A METHODOLOGY FOR ESTIMATING INITIAL RESERVOIR RECREATION DEMAND

By

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CHAPTER I

INTRODUCTION

A. General

It has been commonly accepted by many that water quality and quantity in this country will be adequate to meet the increasing water-oriented recreation needs of the increasing population. However, as has been stated by the Ohio Division of Water (1), several critical factors illustrate an increasing concern for not taking recreation's quality and quantity requirements for granted. These factors are: (1) the nation's need for water will continue to increase as the population and standard of living increase, (2) with an increasing population using more water in more ways, water uses will further conflict with each other, (3) pollutants decrease the amount of water available because they render water unfit for recreation, and (4) current and anticipated misuses of watershed lands will affect water quality and quantity of available water. Studies of the Outdoor Recreation Resources Review Commission (2) have shown a national tendency toward an increasing demand for water-oriented recreation and a decreasing recreation resource supply. Clawson (3) relates that consumptive use of recreation is increasing at the rate of 8 to 10 percent per year.

Such use predictions raise the question of whether or not demand can be met by existing and future proposed recreation resources.

Through planning, however, immediate demand and supply can be analyzed and projections made to indicate long-range water-oriented recreation needs.

Because of the growing rate of demand for water-oriented recreation, Senate Document 97 was issued in 1962 authorizing the inclusion of recreation as a project purpose for water and related land development programs of the Federal Government. Subsequently, methods for prediction of initial reservoir recreation use became essential in determining economic feasibility of recreation development in the project formulation process.

B. Justification for This Research

The Bureau of Outdoor Recreation (4) has been directed to provide a nationwide recreation plan to structure needs for national recreation development. Since substantial amounts of money will be involved in execution of future plans providing public need facilities, realistic guidelines and demand analysis methods for determining that very need must be developed.

Federal Government publications cite the growing need for research in the water-oriented field of recreation demand analysis to improve existing methods and develop new ones (5) (6) (7) (8). The Corps of Engineers is aware that the similar project concept (present criteria recently issued and used in recreation planning that has been the focal point of much published criticism) is by no means the final solution in estimating initial recreation demand for determining benefits for Corps water resource development programs. Ditton (9) states that the variables affecting demand (socio-economic and environmental) must

receive intensive research attention if we are to develop realistic methods for estimating attendance levels.

It is the intent that results derived from the research of this study will provide new light on some basic considerations that must be included in the planning process to provide satisfactory development.

C. Objectives

The objectives of this study are listed below.

1. Determine the influence of specific socioeconomic factors on demand for water-oriented recreation within the chosen study area.
2. Present in detail the similar project concept. An evaluation of conceptual weaknesses will be made to formulate a basis for development of the proposed methodology within this study.
3. Develop a methodology to:
   (a) Quantify the consumptive-use for recreation of existing reservoirs within the market area of a proposed reservoir.
   (b) Quantify the effective initial demand for water-oriented recreation within the market area of the proposed reservoir, taking into account existing consumptive-use by competitive market areas.
4. Develop a mapping technique showing changes of total consumptive-use within the study area, both with and without the proposed reservoir. Demonstrate the applicability of the technique in making regional comprehensive recreation planning studies.

CHAPTER II

LITERATURE SURVEY

A. General

On May 15, 1962, President Kennedy approved the statement of "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources" (5). Significance of this statement issued as Senate Document 97 was that it directed federal planners to give full consideration to recreation as a purpose in federal project formulation and evaluation studies.

On June 4, 1964, the Secretaries of the Army, Agriculture, Interior, Health, Eduction and Welfare, in cooperation with the Recreation Advisory Council, issued Supplement No. 1 to Senate Document 97 (5), entitled "Evaluation Standards for Primary Outdoor Recreation Benefits." The supplement provided standards for evaluation of recreation benefits obtained from usage of recreation resources created by water and related land development projects. It stated that investigation and planning for recreation was to be of comparable scope and intensity to engineering studies of other potential purposes. Although the supplement did standardize terminology and establish a schedule of monetary unit values for annual visitation, it offered little guidance toward estimation of initial recreation visitation for a proposed project. Since that time, the Sacramento District, Corps of Engineers,

has devised a procedure for federal planners to determine the initial visitation at a proposed project. Numerous other methods have been developed by other investigators, but have not been incorporated into criteria for federal planning use.

B. Elements of Recreation Demand

Clawson and Knetsch (3) define a demand schedule as a statement of the quantity of good or service that will be obtained in a given time period at specified unit prices. The demand curve usually focuses on a consumer's willingness to pay. Cost, an expression of the monetary outlay per unit of recreation, consists of such things as cost of transportation and cost of food in excess of that at home. A typical demand curve is shown in Figure 1. The abscissa of the curve is the total annual volume in visits. Consumptive-use is the present use of the outdoor recreation product and can be measured by recreation site attendance data.

C. Factors that Affect Demand

The following factors are described in the literature as being general factors believed to have a degree of influence on demand: (1) population, (2) distance to the recreation site, (3) length of work week, (4) education, (5) age, (6) length of residency within the market area of the recreation facility, and (7) length of vacation (8) (9) (10) (11).

The relative influence of each of these factors may vary under competitive market conditions and different market regions in the country.

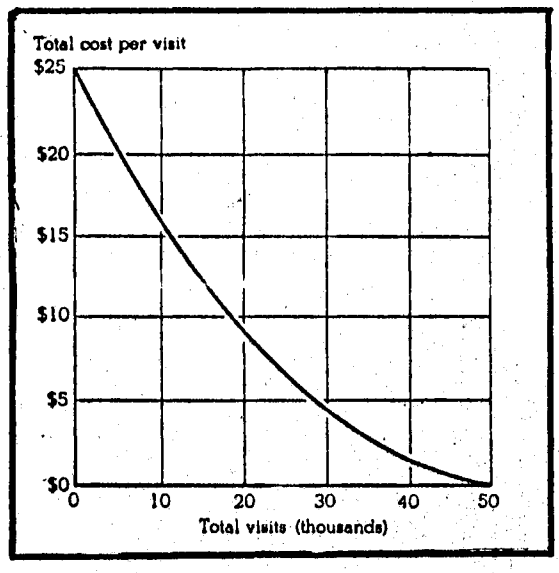

Figure 1. Typical Demand Curve. (After Clawson and Knetsch 1966)

D. Methods Previously Developed for Determining Recreation Demand

Recreation planning is very much a new field. There has been a recent surge of professional interest to develop methodologies for demand determination. Some methods are discussed below.

1. Multiple Regression Method.

Prediction of area-wide site consumption requires identification and quantification of all factors influencing participation. The most promising technique for quantification of variables to estimate demand, as expressed by Ditton (9), is multiple regression.

Storey (12) develops the process of site demand analysis by using socio-economic variables and other factors in a linear regression model. He indicates the lack of reliable statistical data of the demand factors. Results of the demand analysis are only as reliable as the basic data with which the regression equation is formulated. Others, including Seneca (13), U. S. Outdoor Recreation Resources Review Commission (14), and Cesario (15), have developed multiple regression models to estimate initial and future site demand.

2. Regional Study Method

This procedure involves conducting an intensive survey to compile data for both supply and demand which may be equated to determine the resulting need for recreation facilities. The regional study attempts to determine the present need for recreational facilities within the area of study.

3. Similar Project Concept.

The Sacramento District, Corps of Engineers, has devised a procedure to guide federal recreation planners in estimating the initial

site demand for proposed reservoir sites. This method provides guidelines for selection of the project most similar to that one which is proposed, equating visitation at the similar site to provide an estimate of anticipated visitation at the proposed site.

CHAPTER III

METHODS OF INVESTIGATION

A. Selection of the Study Area

The selected study area is delineated in Figure 2. This region, comprised of portions of east central Oklahoma and west central Arkansas, was selected for study for the following reasons. Existing Lakes Tenkiller and Beaver create a competitive recreation market area upon the proposed market area for hypothetical Lake Harper. This competitive market situation provides the proper framework to evaluate effects of adjacent reservoir use on the proposed market area. Homogeneous distribution of access roads leading to each of the three reservoirs in the study area tends to minimize variation of this function on demand for each of the three sites investigated.

B. Limits of the Study Area

Recreation medium investigated is the intermediate recreation area, a category prescribed for federal reservoirs by Clawson and Knetsch (3). These areas are normally within a two-hour drive for day outings.

Limits of water-oriented recreation activities considered are: (1) boating, (2) fishing, (3) picnicking, (4) swimming, (5) skiing, and (6) sightseeing.

Developmental limits of a demand methodology refer to initial recreation site. Projection methods, monetary evaluation of a user-day,

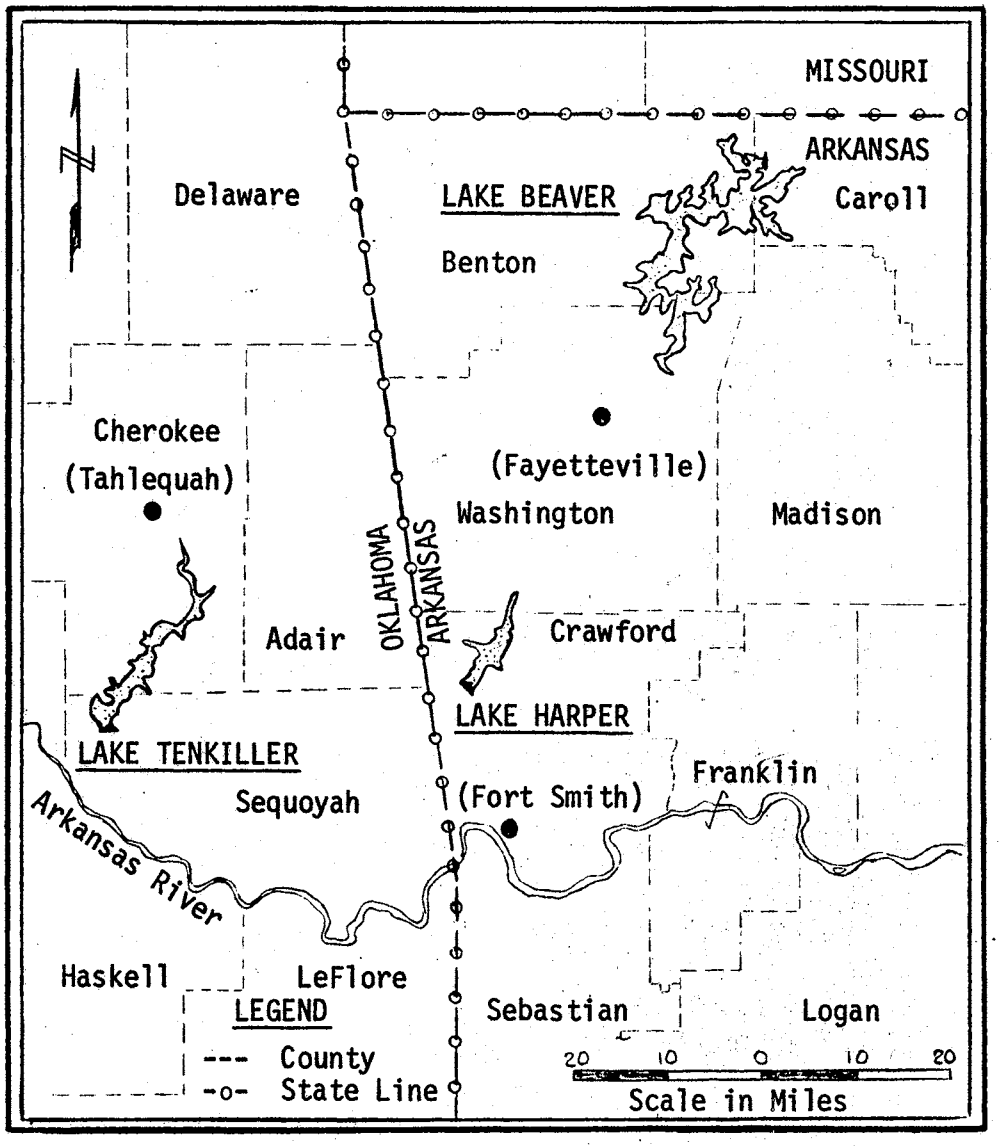

Figure 2. The Study Region Including Lake Tenkiller, Lake Beaver, and Hypothetical Lake Harper.

and benefits analysis for recreation as a project purpose as encountered in formulation studies are specifically excluded from the study limits.

C. Methods of Investigation

Investigation methods to be used are listed below with respect to the stated objective.

1. Correlation Analysis of Demand Factors

Standardized statistical methods presented by Barish (16) and Klein (17) were employed. Statistical data used in analysis were obtained from files of the State of Arkansas Planning Commission, Little Rock, Arkansas, and from records and files of the Tulsa District, Corps of Engineers. Statistical data gathering surveys at existing Corps of Engineers projects were conducted during the course of the author's work participating in plan formulation studies.

2. Development of Methodology

In addition to the statistical data described above, supporting information of present concepts for determining initial site demand was obtained through interviews and consultation with Corps of Engineers planners. Statistical data for city and county populations within the study area were obtained from county records and library publications (18).

CHAPTER IV

PRESENT AND PROPOSED METHODOLOGIES AND THEIR APPLICATIONS

A. Statistical Analysis of Demand Factors

1. Origin of Statistical Data

The statistical data used in the analysis were obtained from files of the State of Arkansas Planning Commission, Little Rock, Arkansas, and from records and files of the Tulsa District, Corps of Engineers (7) (19).

The State of Arkansas Planning Commission has recently completed a state-wide recreation data gathering survey. Assembling of these raw data, completed late in 1969, provides data for future research, and for formulating a comprehensive outdoor recreation plan for the State of Arkansas. The data used herein were collected by interview of recreation participants at existing recreation sites (19).

In December 1962, the Office of the Chief of Engineers instituted a program for Corps of Engineers' Districts to conduct recreation-use surveys at district projects. Justification of this survey was collection of information for reporting public attendance at Corps' reservoirs. Survey data collected provided planners with very limited statistical data for detailed analysis. In 1966 the Sacramento District, Corps of Engineers recommended that refined surveys with more rigid, statistical approaches be instituted at certain Corps' projects. The recommendation was implemented with the Tulsa District and the

Little Rock District participating in the survey. Portions of each of these districts form a part of this thesis study area. Much of the field survey work was performed during the time of the author's work in project plan formulation studies as an employee of the Tulsa District. Corps-wide results of the survey showed that approximately 735,000 people were interviewed. Data types collected primarily included project visitors' point of origin (by city, county and state), estimated project visits per year and the type of activity in which the visitor was participating.

Specific types of demand factors analyzed, by available data extracted from previously mentioned sources, are listed in Table I. Sample statistical data sheets are shown in Figure 3 and Figure 4.

TABLE I

TYPES OF DEMAND FUNCTIONS ANALYZED

Dependent Variable	Independent Variable	Independent Variable Designation
Visitation (Y)	Distance to the recreation site	X_1
	Length of work week (leisure time)	X_2
	Education	X_3
	Age	X_4
	Length of residence in the area	X_5
	Length of vacation	X_6
	Income	X_7

A. LENGTH OF RESIDENCY

	NO.	%
ONE YEAR OR LESS	8	6.0
TWO YEARS	6	4.5
THREE YEARS	4	3.0
FOUR YEARS	6	4.5
FIVE YEARS	6	4.5
SIX TO TEN YEARS	11	8.3
ELEVEN OR MORE	16	12.0
LIFETIME	76	57.1
NOT REPORTED	0	0.0
TOTAL	133	100.0
AVERAGE	17	
MEDIAN	25	

B. AGE

	NO.	%
29 YEARS OR UNDER	23	17.3
30 TO 39 YEARS	37	27.8
40 TO 49 YEARS	24	18.0
50 TO 59 YEARS	21	15.8
60 TO 69 YEARS	17	12.8
70 YEARS AND OVER	11	8.3
NOT REPORTED	0	0.0
TOTAL	133	100.0
AVERAGE	45	
MEDIAN	45	

C. EDUCATION (IN SCHOOL YEARS)

	NO.	%
7 YEARS OR LESS	3	2.3
8 TO 10 YEARS	36	27.1
11 TO 13 YEARS	54	40.6
14 TO 17 YEARS	25	18.8
18 OR MORE YEARS	15	11.3
NOT REPORTED	0	0.0
TOTAL	133	100.0
AVERAGE	12	
MEDIAN	12	

D. GROSS FAMILY INCOME (1967)

	NO.	%
UNDER $3,000	10	7.5
$3,000 TO 5,999	30	22.6
$6,000 TO 7,999	46	34.6
$8,000 TO 9,999	29	21.8
$10,000 TO 14,999	6	4.5
$15,000 TO 24,999	3	2.3
$25,000 AND OVER	2	1.5
NOT REPORTED	7	5.3
TOTAL	133	100.0
AVERAGE	7365	
MEDIAN	7000	

E. EMPLOYMENT RECORD (1967)

	NO.	%
WORKED FULL TIME	100	75.2
UNEMPL. 1 MO/LESS	1	0.8
UNEMPL. 1 TO 3 MO	1	0.8
UNEMPL. 3 TO 9 MO	2	1.5
UNEMPL. 9 TO 12 MO	2	1.5
STUDENT-WORKED PART	3	2.3
STUDENT-FULL TIME	1	0.8
DISABLED	1	0.8
RETIRED	22	16.5
NOT REPORTED	0	0.0
TOTAL	133	100.0

Courtesy Arkansas Planning Commission

Figure 3. Number Sampled by Category (Region 1).

FAMILY INCOME - $	UNDER 3000		3000 TO 5999		6000 TO 7999		8000 TO 9999		10000 TO 14999	
A - ADULTS, C - CHILDREN	A	C	A	C	A	C	A	C	A	C
NUMBER IN SAMPLE	19	2	56	22	92	36	58	32	12	8
01. FISHING, COLD WATER	0.00	0.00	0.00	0.00	0.10	0.17	0.53	0.13	0.00	0.00
02. FISHING, WARM WATER	6.11	9.00	9.59	6.82	20.10	20.94	14.40	9.28	10.17	6.88
03. SWIMMING	0.26	4.50	2.70	33.95	7.52	23.06	9.45	23.78	22.17	35.25
04. WATER SKIING	0.00	2.00	0.00	0.09	1.82	1.61	0.90	0.63	0.33	3.00
05. CANOEING	0.00	0.00	0.00	0.00	0.09	0.11	0.38	0.31	0.67	1.00
06. SAILING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41	1.17	0.50
07. BOATING	2.05	3.50	6.13	1.95	12.93	13.81	10.79	5.38	9.00	13.50
08. WATERFOWL HUNTING	1.58	0.00	2.50	0.00	0.26	0.19	0.86	0.25	0.00	0.00
09. BIKING	0.00	50.00	0.63	130.86	0.00	113.81	3.97	132.47	0.00	18.75
10. HORSEBACK RIDING	0.00	0.00	0.18	1.68	0.28	0.78	0.19	0.41	0.00	0.00
11. HIKING WITH GEAR	0.00	0.00	0.02	0.05	0.03	0.08	0.03	0.22	0.00	0.00
12. NATURE WALKING	11.63	3.00	5.02	20.91	1.99	3.58	3.24	3.75	3.67	5.50
13. URBAN WALKING	18.26	0.00	2.61	7.64	1.55	2.75	5.78	2.00	8.33	17.50
14. BIRD WATCHING	14.32	0.00	2.21	2.73	0.91	0.28	0.52	0.00	32.08	5.13
15. WILDLIFE/BIRD PHOTO	0.00	0.00	2.04	0.00	0.07	0.17	0.41	0.88	0.00	0.00
16. PLAYING OUTDOOR GAMES	3.05	50.00	5.50	100.50	5.39	29.89	2.05	118.06	31.58	75.50
17. VIEWING OUTDOOR GAMES	44.74	5.00	3.57	7.27	2.12	3.58	2.98	3.72	10.58	7.38
18. ATTEND OUTDOOR CONC.	1.05	1.00	0.61	1.18	0.22	0.61	0.66	0.78	1.83	1.50
19. PLAYING GOLF	0.00	15.00	0.11	0.00	2.15	0.00	6.02	1.31	5.42	0.00
20. PLAYING TENNIS	0.00	30.00	0.00	0.00	0.03	0.28	0.00	4.50	4.42	3.00
21. MOUNTAIN CLIMBING	0.00	0.00	0.02	0.00	0.00	0.28	0.00	0.00	0.00	0.00
22. PICNICKING	5.11	6.50	11.05	10.00	12.60	20.39	12.03	14.22	15.17	20.63
23. TRAILER CAMPING	0.53	0.00	1.64	0.41	3.58	9.89	0.83	0.16	0.50	0.75
24. TENT CAMPING	0.32	0.00	0.75	1.73	3.12	7.03	1.29	0.78	0.00	0.00
25. ORGANIZED CAMPING	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.16	0.00	0.00
26. SIGHT-SEEING	7.58	14.00	5.68	7.59	2.26	1.89	4.52	4.59	6.83	7.63
27. PLEASURE DRIVING-AUTO	9.00	19.50	26.61	38.27	18.46	12.03	14.52	13.81	25.83	24.63
28. PLEASURE DRIVING-JEEP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29. TRAP & SKEET SHOOTING	0.00	0.00	0.00	0.00	0.99	0.11	0.00	0.00	0.00	0.00
30. ARCHERY	0.00	3.00	0.00	0.18	0.17	0.67	0.28	0.13	0.00	0.00
31. TARGET SHOOTING	0.00	3.00	0.16	0.27	0.88	2.36	0.57	0.34	0.00	0.00
32. HUNTING SMALL GAME	0.00	1.50	2.52	1.45	6.83	4.31	2.84	2.31	0.00	0.00
33. HUNTING BIG GAME	0.00	0.00	0.57	0.77	1.09	1.33	0.52	0.56	0.00	0.00
34. VISITING ZOO	0.21	0.00	0.23	0.50	0.26	0.42	0.22	0.41	0.67	1.00
35. VISIT OUTDOOR EXHIBIT	0.47	1.50	0.86	1.27	0.01	0.28	0.83	0.53	0.83	1.13
36. SNOW SKIING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS	126.27	222.00	93.69	379.17	108.36	280.50	101.66	349.80	191.58	250.66

Courtesy Arkansas Planning Commission

Figure 4. Distribution of Total Annual Participation (Days) by Income Level (Region 1).

2. Method of Analysis

Statistical data analyses were accomplished through application of statistical methods for regression equation and correlation analysis. These classical methods are found in Barish (16) and Klein (17). Coefficients of correlation were determined by development of simple linear regression equations for the State of Arkansas Planning Commission data and exponential regression equations for Corps of Engineers data.

3. Example of Method of Analysis

A typical example for determining the coefficient of correlation is shown in Figure 12, Appendix B.

4. Summary of Results

The test criterion used for correlation was that the coefficient of correlation, "r," between the dependent and independent variable must be equal to or greater than .8. Table II shows a summary of the developed coefficients of correlation for each demand function investigated. Coefficient of correlation, "r," of the dependent variable, visitation, failed to reach the .8 level with the independent variables, leisure time, education, age, length of residence and length of vacation. Distance correlated with the dependent variable above the .8 level.

B. Presentation of the Similar Project Concept

The following is the present procedure employed by the Corps of Engineers for determining initial recreation demand at a proposed reservoir. Reasons for presentation of this similar concept method have been previously discussed. This method evolves from the author's experience in project formulation studies and from unpublished

TABLE II

SUMMARY OF CORRELATION ANALYSIS

		Independent Variables							Dependent Variable "Y"
		Hours Worked Per Week "X_2"	Education "X_3"	Age "X_4"	Years of Residence About Rec. Site "X_5"	Length of Vacation "X_6"	Income "X_7"	Dist. to Recreation Site "X_1"	
"r"	Region 1[1]	.10	.29	.05	.04	.25	.68	"Corps Data"	
	Region 5[2]	.02	.06	.03	.04	.25	.16	.8 to .95	
Mean of Dependent Variable (Region 5)		44 Hrs.	10 Yrs.	50 Yrs.	20	8.4 days	$5,190	--	Visits (Total annual day visits)

(1) Region 1 comprises the northern portion of the Arkansas study area.

(2) Region 5 comprises the southern portion of the Arkansas study area.

guidelines provided by the Sacramento District, Corps of Engineers, the group instrumental in development of the method used by many Corps of Engineers' districts (20).

1. A Synopsis of the Similar Project Concept

The procedure for determining initial demand at a proposed reservoir site is comprised of the steps as summarized below.

- (a) Evaluate the proposed reservoir project characteristics.
  (b) Select a similar project by comparing reservoir sizes, shoreline miles, accessible areas, and other common reservoir characteristics.
  (c) Evaluate the day-use market area of the similar project.
  (d) Select a per capita use curve from the chosen similar project.
  (e) Modify the per capita use curve to reflect the dissimilarities between similar and proposed projects.
  (f) Calculate annual day use for each county (per capita rate multiplied by the county population).
  (g) Sum the contribution from each county to determine initial annual project visitation.

2. Detailed Discussion of the Similar Project Concept

(a) Project Area Evaluation - Primary physical characteristics considered are the various measurements of reservoir size and topography of the reservoir basin. In addition, the number and quality of major access routes from population centers to the general proposed reservoir area are important considerations.

The amount of fluctuation in a reservoir is generally considered an important influence on recreation-use potential. Large reservoir

drawdowns are usually detrimental to recreation potential, while small drawdowns provide comparatively more potential.

(b) Selection of Similar Project - Subsequent to evaluation of proposed characteristics, an existing similar project should be selected by evaluation of the same project characteristics.

(c) Day-use Market Area Evaluation - The day-use market represents an area contributing 80 percent or more of the annual day-use visitation to a reservoir project. A per capita use curve, as shown in Figure 11, Appendix A, is developed by applying the per capita use curve of the existing selected project. Therefore, to calculate a per capita visitation rate by county, an estimate of each county's population and aggregate recreation use is made. Annual recreation use contributed by each county is summed, with the total representing initial demand for the proposed project.

(d) Day-use Market Area - The day-use market area for a proposed reservoir project under study is established using the existing market area of the similar project with appropriate adjustment by the planner based on his experience and personal knowledge of the area. (This provides the recreational planner with much latitude to vary important factors that can significantly affect the resulting estimate.)

(e) Selection of Per Capita Rates - No two projects are identical. (This fact is the focal point of critics of the similar concept method.) Therefore, the recreation planner must empirically modify existing project information to obtain estimates applicable to the proposed project. (This is a challenge even to the most competent planner in the field.) Summary of the projects within each average recreation pool category is obtained by review of Corps of Engineers projects for

which pertinent data are available. The reservoir most similar in physical characteristics should serve as the similar reservoir.

(f) Comparison of Physical Features of Existing and Proposed Projects - The following variables are examined to determine differences between the similar project and project under study. Adjustment in per capita rates are based upon differences in these variables. (The magnitude of adjustment can exert a tremendous effect upon the total estimate.)

1. Size and quality:

   Surface area of reservoir pool
   Land area and gradient
   Fishery potential
   Water quality

2. Accessibility:

   Number of major access routes
   Number of access points
   Length of shoreline accessible by automobile

3. Reservoir fluctuation:

   Extent
   Frequency
   Duration

4. Recreation facilities:

   Number and type
   Quality

5. Activity limitation:

   Size of project
   Laws or regulations
   Water temperature
   Water quality
   Weather conditions

(g) Estimating Initial Day-use - The per capita use rates calculated on the county basis yield estimates for the total participation

per county. Recreation use for each county is summed, yielding total recreation use for the proposed reservoir market area.

(h) Example of the Similar Project Concept as Applied to the Thesis Study Area - An example of the application of the aforementioned similar project concept method is shown in Appendix A. This method is applied to the thesis study area for comparison of results with the proposed method to be developed.

3. Evaluation of the Similar Project Concept

Views of critics involved in outdoor recreation planning are projected in the following discussion.

a. Sacramento District - The Sacramento District summarizes evaluation of the concept as follows:

(1) It has eliminated much of the "guess work" previously associated with estimation of recreation use and benefits for Corps reservoir projects. (Before the advent of this similar project concept there were few guidelines for Federal planners to follow in determining initial recreation use at prospective reservoirs.)

(2) It is emphasized that it is by no means the "last word" or final solution in this infant stage of demand analysis.

(3) There are inherent deficiencies in the method.

(4) As more recreation-use data are collected and analyzed, plans call for revision and improvement of the technique.

b. Ditton (8) relates the following concerning planners who use participation as a planning indicator for demand. "A common demand analysis approach focuses entirely on the extent of participation.

These approaches appear logical for determining the amount and rate of consumption at a particular site, but danger lies in over

generalization with intent to simplify the concept of demand. Studies purporting to project demand on the basis of participation or use data (similar project concept) do so subject to the general criticism of professionals in the field because they equate consumption with total demand. These criticisms point out that recreation resource planners are too preoccupied with projecting consumption and ignore the other aspect of demand. Efforts must be made to closer investigation (by survey) to measure total demand for water recreation. Effective needs can then be equated as a function of total demand less the supply."

c. Knetsch (21) relates that attendance figures are the net effect of the existing supply. The result of projection of consumption used to equate demand at a proposed site is not an estimate of the demand but an estimate of the consumptive use at the site.

d. Lee (22) has shown how site demand is affected by proximity of the proposed site to existing recreation supply centers. (The similar project concept does not quantitatively take this into account.)

In summary, critics of the similar project concept show that projecting the consumptive-use of one reservoir cannot be equated to the demand of the prospective one. In addition, patterns of expressed preference for recreation vary from one area to the next. No two projects are alike. The competition created by existing market areas for outdoor recreation at the proposed site may not be like that at the existing similar project. This condition can exert a very significant influence on actual demand for the prospective site.

These points of criticism made by planners and economists within the recreation planning field will receive serious consideration in forming the framework for the methodology to be developed herein.

C. Proposed Methodology for Estimating Initial Reservoir Recreation Demand

1. General Considerations

The results of correlation analyses, paragraph A of this chapter, and results of evaluation of the similar project concept, paragraph B, were employed to formulate a basis for development. Areas considered to have been of primary importance are discussed below.

a. Correlation Analysis - The demand function of distance to the recreation site and population were the variables used in the development. Although correlation studies of demand with population were not investigated (time series statistical data were not available), literature firmly demonstrates this to be of primary consideration in demand analysis. Clawson and Knetsch (3) have shown that demand is a direct function of the population.

b. Results of Evaluation of Similar Project Concept - The proposed methodology does not attempt to equate consumptive-use at an existing site to the demand at a proposed site. The total demand at the proposed Lake Harper site was determined from statistical survey data collected from population interviews within the study area. The total demand is that preferred by the population (19). It is an expression for the total need of recreation activity.

The volume of existing supply partially satisfying that total need within the proposed market area was determined. The resulting effective demand for the proposed market area can then be expressed as

$$V_{eff} = G - C \qquad \text{Equation 1}$$

where V_{eff} is the volume in annual day visits of the effective initial site demand for recreation at the proposed market area, G is the total

preferred demand by population expression within the market area and C is the existing consumptive-use within the proposed market area as a result of an existing competitive market situation created by adjacent reservoir recreation centers of supply.

As was discussed in paragraph B of this chapter, this concept is the one believed to be most correct by both economists and other professionals in the recreation demand analysis field. Results of development of the methodology, taking into account these basic formulation considerations, are discussed below.

2. Synopsis of Methodology Development

In summary, the developed methodology is comprised of the following steps:

a. Determine the existing consumptive-use within the proposed market area.

(1) Develop the per capita use curve for each existing reservoir that creates competition for recreation within the proposed market area.

(2) Develop concentric zones of per capita use about the existing reservoir. Designate the average per capita use within each zone constructed from the per capita use curve.

(3) Delineate the primary market area limit of the proposed reservoir. Construct zones of per capita recreation demand within the delineated market area.

(4) Determine the population within each subzone of the proposed market area.

(5) Calculate the existing annual recreation day use within each subzone of the proposed market area. This is accomplished by

multiplying total per capita use within each subzone by the determined population in the subzone.

(6) Total the existing annual day use of each subzone within the proposed market area. The total is the existing annual recreation day use within the proposed market area. This value has been previously designated in Equation 1 as the quantity (C).

b. Determine the total annual day demand for recreation within the proposed market area.

(1) Develop a per capita demand curve with the maximum per capita demand value to be that expressed population demand for water-oriented recreation within the study area. (This value was determined by statistical survey of the population within the proposed market area and represents the total expressed demand for recreation activity.)

(2) Calculate the total population within each concentric zone of the prospective market area.

(3) Calculate the total expressed demand for each zone by multiplying the per capita demand by the total population of the zone.

(4) Sum the expressed total demand of each zone within the market area. This total is equal to the previously designated quantity (G) in Equation 1.

c. Determine the effective initial site demand for recreation at the proposed reservoir site.

This value is calculated by subtracting the determined value (C) from the determined value (G).

3. Application of the Developed Methodology to the Study Area

The developed methodology is applied as a case study investigation to:

a. Estimate the initial effective site demand for recreation at hypothetical Lake Harper, located within the highly competitive market areas of Lake Tenkiller and Lake Beaver.

b. Clarify development of the methodology.

Some detailed data used for developing the estimate of initial demand at Lake Harper are contained in Appendix B. In addition, illustrations are provided within the discussion to clarify interim points throughout the presentation of the methodology. The sequence of presentation will closely follow that in the previously presented synopsis of development.

4. Estimating Existing Consumptive-use Within the Proposed Lake Harper Market Area

Figures 13 and 14, Appendix B, show the per capita use curves for Lake Tenkiller and Lake Beaver, respectively. The abscissa of the per capita curves shown in Figure 13 and Figure 14 have been divided into 10-mile-wide zones. These zones are then constructed about the existing Lake Tenkiller and Lake Beaver. Figure 5 shows the resulting plan geometry. Note that identification of the zones is accomplished by numbering the reservoir market zones in consecutive order from the nearest to the most distant zone. In addition, the average per capita use rate for each zone has been indicated as obtained from the per capita use curve. By the proposed reservoir size, the prospective market area is determined. This is accomplished by comparing the reservoir size to existing reservoirs of the same surface area. Correlation studies show that there exists a relationship of the market area to the surface area of the reservoir. Table VI, Appendix A, shows the comparative size of the proposed Lake Harper to that of Lake Wister in southeastern Oklahoma. The primary market area is determined to be 50

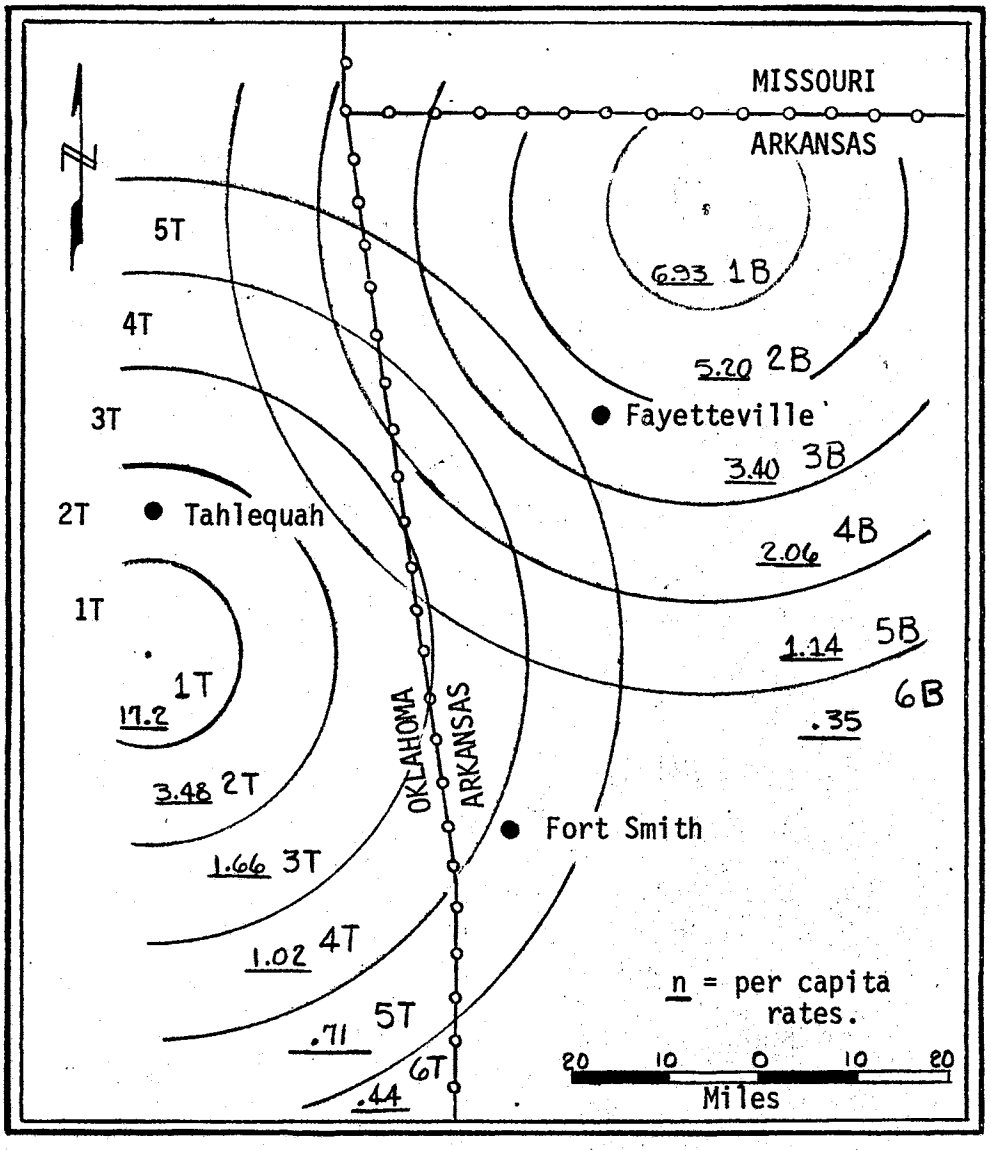

Figure 5. Diagram of Concentric Zones of Per Capita Consumptive-Use for Lake Tenkiller and Lake Beaver.

miles in radius. This market area limit is then constructed on the plan of the study area. The prospective market area is then divided into 10-mile-wide concentric zones. The resulting plan geometry about each reservoir, proposed and existing, is as shown in Figure 6. Note that subzones are created within each zone for Lake Harper. With reference to the shaded subzone in Figure 6, we can identify this subzone by designation of zones that form its boundary. The resulting identification for the shaded zone would then be 1H-5T-5B.

With reference to the Summary Computation Sheet, Table III, the step-by-step computation for determining existing consumptive-use within the Lake Harper market area is computed. The format of the computation sheet is one suggested by the author to facilitate efficient and organized procedure for calculation. The following discussion will follow in the numerical order of columns shown on the computation sheet.

Column 1 is the line reference number to line computation of the worksheet.

Column 2 lists the primary zones within the proposed Lake Harper market area.

Column 3 lists the subzones within the primary zone in Column 2.

Column 4 is the planimetered area for each subzone listed in Column 3.

Columns 5 through 8 are the required population analyses. Note that the value of Column 6 is the product of the value in Column 4 times that in Column 5. Column 7 is a list of population centers. Table IV shows a listing of counties and population centers within each respective county for the prospective market area. Population density

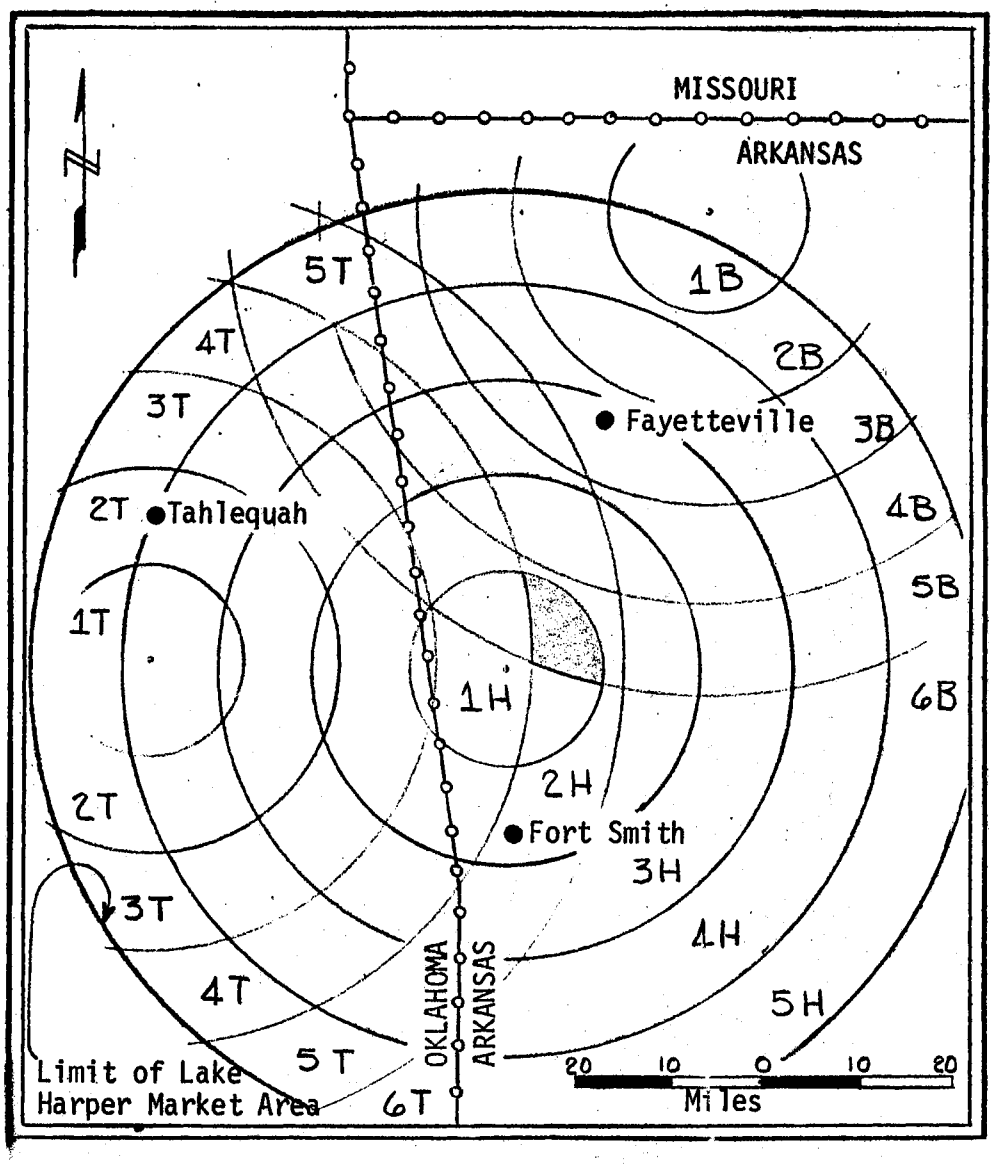

Figure 6. Diagram of Concentric Zones of Per Capita Consumptive-Use for Lake Tenkiller, Lake Beaver and Lake Harper.

TABLE III

SUMMARY COMPUTATION SHEET, LAKE HARPER. INITIAL SITE DEMAND ANALYSIS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Area	Population Analysis				Consumptive-Use		Expressed Total Demand	
	Proposed Market Area Zone	Consumptive-use Influence Subzones	Area Sq. Mi.	Population Density Per Sq. Mi.	Population Subtotal	Population Centers	Total Population	Tenkiller + Beaver Per Capita Use	Consumptive-use Annual Visitor Days	Expressed Per Capita Demand	Gross Demand
1.	1H		314	21.26	6,675	--	6,675			35	233,625
2.		1H-5T-6B	52	21.26	1,105	--	1,105	1.1	1,216		
3.		1H-5T-5B	52		1,105	--	1,105	1.8	1,989		
4.		1H-4T-5B	59		1,254	--	1,254	2.1	2,633		
5.		1H-4T-6B	118		2,508	--	2,508	1.4	3,511		
6.		1H-3T-6B	33	---	700	--	700	2.1	1,470		
7.								Totals	10,819		233,625
8.											

Total Consumptive-Use, Σ1H, 2H, 3H, and 5H = 935,000 annual visitor days.

Total Expressed Demand, Σ1H, 2H, 3H, 4H, and 5H = 1,450,000 annual visitor days.

Initial Reservoir Recreation Demand, Lake Harper = V_{eff} = G - C = 1,450,000 - 935,000 = 515,000 annual day visits.

TABLE IV

CITY AND COUNTY POPULATIONS IN THE STUDY AREA (18)

State	County	Rural Population per Sq. Mi.	Population Center	City Residents	County Area Sq. Mi.
	Adair	23	Stilwell	1,916	570
	Cherokee	19	Tahlequah	5,840	756
Okla.	Delaware	19	Jay	1,120	707
	LeFlore	19	Poteau	4,428	1,560
	Sequoyah	26	Sallisaw	3,351	656
	Weighted[1] Avg.	21.25			
	Benton	41	Bentonville Siloam Springs	5,223 5,553	886
	Crawford	22	Van Buren	7,805	596
Ark.	Franklin	17	Ozark	2,568	613
	Logan	22	Paris Booneville	3,597 3,263	718
	Madison	11	Huntsville	1,176	832
	Sebastian	26	Fort Smith	52,991	527
	Washington	10	Fayetteville	29,724	962
	Weighted[1] Avg.	21.26			

[1]Weighted average is equal to the summed population of counties divided by the summed county area in square miles.

calculations for the proposed market are also shown in the table. The population density value has been entered in Column 5 and population centers for each respective subzone listed in Column 7.

Column 9 is the summed per capita use by Lake Tenkiller and Lake Beaver as applied to the subzone. For example, refer to the shaded area of subzone 1H-5T-5B in Figure 6. The applicable average per capita rates are: (1) zone 5T, .71 and (2) zone 5B, 1.1. These values are summed to equal 1.8 per capita use visits per year and this value is shown entered on line 3, Column 9.

Column 8 shows the total consumptive-use per subzone in Lake Harper zone 1. Line 7 of the column shows the total existing consumptive-use in zone 1H for water-oriented recreation within the proposed Lake Harper market area.

The aforementioned procedure is then applied to zones 2H, 3H, 4H, and 5H. The total of each zone is summed to yield the total existing consumptive-use for recreation within the prospective Lake Harper market area. This value, as shown in the Summary Computation Sheet, Table III, is 935,000 consumptive-use day visits per year. This quantity is the total existing consumptive-use for Lake Tenkiller and Lake Beaver as originating within the proposed Lake Harper market area.

5. Determining the Total Annual Day Demand for Recreation within the Proposed Market Area

Figure 11, contained in Appendix A, shows the per capita curve for the total expressed population demand for water-oriented recreation within the study area. The maximum per capita value of 52 day visits per year was determined from analysis of statistical survey data shown in Table V. The appropriate per capita demand values are then recorded

TABLE V

EXPRESSED DEMAND FOR RECREATION BY TYPE OF ACTIVITY

Activity Type	Total Expressed Participation Annual Day Visits	
	Region 1	Region 5
Skiing	135,000	45,000
Swimming	1,273,000	1,468,000
Boating	1,261,000	822,000
Fishing	1,882,000	642,000
Picnicking	1,729,000	2,680,000
Sightseeing	713,000	1,349,000
Total	6,993,000	8,008,000
Region Population 1967 est.	131,910	153,958
Per capita Demand	52	52

on the respective concentric zones. With reference to the Summary Computation Sheet, Table III, the step-by-step computation for total expressed demand, (G), for recreation within the proposed Lake Harper market area will be developed. The following discussion relates to line 1 of the Summary Computation Sheet.

Columns 1 through 8 are as previously described.

Columns 9 and 10 contain no entries. These columns pertain to consumptive-use analysis.

Column 11 is the total per capita demand for zone 1H. The value entered of 35 day visits per year is taken from Figure 11, Appendix A.

Column 12 is the total demand of day visits for zone 1H. It is the product of the value shown in Column 11 multiplied by the value shown in Column 8.

The aforementioned procedure for determining total demand is applied to zones 2H, 3H, 4H, and 5H. The quantity for each of these zones is summed. The total quantity is the preferred demand for water-oriented recreation within the market area for Lake Harper. This quantity is shown on the Summary Computation Sheet to be 1,450,000 demand visits per year.

6. Determining the Effective Initial Site Demand for Recreation

The effective initial site demand for recreation use at the proposed Lake Harper is

$$V_{eff} = G - C$$

$$V_{eff} = 1,450,000 - 935,000$$

$$V_{eff} = 515,000 \text{ day visits per year}$$

D. Consumptive-use Mapping Techniques

Although the literature reviewed reveals no precedent for the application of consumptive-use mapping techniques in the demand analysis field, it is the author's belief that utilization of the proposed method results in an effective and comprehensive technique to display intensity and pattern of area-wide recreation use for water-oriented recreation. In addition, the consumptive-use map resulting from application of the technique permits ease of understanding results of demand analysis by both professionals and non-professionals in the recreation planning field. For these reasons mapping techniques are being introduced in this thesis.

Paragraph C of Chapter IV has shown that patterns of consumptive-use are distributed about a recreation center (reservoir) in concentric zone distribution patterns. For a reservoir not influenced by other market competition the concentric zones would yield the consumptive-use map. However, this is seldom the market situation.

1. Development of the Isopercapita Consumptive-use Map in a Competitive Market Region

As shown in Figure 7, each line forming a concentric zone about the recreation site possesses an equal per capita use value. This line hereafter is referred to as an isopercapita line. However, in a competitive market situation, the concentric zone patterns are changed by the degree of influence of adjacent competing market areas. This change will be shown on consumptive-use maps developed in the following step-by-step procedure. The consumptive-use maps to be developed will consider two existing reservoirs, each creating a competitive market

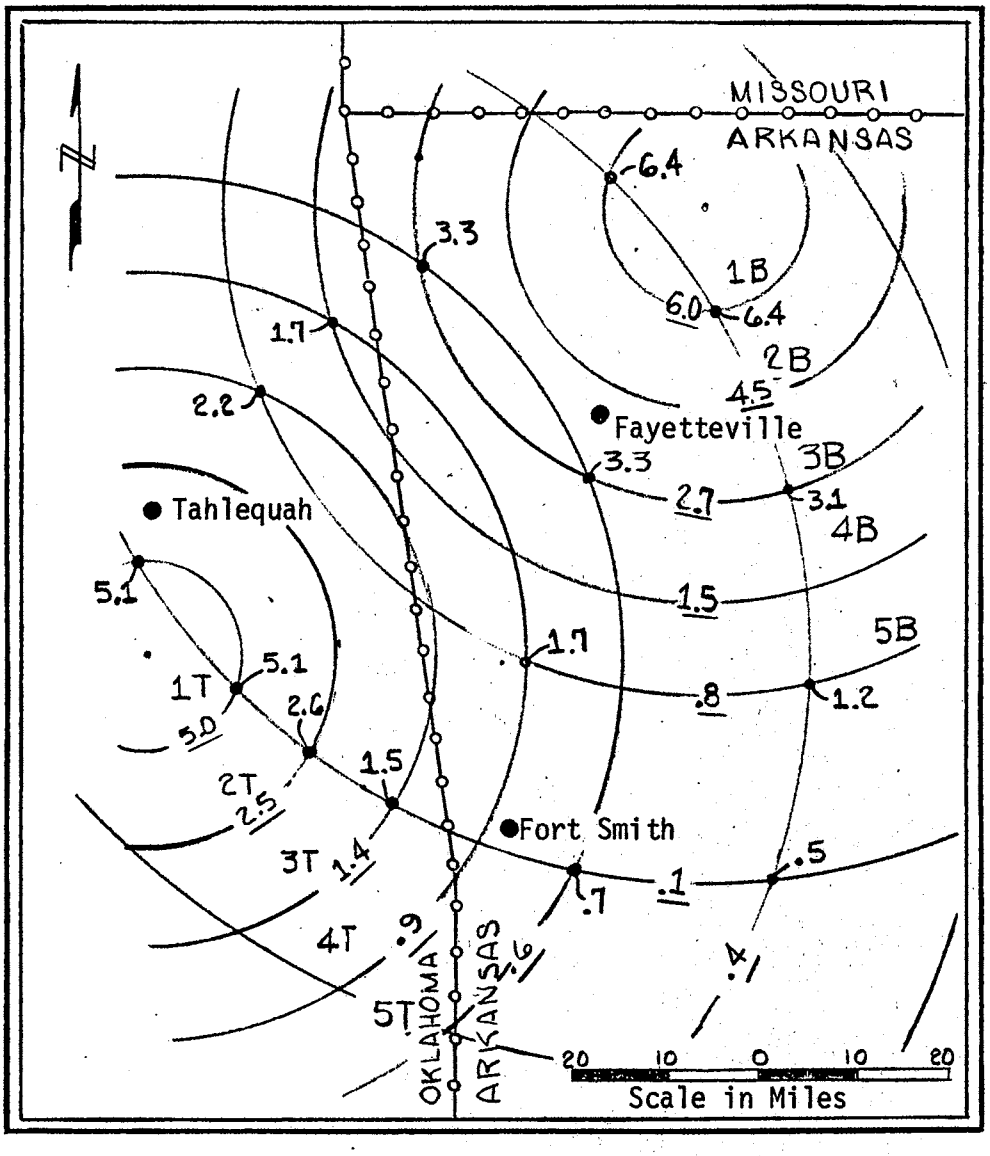

Figure 7. Diagram of Summed Per Capita Consumptive-Use Points at Intersections of Concentric Zone Limits.

area with the other. To develop the combined isopercapita consumptive-use map, we proceed with the following steps.

Step 1. Construct the isopercapita zones for each reservoir supply center for Lake Tenkiller and Lake Beaver, as shown in Figure 7.

Step 2. Superimpose a transparency over the developed concentric zone diagram developed in step 1. At each point of intersection by the isopercapita lines, note the sum of the combined consumptive use. See Figure 7.

Step 3. Draw lines connecting points of equal value of the summed per capita use points in step 2. The resulting map shows the pattern distribution of per capita consumptive-use within the competitive market area. Figure 8 shows the completed consumptive-use map for existing Lake Tenkiller and Lake Beaver.

2. Development of a Consumptive-use Map for a Proposed Reservoir

Figure 9 shows the combined consumptive-use map for the study area region as a result of the three competitive recreation supply centers of Lake Tenkiller, Lake Beaver, and proposed Lake Harper. The map was developed by superimposing the isopercapita concentric zones of Lake Harper over the consumptive-use map as shown in Figure 8. Following the step-by-step procedure outlined above, the procedure yields the map of the total consumptive-use for water-oriented recreation within the study area.

3. Regional Dormant Demand Maps

Figure 10 shows the dormant demand for water-oriented recreation in the study region. It was developed by subtracting the value of each isopercapita line shown in Figure 9 from 52 per capita demand visits per year, which is the total expressed demand for recreation in the

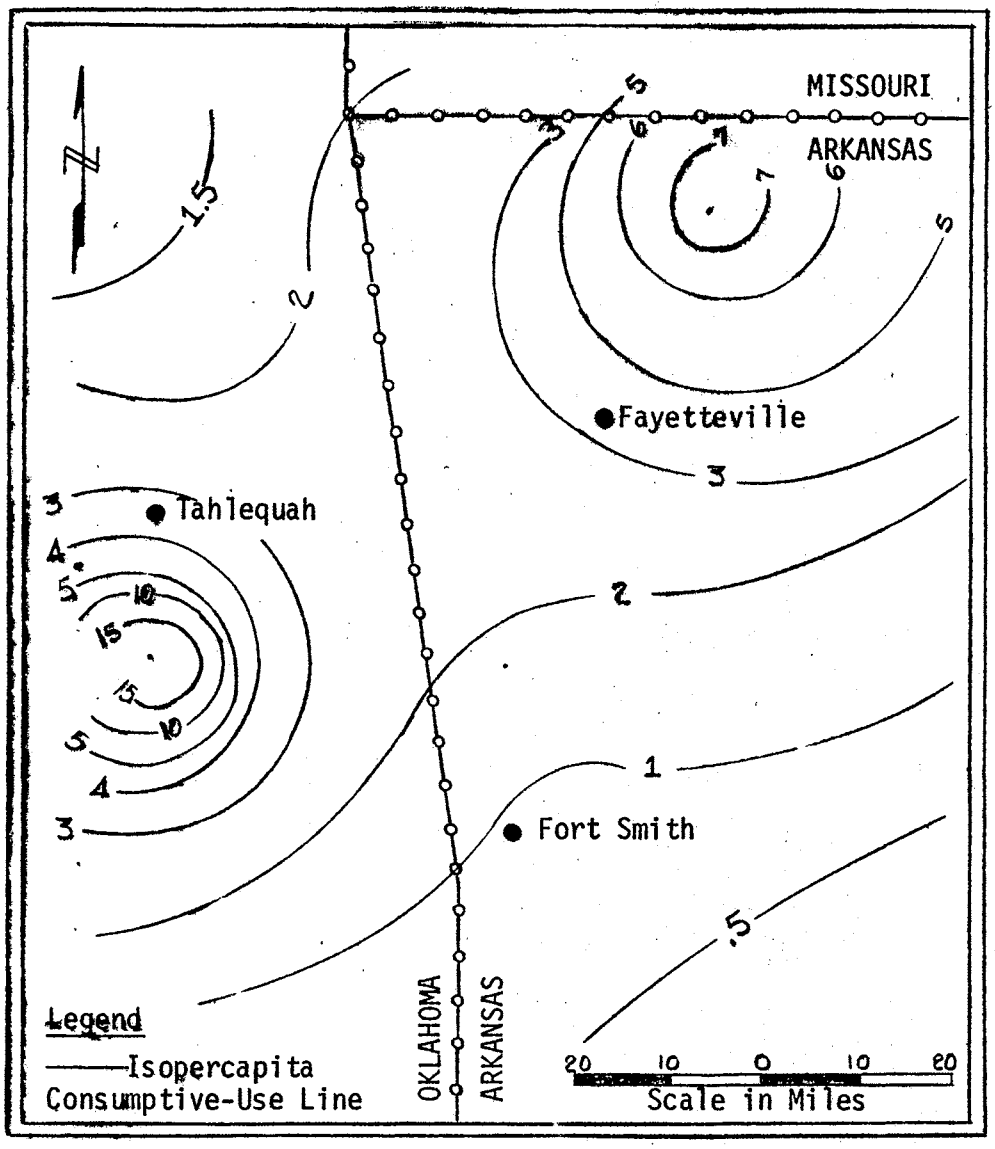

Figure 8. Map of Consumptive-Use for Lake Tenkiller and Lake Beaver.

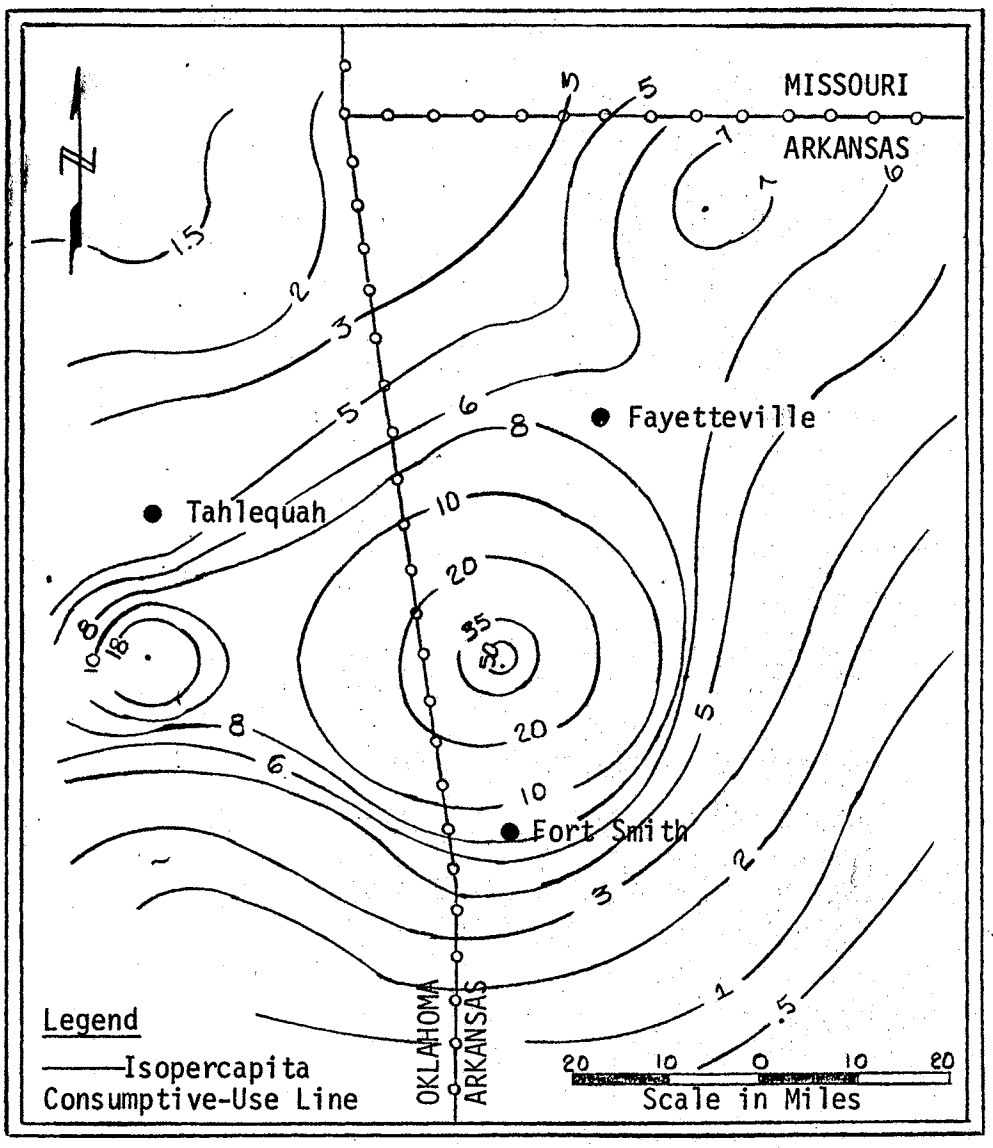

Figure 9. Map of Consumptive-Use for Lake Tenkiller, Lake Beaver, and Proposed Lake Harper.

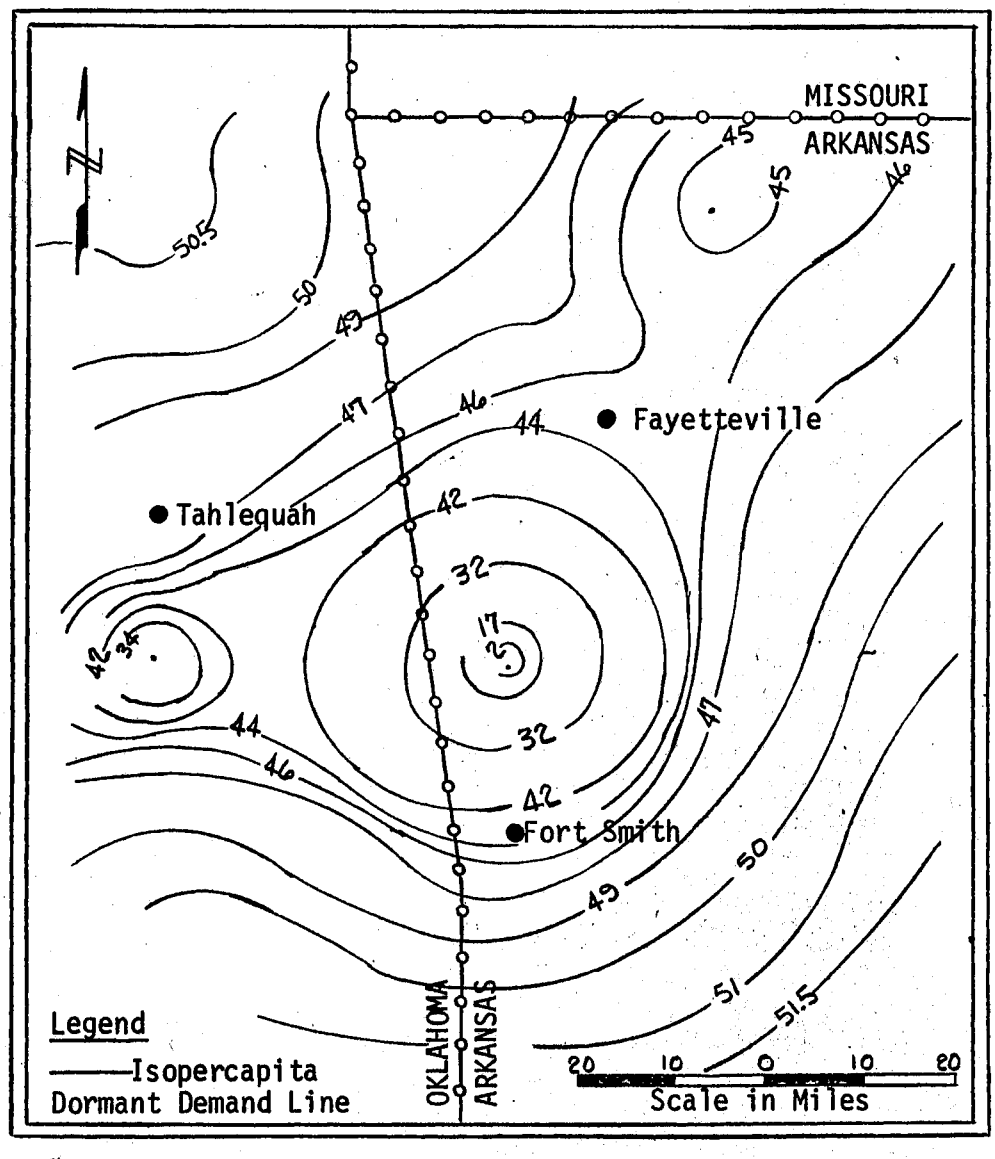

Figure 10. Map of Dormant Demand Within the Study Region.

study area. The dormant demand map shows the per capita need for recreation that is not satisfied by existing recreation facilities of the study region. This map would be useful in obtaining a "bird's-eye" view of the dormant demand within a state or national region, and would serve as a valuable tool in comprehensive recreational planning studies. A comprehensive map would have to include the combined influence of all major recreation supply centers within the study region. Similarly consumptive-use maps can be developed for each specific type of recreation activity.

CHAPTER V

CONCLUSIONS

Conclusions based upon results of investigations presented in Chapter IV are listed below in order of presentation of the study objectives.

A. Statistical Analysis of Socio-Economic and Environmental Variables

Results of research to identify the demand variables relating to participation in the study area are as follows:

(1) Poor correlation exists between the independent variables of leisure time, education, age, years of residence about the recreation site, and length of vacation and the dependent variable participation.

(2) Higher correlation exists between the dependent variable participation and the independent variable distance to the recreation site.

(3) In order to obtain statistical data for socio-economic factors within Region 5 of the State of Arkansas Recreation Survey, a random sample of 158 people were interviewed of the region population of 153,958. With the collection of a higher number of samples of the region population, the statistical results may have reflected more reliable correlation of the socio-economic and environmental variables.

B. Evaluation of the Similar Project Concept

The consensual opinion of published criticism of the concept is summarized as follows:

(1) The concept equates participation at the existing project (most similar to that proposed) to the total demand or recreation need at the proposed site. This approach has been subject to general criticism of economists because they theorize that participation or attendance figures at existing sites are the net effect of the existing supply. The subsequent estimate for demand at the proposed site is not an estimate for demand but an estimate of consumption relating to the existing site.

(2) Site demand bears upon direct interdependence to location with respect to adjacent competitive market areas as created by neighboring recreation reservoirs. Empirical adjustment of per capita use curves of the most similar project to compensate for differences of the competitive market situation dangerously oversimplifies the effects of competition for recreation.

(3) Application of the similar project concept for determining initial site demand at Lake Harper provided an estimate of 673,000 annual day visits.

C. Development of the Methodology

Based upon results of the first two study objectives, the methodology was formulated to:

(1) Include the demand variable of distance to the recreation site.

(2) Equate the effective initial site demand to the existing consumptive-use created by existing competitive markets within the

proposed market area to the total population expressing desire to participate in recreation activity within the study region.

Application of the developed methodology to hypothetical Lake Harper showed:

(1) Lake Harper is located within a highly competitive market area for outdoor recreation. Approximately 935,000 annual day visits to Lake Tenkiller and Lake Beaver originate within the Lake Harper market area. This quantity of visitation represents 30 percent of the 3,140,000 combined total of year 1967 day visits to Lake Tenkiller and Lake Beaver.

(2) The total population desire to participate in recreation activity in the Lake Harper market region is 1,450,000 annual day visits.

(3) The effective initial Lake Harper site demand is 515,000 annual day visits.

(4) Per capita consumptive-use rates constantly change with respect to distance from the recreation site within a competitive market region. This condition results in much difficulty in communicating overall regional per capita consumptive-use to others within and outside of the recreation planning field.

D. Mapping Techniques

Because of the previously concluded difficulty in communicating results of demand analysis to others by the present figure tabulation method, mapping techniques have been introduced for application within the recreation planning field. Primary merits of the techniques are:

(1) Maps reveal in a comprehensive manner the regional pattern of distribution of per capita consumptive-use.

(2) Maps can be developed to show both regional consumptive-use pattern distribution and per capita dormant demand pattern distribution for recreation.

(3) Maps can be developed to show consumptive-use of a specific recreation activity or can be developed to show consumptive-use of an aggregate of recreation activities.

(4) Development of the regional per capita consumptive-use map displays comprehensively the location of recreation supply centers and the intensity pattern of consumptive-use about the supply source.

CHAPTER VII

SUGGESTIONS FOR FUTURE WORK

The following are suggestions for future work in the water-oriented recreation resources planning field:

1. Institution of a nationwide data collecting recreational field survey of a rigid and statistical approach type.

2. A study to better quantify the relationship between levels of resource opportunity and recreational behavior. The study should focus on the examination, identification, use, and effect of socio-economic and environmental factors of demand.

3. A study to develop a methodology for estimating projected site demand for recreation at proposed reservoirs.

4. A study to develop a methodology for determination of recreation benefits at proposed Federal projects.

5. A five-year interval nationwide monitoring program to update effectiveness of developed demand analysis methods and provide updated statistical data for future research.

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APPENDIX A

APPLICATION OF THE SIMILAR PROJECT CONCEPT

EXAMPLE OF THE APPLICATION OF THE SIMILAR PROJECT CONCEPT FOR DETERMINING INITIAL PROJECT RECREATION DEMAND

A. Example of the Similar Project Concept Procedure

An initial recreation-use estimate for Harper Reservoir, a hypothetical multipurpose reservoir in the study, is presented in the following paragraphs.

Examination of pertinent data of existing projects shows the Wister project in eastern Oklahoma to be similar to Harper Reservoir. For comparison, pertinent data for Harper and Wister are shown in Table VI.

Comparison of day-use recreation attendance data for the similar project reveals that the majority of day-use visits originate from within a 50-mile radius of the Wister project. Therefore, fifty miles is also applicable as the day-use market area boundary for the Harper project. Counties expected to contribute the majority of day-use recreationists to the Harper project are listed in Table VII.

Anticipated per capita use rate for Harper is assumed to be the same as that of Wister. See Figure 11.

Following determination of counties and population and establishment of a per capita recreation use curve, per capita use rates corresponding to those counties are recorded. See Table VII. The tabulation presented summarizes the data used in determining initial

TABLE VI

PERTINENT DATA - COMPARATIVE TABULATION

Item	Lake Harper	Lake Wister
Location (State)	Arkansas	Oklahoma
Pool Surface Acres	20,000	23,000
Year Impounded	--	1949
Project Purpose	Flood Control, Rec.	Flood Control, Rec.
Timber Cover	Dense	Moderate
Terrain	Steep	Steep
Recreation Season	Apr. - Sept.	Apr. - Sept.
Attendance by Year		
1964	--	490,000
1965	--	484,000
1966	--	613,000
1967	--	566,000
1968	--	687,000

TABLE VII

ESTIMATION OF INITIAL RECREATION DEMAND FOR HARPER RESERVOIR

100 Percent of Base Year Day Use				
County	Population	Distance (Miles)	Use Rate	Day Use
Crawford	7,000	0-10	25	175,000
Crawford	17,200	18	6.2	106,640
Sebastian	73,600	23	3.8	279,680
Adair	14,800	28	2.5	37,000
Washington	72,600	40	.68	49,368
Le Flore	16,000	41	.59	9,440
Sequoyah	21,500	46	.35	7,525
Cherokee	22,600	48	.28	6,328
Franklin	11,300	49	.25	2,825
Madison	20,300	69	--	--
			Rounded Total Annual =	673,000

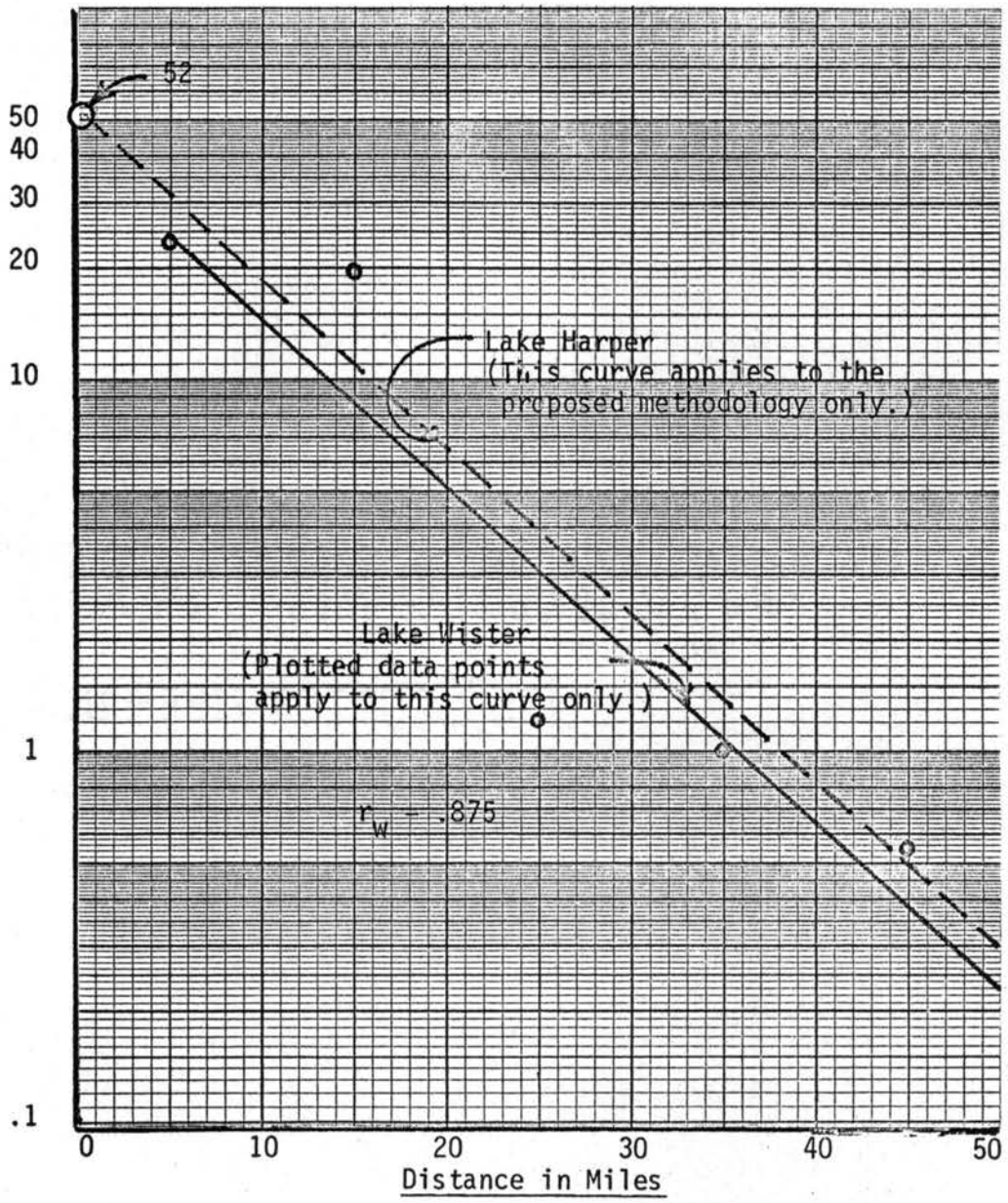
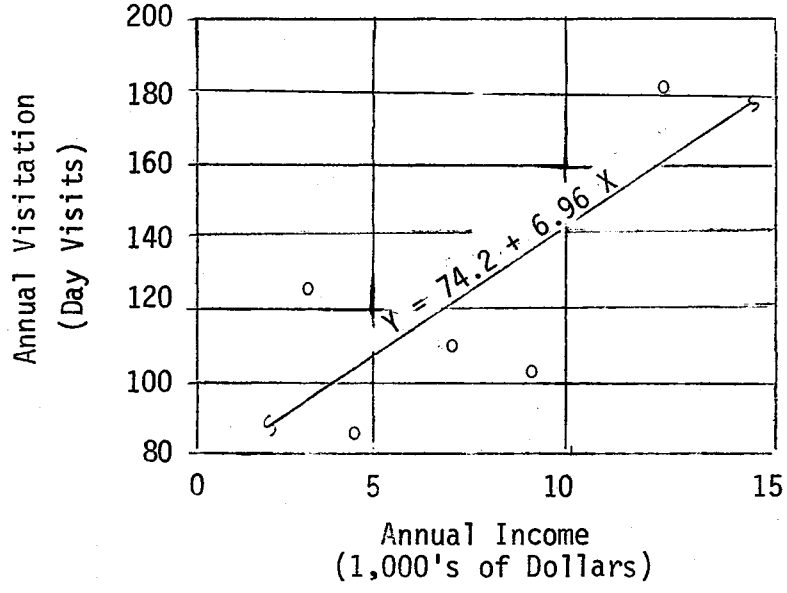


Figure 11. Per Capita Use Curve - Lake Wister and Lake Harper.

year day demand for the Harper project. Results of the analysis show a total initial day use of visitors to Harper Reservoir per year.

APPENDIX B

COMPUTATIONS AND FIGURES



For Coefficient of Correlation

X	Y(100's)	Y_F	$Y-Y_F$	$(Y-Y_F)^2$
3	1.26	.93	+.33	.1090
4.5	.94	1.05	-.11	.0120
7	1.08	1.22	-.14	.0196
9	1.02	1.36	-.34	.1160
12.5	1.92	1.61	+.31	.0961
Σ	6.22			.3527

For Regression Equation

	X	Y(100's)	XY	X^2	Y^2
	3	1.26	3.78	9.0	1.59
	4.5	.94	4.23	20.25	.88
	7	1.08	7.60	49.0	1.17
	9	1.02	9.18	81.0	1.04
	12.5	1.92	24.00	157.0	3.69
Σ	36.0	6.22	48.79	315.25	8.37

General Regression Equation: $Y = a + bX$

and, $\Sigma Y = Na + b\Sigma X$

$\Sigma XY = a\Sigma X + bX^2$

solving: $a = 74.20$

$b = 6.96$

then, $Y = 74.2 + 6.96X$

"r" = Coefficient of Correlation

$$r = \sqrt{1 - \frac{\frac{\Sigma(Y - Y_F)^2}{N}}{\Sigma \frac{Y^2}{N} - \left(\frac{\Sigma Y}{N}\right)^2}}$$

$r = .68$

Figure 12. Example of Regression Equation and Correlation Analysis.

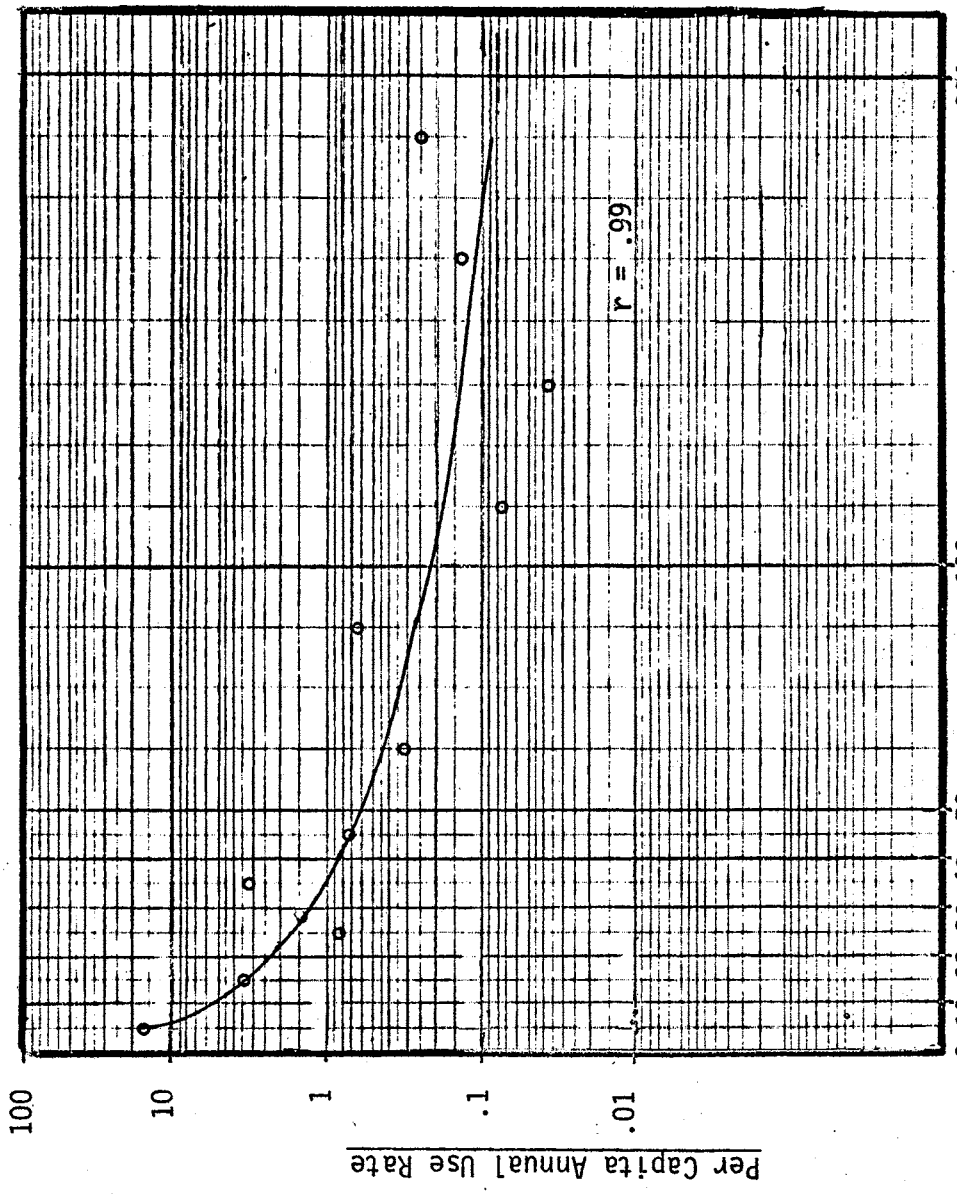
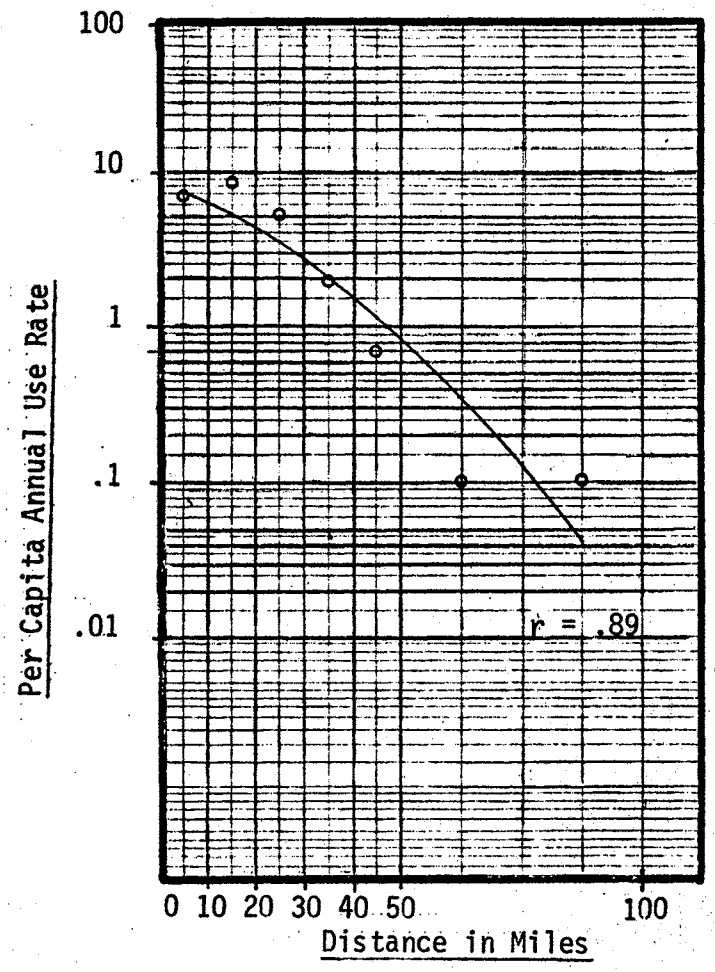


Figure 13. Per Capita Use Curve - Lake Tenkiller.



Courtesy U. S. Army Corps of Engineers.

Figure 14. Per Capita Use Curve - Lake Beaver.

VITA

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Master of Science

Thesis: A METHODOLOGY FOR ESTIMATING INITIAL RESERVOIR RECREATION DEMAND

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