-feet	471,128	280,580	-190,548
Decrease in Value of water per acre-foot decrease in water storage	dollars	---	---	21.67
Total Recreational use of water[2/]	acre-feet	26,795	11,446	---
Value of water per acre-foot	dollars	394.18	562.08	---

1/ Anderson-Gray procedure
2/ Based on Bureau of Reclamation records of recreational pool, water levels, evaporation, and seepage.

In order to more fully explore the effect of water levels on recreation, additional questions were asked of the respondents in the field survey. These responses are shown in Table 3.

Table 3. Reactions of Sample to the Water Level, Elephant Butte Reservoir, 1966.

Item	Elephant Butte
	number
Response to How Water Level Affects Decision to Visit Reservoir:	
No Reaction	430
Like High Water Level	29
Like Constant Water Level	6
Like Low Water Level	8
If Low Water Level, Don't Come	45
Reaction to High Water Level upon Arrival at Reservoir:	
No reaction	129
Like High Water Level	374
Dislike High Water Level	15
Reaction to Low Water Level upon Arrival at Reservoir:	
No Reaction	130
Like Low Water Level	20
Dislike Low Water Level	368

Although most recreationists interviewed indicated that the water level didn't affect their decision to visit the reservoir, most of the respondents indicated a favorable reaction to high water levels, and a dislike for low water levels. From these responses, the inference might be drawn that the recreationists' decisions might not be affected in the short run, but if consistently unfavorable conditions prevailed (low water levels), the long-run decisions might be affected.

Needs for Further Research

From the above results, it is evident that further research is needed. Seasonal effects should be segregated from the effects of the water level. To accomplish this, data should be gathered over several years under varying conditions. It would be beneficial to measure the impact of a new recreation area and/or improved recreational facilities on the local (and non-local) area and to measure the cross-elasticities of demand between or among reservoirs. The extent to which recreation is a competitive use of water is a salient problem. These are only a few of the future possibilities for expanded research. Much remains to be done in the area of recreation economics.

Literature Cited

1. Brown, William G., Ajmer Singh, and Emery N. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery, Oregon State University: Agricultural Experiment Station, Bulletin 78, September 1964, 47 pp.

2. Clawson, Marion, Methods of Measuring the Demand for and Value of Outdoor Recreation, Washington, D. C.: Resources for the Future, Reprint Number 10, February 1959, 36 pp.

3. Gray, James R., and L. Wayne Anderson, Recreation Economics in South Central New Mexico, New Mexico State University: Agricultural Experiment Station, Bulletin 488, May 1964, 22 pp.

4. Lerner, L. J., "Quantitative Indices of Recreational Values", Proceedings of the Western Farm Economics Association, Thirty-Fifth Annual Meeting, University of Nevada: August 1962, pp. 12-18.