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EVALUATION OF THE REGIONAL MULTIPURPOSE ECONOMIC BENEFITS RESULTING FROM A WATER AND RELATED LAND RESOURCE DEVELOPMENT

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FOREWARD

The Water Resources Research Institute has provided the administrative coordination for this study and organized the interdisciplinary team that conducted the investigation. It is the Institute's policy to make available the results of significant water related research conducted in Idaho's universities and colleges. The Institute neither endorses nor rejects the findings of the authors. It does recommend careful consideration of the accumulated facts by those who are assuredly going to continue to investigate this important field.

ABSTRACT

An attempt was made to determine the physical and economic impacts of the water resources development on the seven major uses: (1) irrigation, (2) recreation, (3) power, (4) municipal and industrial use, (5) flood control, (6) water quality and (7) fish and wildlife. The study area was the Mountain Home Division of the Southwest Idaho Water Development Project. The major effort of the investigation was centered around the two functions, irrigation and recreation. Economic models were developed for these two functions. In measuring the changed conditions from new irrigation land development two approaches were used. One was simple budgeting analysis and the other was using a Linear Programming model including sensitivity analysis. Parametric programming on the objective function was used for two of the activities, sugar beets and potatoes. The number of farms on the project area is estimated under varying farm sizes. Population increases is estimated. The recreation model was limited to the empirical investigation of pheasant hunting in the Southwestern Idaho region. The predictive model was based on the concept of marginal utility of the recreationists and is a simple one based on three utility producing variables: (1) travel distance to recreation site, (2) irrigated cropland as the sites of recreation, (3) hunter success. The over five functions of multiple water uses are treated in a descriptive manner.

ACKNOWLEDGMENTS

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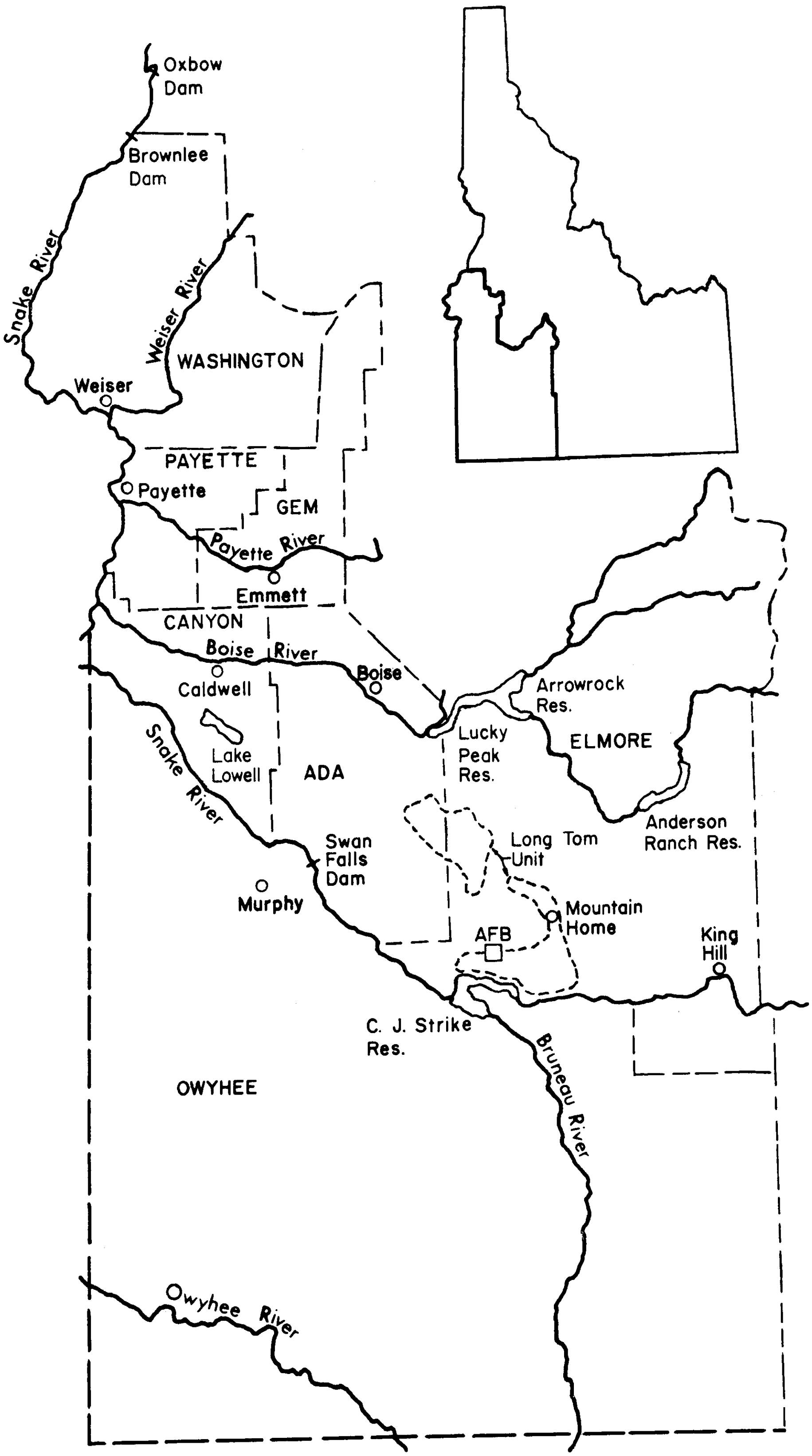

FIGURE 1: Southwestern Idaho Study Region

INTRODUCTION

In 1966 the Bureau of Reclamation submitted a plan for the multi-purpose development of water resources in Southwest Idaho. These development proposals were designed to meet the present and foreseeable future water needs of an area comprising the project of Mountain Home, Garden Valley, Bruneau and Weiser River Divisions of the Southwest Idaho Water Development Project. The projects encompass 15,500 square miles, or about 10 million acres, of which about 20 percent are suitable for irrigation.

The Mountain Home Division was singled out for the present study. It comprises the units of Guffey, Long Tom, and Hillcrest. The plan of this division is designed to serve the functions of irrigation, flood control, power production, recreation, and municipal and industrial uses. The plan proposes an exchange of water between the Snake River and Boise River. The project will entail the building of the Long Tom Diversion Dam on the South Fork of the Boise River below Anderson Ranch Dam. Here the water will be diverted by the Long Tom Tunnel to canals which will serve the three sections of the Long Tom Unit. One section is located south of Mountain Home itself. The second section is located southwest of Mountain Home and the Mountain Home Air Force Base. The third unit is northwest of Mountain Home along Highway 80 connecting Boise and Mountain Home.

The Hillcrest Pumping Unit will be located at the present Boise River Diversion Dam and will supply water by canal to the Hillcrest Unit south of Gowen Field at Boise. The Guffey Dam and Power Plant will be located on the Snake River directly south of Nampa. From here, water will be pumped into the Dry Lake Area and the South Side Area across the Snake River. With development of the project many benefits to the area can be estimated. The economic and social impact will be local, regional and national in scope.

It was the purpose of this study to attempt to conceptualize the development of the Mountain Home Division and provide methodologies upon which future development priorities can be based with respect to multipurpose uses of water resources.

General Purpose and Objectives

This study has as its goal the developing of criteria for establishing priorities in water resources allocation. That is, to develop methodologies that water administrators can apply in allocating water under different situations. It was hoped that a model could be developed to measure the impact of water project development on the local economy including all the functions of a multipurpose water project.

The specific objectives are:

1. To determine the economic benefits of the multiple use of water and related land resources in the Mountain Home Division, Southwest Idaho Water Development Project, as identified in the Bureau of Reclamation feasibility report. They are the functions of power, irrigation, recreation, municipal and industrial use, flood control, water quality, and fish and wildlife.
2. To develop methodology for evaluating the multipurpose economic benefits from a water and related land resource development.
   a. Determine economic optimum allocation of resources at the farm level.
   b. Estimate the impact on the regional allocation of resources after the economic efficiencies at the farm level has been attained.

Deviations From Objectives

The last objective calls for a model of the economic system in a region which would generate changes over time as project growth is expected to occur. Changes from dry land range to irrigated agriculture would be simulated and the interrelations and impacts that a new irrigation project would have on the existing agriculture were to be examined in detail. The impact of future technological changes were also to be considered.

The overall economic model of the region has not been developed as planned because in order to have a workable model much more time than available would have to be allocated.

Even though the Department of Agricultural Economics, University of Idaho, and the Idaho Water Resources Board worked closely together on the study, the two reports resulting from the study are somewhat separate studies with emphasis on different aspects of the specific objectives. The methodologies used in the two reports are quite different with respect to practical and theoretical applications. Despite this difference and also some duplication of efforts the two reports supplement each other.

The following sections of this completion report are summarizations of these two reports. If the reader wished to study the different sections in more detail he is referred to one of the two reports.

METHODOLOGY

Source of Data

Primary data were gathered from farm operators in adjacent areas to the study area. Purposive sampling was used in selecting the participants; that is, representative farmers were selected for interviews in cooperation with extension agents and other county and state officials. This implies that the farmers interviewed operated their farms similar to the majority of farm operators in the area. The information collected pertained to such items as rotations, input-output data and a detailed account of operations performed on each crop growing in one production season. Forty-five farmers cooperated of which thirty-nine records were used in the analysis.

The demographic and economic data were for the general economic conditions of the area collected from secondary sources. The analysis of these data is compiled in the report from Idaho Water Resources Board. The region from which the data are collected consist of the following counties: Ada, Canyon, Elmore, Gem, Owyhee, Payette and Washington.

Methods of Analysis

Simple tabulation of data from secondary sources was used in showing historical changes in population and economic activities. Costs-benefit analysis was used in determining the economic benefits of the multiple uses of water for power, municipal and industrial use, flood control and fish and wildlife.

The model developed to predict the selection of alternative recreation sites available to recreationists is based on the concepts of value for a recreation site and the location value associated with the same site.

The methodologies of deciding the agricultural development of the project site were quite different for the two cooperating institutions. The Idaho Water Resources Board developed farm budgets for different size farms by using a computer program developed by the Bureau of Reclamation. The main importance of this program is that the budgets are developed from normative requirements of resources for the different farm sizes.

The methodology used by the University of Idaho was based on representative farms developed from purposive sampling of farmers in adjacent areas to the study area. The input-output coefficients computed from the sample were used in determining a long run planning curve or unit cost curve for establishing any economies of size among the farms. A simple curvilinear regression equation of the form $\frac{1}{Y} = a + bX$ was used to estimate the relationship between cost per dollar of farm income (Y) and acres of each farm (X). Data from four other areas along the Snake River such as Dry Lake, Twin Falls, Oakley, and Rupert were included in the sample and the result of the regression analysis was applied in order to establish model farms with increasing economies of size.

Linear programming models were used to determine optimum allocation of the limited resources such as land, labor, and water in the production of alfalfa, corn, mixed grain, mint, potatoes, and sugar beets, for the entire area and with the limitations of farm size requirements.

Post optimal procedure of varying the objective function (parametric programming) was used in order to establish functions for sugar beets and potatoes. Two way price mapping of the two crops was carried out with optimum solution changes caused by changing prices of the two crops.

RESULTS OF ANALYSIS

Demographic and Land Information

In order to show the economic activities of the region the years 1960 and 1970 were compared. The population of the seven counties included in the 1970 census, an increase of 22,756 over 1960. The changes in the composition of rural and urban population on a county basis are illustrated in Table 1.

Of the seven counties in the region Elmore County would receive the greatest direct impact from the development of the Mountain Home project since most of the proposed farms will be situated in this county.

The farming patterns of the region is given in Table 2.

The continuing increase in farm size is evident in Table 2. The general trend in this region has been the same as in the rest of the nation during the five years of observation. Elmore county shows an increase in both farm numbers and farm size. The reason is a large development of private farms from desert land and sales of state land for agricultural

Table 1. Population in Seven Southwestern Counties for 1960 and 1970.

County	1960 Urban	1960 Rural	1960 Total	1970 Urban	1970 Rural	1970 Total
Ada	65,640	27,820	93,460	87,803	24,427	112,230
Canyon	30,243	27,419	56,662	34,987	26,301	61,288
Elmore	5,984	10,735	16,719	12,489	4,990	17,479
Gem	3,769	5,358	9,127	3,945	5,442	9,387
Owyhee	--	6,375	6,375	--	6,422	6,422
Payette	4,451	7,912	12,363	4,521	7,880	12,401
Washington	4,208	4,170	8,378	4,108	3,525	7,633
County Total	114,295	89,789	204,084	147,853	78,987	226,840
State Total	317,097	350,094	667,191	385,183	327,825	713,008
County Total as a % of State Total	36%	26%	31%	38%	24%	32%

Source: Number of Inhabitants, Idaho. Bureau of Census, 1970 Census of Population.

Table 2. Size and Number of Irrigated Commercial Farms* 1964 & 1969.

County	No.	1964 Acres	Average Size (Acres)	No.	1969 Acres	Average Size (Acres)
Ada	987	87, 106	88. 2	825	77, 450	93. 8
Canyon	1, 903	220, 686	116. 0	1, 594	208, 820	131. 0
Elmore	150	35, 815	238. 8	159	51, 127	321. 5
Gem	431	45, 250	105. 0	356	36, 614	102. 8
Owyhee	462	85, 261	184. 6	437	98, 541	225. 4
Payette	530	49, 679	93. 7	443	42, 777	96. 5
Washington	334	30, 861	92. 4	276	30, 799	111. 5
Region	4, 797	554, 658	115. 6	4, 090	546, 128	133. 5

*Farms with Sales of $2, 500 and over.
Source: U. S. Bureau of Census, Census of Agriculture, Volume I., Idaho, 1964, 1969.

purposes. It is estimated that the amount of land irrigated was approximately 60,000 acres or about 15 percent increase over 1969 census figure. Many of these newer farms are relatively large, but because of the small farms that were developed earlier under the Reclamation Act, the average size is not indicative of the newer agricultural units. The irrigation water for the new farms has been developed from ground water sources and also some from high-lift pumping from the Snake River.

The agricultural land included in the region is mostly irrigated by gravity methods, however sprinkler irrigation units are very much in use on many of the new farms.

Sprinkler irrigation eliminates the need for land leveling and at the same time applies the water evenly to the plants with the result that efficiencies of water use increase over the gravity methods. However, there are certain crops that are not allowed to be grown with sprinkler irrigation; no field bean crop can be certified if grown under sprinklers and certain other horticultural seed crop production has been limited under this type of irrigation. Increased disease problems are cited as the primary reason for the restrictions.

Sprinkler irrigation systems were used in developing both the normative budgets as well as the positive budgets.

Amount of Water Available

In the Southwest Idaho Water Development Project Study of 1966, by the Bureau of Reclamation, it was estimated that an annual average diversion through the Long Tom Tunnel of 486,000 acre-feet would be available.

The proposed allocation of this quantity of water is given in Table 3.

Table No. 3. Identification of Water Uses for the Boise River.

Water Allocation		Amount (Acre Feet)
Total Water Supply		486,000
Supplemental Water	8,000	
Mountain Home City	5,000	
Boise City	20,000	
Minimum Flow Augmentation	19,000	
Wildlife Uses	4,000	
Total Allocation Water		56,000
Water Available for Irrigation in project area		430,000

The table illustrates the amounts of water allocated to the various non-agricultural uses. The detailed explanation of how the water has been allocated can be found on pages 14, 15, & 16 of the report by the Idaho Water Resource Board.

Agriculture - Irrigation

Economic analysis of alternative water plans can take many forms. One can take a direct approach and measure the average between changed conditions by simple budgeting analysis. Or one can take a refined approach and measure the changed conditions in details by using the marginal analysis. Both methods have been used in deciding the economic impact of developing the Mountain Home project.

1. Budgeting - Normative Approach

In the first approach to estimate how many farms could be established in the project area a 320 acre farm unit was used as the basic unit in conformance with the amount of land presently allowed on desert land entries.

Basic farm budgets were constructed from normative requirements for four specific crops: alfalfa, barley, potatoes, and sugar beets. The amount of water available was assumed to be 430,000 acre-feet for the entire project; the acres of land were assumed to vary in relationship with the irrigation efficiencies obtained in the project, that is, with high efficiencies more water would be available for irrigating more land. For the 320 acre farm unit established throughout the area the land requirements for the fixed water supply would vary from 131,320 acres to 161,680 acres with the irrigation efficiencies ranging from 65 percent to 80 percent. That is, an increase in the efficiencies from 65 percent to 80 percent would save enough water to irrigate 30,000 additional acres.

The results of the budgeting analysis were that 462 farms of 320 acres each could be established in the project area assuming 70 percent irrigation efficiency for sprinkling application and 60 percent for gravity application. The Gross Revenue per farm is estimated to be $89,360 with $78,590 in Total Expenditures leaving $10,770 to pay for the water input. The Total Revenue for the entire project would amount to about $41 million; subtracting the cost of all the input factors, except water, there would be about $5 million to pay for irrigation water.

These figures reflect the contribution to the economy of the area and the region. Breaking down the various input factors it was estimated that the project would generate about 3 to 4 million dollars of business yearly for the 320 acre farm unit. At an hourly rate of $1.90, this amounts to $5,272.50 yearly, or about $2.5 million for the entire project. How the farmer spends his own income and return on investment which is estimated to about $8.5 million are not evaluated but for the entire project this amount would have a considerable impact on the local and regional economy.

2. Budgeting and Linear Programming - Marginal Analysis

The second approach to estimate how many farm units could be established in the project area was based on positive input-output data; that is, the analysis is based on actual information collected from farm operators in the adjacent areas to the project area.

Basic farm budgets were developed from actual farm data collected from five areas along the Snake River. Detailed information of input quantities and costs in addition to detailed tillage practices were obtained for each commodity on a farm basis. The long run cost curve estimated from the data in the adjacent areas to the study area was applied in order to establish the model farms with the same degree of economies of size as was found in the farm sample. The model farms were of four sizes 160, 320, 480 and 640 acres with six possible crops being grown on the farms determined by rotation and land restrictions. The rotations on the different farm sizes were in accordance with the general practices in the region.

Linear programming was applied to the input-output data with water being fixed at 470,000 acre-feet and land at 130,800 acres for the entire project. Maximum and minimum restrictions were set for the various commodities; for example, alfalfa would not be a profitable crop to grow in most cases in the study, but the crop is necessary for its soil building quality. Therefore a minimum quantity of acres would have to be present in the rotation. The availability of labor was included as seasonal labor restrictions.

The activities in the linear programming model were the six crops subdivided into the four farm sizes for each crop. This allows different crops to be grown on the different farm sizes depending upon in addition to land and water the minimum and maximum restrictions placed upon the acreage needed or allowed for the crops. The objective function was expressed in terms of dollar returns to fixed factors, management and water. [1]

The solution of the linear programming model is given in Table 4.

The idle acres in the table are the result of the water restriction limiting the use of all the 130,800 acres for agricultural purposes. The model could have been modified to allow the use of all the land, but the ten percent idle land might be used for wildlife refuge. It should be noted from the table that as farm size increases the farmers become more specialized in their farming practices.

[1] See Report 1, page 33, Table 3.8 for a detailed view of the matrix used in one of the Linear Programming models. Note the degeneracy in the model.

Table 4. Crop Acreages, Number of Farms, and Income by Model Farms.

	Model Farm Size (Acres)				
	160	320	480	640	Total
Alfalfa	15,000	7,500	7,500	9,000	39,000
Silage Corn	3,600				3,600
Mixed Grain	10,000	5,375	5,375	6,450	28,000
Mint	1,000				1,000
Potatoes		6,225	12,125	17,078	35,428
Sugar Beets	4,600	5,900			10,500
Idle Acres	3,952	2,823	2,823	3,674	13,272
Total Acres	38,952	27,823	27,823	36,201	130,800
Number of Farms	243	87	58	56	444
Returns $(millions)	1.1	2.6	3.7	5.5	12.9

The Gross Agricultural Income for the entire project was estimated to be about $31 million. The 12.9 million dollars in Table 4 represent the returns to fixed factors of production in addition to the returns to water and management. This is the amount left over when the costs of variable factors have been paid.

When all the input factors are paid for the remaining revenue is the returns to management and water. Table 5 shows the distribution of returns to the individual farm sizes and the entire project.

Table 5. Net Returns to Management and Water by Farm-Size and Total Project.

Model Farm Acres	Net Returns Per Farm	Number of Farms	Project Net Returns
160	$-2,280	243	$ -553,998
320	15,286	87	1,329,875
480	41,073	58	2,382,238
640	67,884	56	3,801,503
Total Net Returns to Management and Water			$6,959,618

The number of farms indicated by the optimum solution is only valid for this solution with the given constraints. Many other solutions exist depending upon the farm sizes decision makers might want to develop on the project. It should be noted that the 160-acre unit is inefficient in its use of resources and is unprofitable for the farming practices of the area. However, the crops grown are considered primary crops without any consideration to what some of the crops could return in income were they to be used in the production of other products such as milk and meat. From the total net return of $6. 9 million deduction should be made for the managerial abilities of the farm operators. If it is assumed management costs $20 per acre then the net return to pay for water would be $4. 3 million or about an average of $33 per acre. The Marginal Value Product of Water was estimated to be about $16 per acre foot.

3. Parametric Programming

Parametric programming on the objective function was carried out for two of the crops in the model, sugar beets and potatoes. This procedure enables testing the sensitivity of the optimum solution with price changes of the two crops when the prices of the other crops remains constant. The result of the parametric programming were supply functions for the two crops sugar beets and potatoes. The supply functions indicate the amount of production of the two crops producers are willing to supply at the specified prices. See figures 2 and 3.

The conclusion of the analysis is that under the present price situation the production of the two crops is quite stable; that means, that

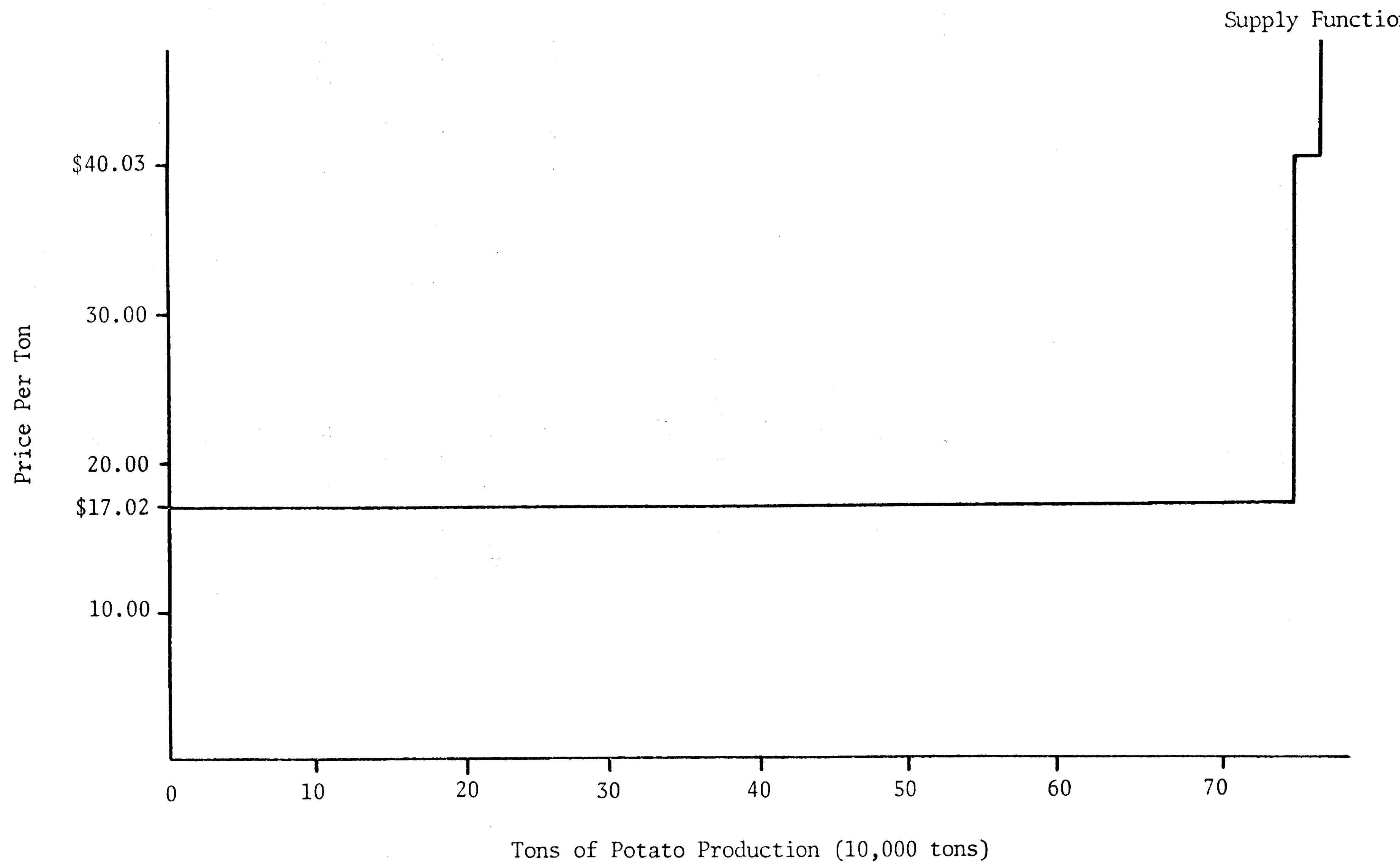

Fig. 2--Potato Supply Function

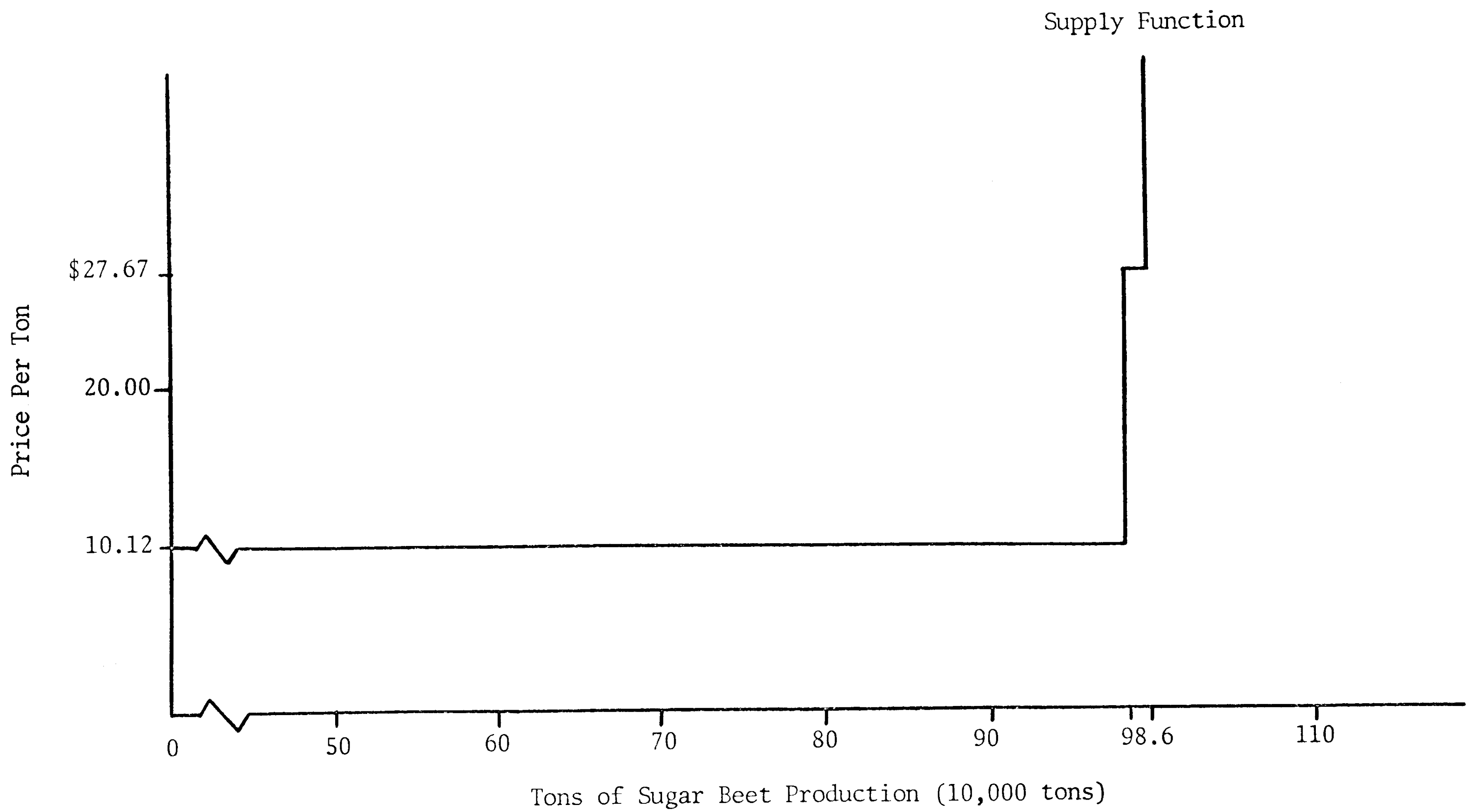

Fig. 3--Sugar Beet Supply Function

price increases do not significantly change the production acreages of the two crops. Comparing the two crops potatoes is the more advantageous crop to produce. This partially explained through the higher fixed costs of sugar beets production and in the higher irrigation requirements of sugar beets. In terms of acre-feet of water more income is realized from potato production.

4. Project Effects, Labor and Population

The number of farms developed on the project area depends upon the sizes of the farm units the policy makers are willing to establish. If the number of farms estimated in the previous section is used the direct effect on the labor force and population amounts to an additional employment for eight to ten thousand people. The methods of estimating how many additional people would be employed are somewhat different in the two accompanying reports of the study, but each method follows a logical pattern in reaching the conclusions. For detailed discussions see pages 46 to 50 in report (1) and pages 26 to 29 in report (2).

OTHER MULTIPURPOSE FUNCTIONS

Although the original proposal anticipates an analysis of the major water use functions in water resource development, time and availability of data did not permit studies of functions of municipal and industrial use, flood control, water quality, and fish and wildlife. A brief part of the effort did present a model for considering outdoor recreation evaluation in the specific area of pheasant hunting. Power studies were considered by the report of the Idaho Water Resource Board (2) in a philosophical manner. Some of the information is pertinent to total project effort of establishing priorities in water resource allocation.

1. Regional Power Allocation

Benefits to power production from irrigation development are diverse and extremely difficult to define. As originally proposed, the Mountain Home project would use public power, thus further compounding the problem. This is due to the inherent differences in federal power purchases relative to those from private sources. Lower rates are the most notable along with the absence of federal taxes. Together they represent a subsidy to the consumers of the public energy and a redistribution of income. While this may be good in terms of regional development, it may represent a cost in terms of national efficiency.

On the other hand, private power sources would impose even higher cost to the region but may be somewhat better in terms of national efficiency. This is recognized through a rating structure more in line with what people would be willing to pay plus the added benefit of federal taxes which can be redistributed at a later date. However, the nature of large private utilities and their needs for large stocks of capital are indicative of vast regional problems. The large influx of foreign capital with its subsequent interest and divident charges promotes intensive leakage to areas outside the region and the state. This slows regional development and constricts the redistribution of income as indicated by a low multiplier of 1. 632. (Rafsnider, 1971).

It appears that projected urban manufacturing and other non-farm uses of electrical energy will require larger amounts of energy both within the region, the state, and the nation. It does not appear that local regional scarcities will prevail. If the project were developed and it would utilize the surplus energy, benefits would occur through growth in population and economic activity within the region as well as areas surrounding it. However, development could cause significant changes in pricing and levels of use to surrounding regions. This would come through higher levels of investment into lines and delivery equipment and resultant rate increases.

The increase in electrical energy prices in those locations of agriculture irrigation where public investment in water supplies and installations are already an accomplished fact would pose complex problems to the distribution of income and capital values among farmers. Those farmers operating in already developed pump irrigation projects would experience a decline in income. Similarly, the price of their land would decline as would a portion of their capital values. Farmers operating with non-power irrigation systems would gain both in income and capital values. Hence, a redistribution of income and capital assets would occur within the region and among the different regions. This redistribution would also extend to the non-farm sector especially in small rural communities. In communities of reduced pump irrigation, the business and service sectors would experience reduced handling of inputs and outputs. Employment in the areas surrounding the project would be reduced. Likewise, areas not experiencing these problems would realize a fuller employment of resources.

The foregoing discussion has pertained to benefits and cost to the region should price of energy increase due to higher capital cost of delivery systems. The magnitude of the cost would depend upon the size of rate increases. Certainly, if the price of electricity were raised to levels equal for all users in the system, the redistribution would be large.

The legal, historic, and institutional constraints to electrical energy pricing among uses and locations, especially within agriculture, bears little resemblance to a pattern of electrical energy in its many competing spatial, regional, or commodity alternatives. All this is indicative of the subsidy paid to irrigation through lower rates. It is readily observable that energy used for irrigation pumping returns less than the energy used in other alternatives. This violation of the equimarginal returns principle indicates the need for compensation to the region for the loss in productivity. Also lower load factors and summer peaking conditions impose pecuniary externalities on the already imperfect market. These may be internalized but may risk pricing changes again.

A brief simulation study by the Idaho Water Resource Board of a portion of the power production of the proposed Southwest Idaho Water Development project showed the effect on one dam in the system from the project development. The revenues from power production were shown to decrease in the case of the proposed expansion of irrigation development. See pages 30-33 and Appendix C in Report 2.

2. <u>Value of Municipal and Industrial Water</u>

As indicated in Table 3, 25,000 acre-feet of water was allocated to Boise City and Mountain Home City.

The present rate structure of the Boise Water Corporation was used in computing the value of the allocated water to the two cities. The rate is approximately $75.00 per acre-foot. Then the annual value of the allocated water amounts to 1,875,000 dollars. See page 23 in Report (2).

3. Outdoor Recreation Benefits

The increased demand for various forms of outdoor recreation, with most of these being oriented towards water, has made it imperative that the benefits and costs from recreation be estimated in quantative terms. Many of the variables which determine the effects of recreation are not exchanged in the market place and therefore no price determination takes place. To get around this problem a theoretical model was developed providing for the estimation of activity levels and distribution as well as the quantification of value differences among recreation sites. Although there are many types of recreation included in the development of the Mountain Home irrigation project it was felt that the specific theoretical model would be representative of the methodology to use in the estimation of economic benefits induced from most forms of area-specific public outdoor recreation.

The analysis was limited to the empirical investigation of pheasant hunting in the Southwestern Idaho region.

The model is based on the concept of marginal utility of the recreationist who will frequent the recreation site which gives him the most quality advantage associated with equal user-costs. The concept of economic rent is used as the basis for estimating the benefits of the recreation sites. The predictive model presented is a simple one based on three utility producing variables: (1) travel distance to recreation site, (2) irrigated cropland as the sites of recreation, (3) hunter success.

The data were collected by the Idaho Department of Fish and Game from a mail questionnaire. Information was obtained relative to the hunter's county of origin, the various counties (sites) hunted during the season, and the number of hunter trips taken to the site from the origin county. Additional information pertaining to origin population was obtained from the 1970 census. In the absence of more refined data, it was assumed that hunter trips would be apportioned to the individual city origins within the origin counties relative to the population of the city. That is, the city having the largest population would have the highest number of hunter trips. It was then assumed that this distribution consituted the "observed" distribution of hunter trips by origins.

Standardized distances from origins (cities) to sites (counties) were calculated by the use of a hand-operated odometer utilizing the most direct routes as measured on a published Idaho road map. A centrally located point within each hunter's unit was used as a common measuring point in calculating the mileage to the unit. In site travel mileage was represented by the average distance from all origins within the site to the common measuring point and was added to the round trip totals. It was assumed that each trip involved two recreationists.

The quality variables (irrigated cropland and hunter success) were quantified from data provided by the IWRB and Idaho Department of Fish and Game, respectively.

The value of recreation for a site is the sum of the difference in user-costs between the most distant user and all intermediate origins using the site.

The results of the analysis is presented in Table 6.

It should be noted from Table 6 that the analysis was made before the development project and after the project was assumed to be finished. In the second part of the analysis with the 130,000 acre additional cropland introduced only the variable, irrigated cropland for Elmore County, was changed.

Table 6. Comparison of Expected Hunter Activity and Values at Seven Alternative Pheasant Hunting Sites in Southwestern Idaho.

	Before Elmore County Development		After Development of 130,000 Acres in Elmore County	
Site	Expected Trips	Value	Expected Trips	Value
Ada	104	$ 441	114	$ 519
Canyon	17, 210	112, 745	18, 134	121, 773
Elmore	26	52	117	800
Gem	256	1, 343	201	1, 054
Owyhee	96	292	62	24
Payette	1, 647	11, 138	1, 079	5, 904
Washington	80	199	73	173
Total	19, 419	$ 126, 210	19, 780	130, 247
Projected to State Totals P. F. - 17. 034	330, 783	$2, 149, 861	336, 933	$2, 218, 627

One hunter day = 1 hunter trip assume 2 hunters per trip.

The increase in irrigated cropland greatly changed the distribution of hunter activity. Elmore County had the greatest increase (350 percent) followed by Ada (10 percent) and Canyon County (5 percent). Owyhee County had the greatest decrease (-35 percent) followed by Payette (-34 percent) Gem (-21 percent) and Washington County (-9 percent).

With the new distribution of hunter activity among the various sites changes occurred in the resource values.

It should be pointed out that the results of the analysis lack reliability because of the data that were used.

Attention must be drawn to the important policy implications accruing from the analysis advanced in this study. Of primary concern is the maintenance of pheasant recreation value within the region. Containing the majority of the states urban population, the region is more prone to further sub-division and urban encroachment into habitat lands. This removal of habitat lands greatly affects the number of consumers drawn to an area and directly relates to the supply of game. However, mere recognition of the problem is not sufficient as the analysis of demand for recreation whether it be for site, region, or the nation has to account for the supply situation. It has to be ascertained in a meaningful context, otherwise estimates of demand will be seriously misleading as to the true demand with consequent misallocation of resources.

As used in the model, irrigated cropland was the proxy for supply but in the real world this may need a more refined set of data. Differentiation in types of water delivery systems and amounts of cropping diversifications would greatly increase the reliability of the model. Additional data is needed that would include all origins and sites within the state. This would enable a proper measurement of interegional transfers.

A broadening of the analysis to include all phases of water-based recreation can be handled with the model and is needed for a comprehensive analysis of regional recreation. The predictive model presented is a simple one based on three utility producing variables: (1) travel distance, (2) irrigated cropland, and (3) hunter success. Obviously, other more sophisticated and elaborate models could be developed which encompass greater numbers of variables and statements of relationships. Such models would provide refinement and greater detail, but the basic conceptual construction reflected by this simplified model would be unaltered. Only an expanded model specification would be realized. See report (2) for a detailed discussion, pages 34-42 and Appendix B.

SUMMARY AND CONCLUSIONS

From the two supporting reports of which this report is a summary, the following are conclusions that should be emphasized.

The returns to the water input (irrigation water) were $45 per acre when computed as a residual of the total income. Under that approach all farm units were 320 acres with no variation in rotation of crops. Using the marginal analysis system and linear programming the returns to water were $33 per acre computed with varying farm sizes and rotations. The Marginal Value Product of Water was $16. 24 per acre foot.

Using sensitivity analysis for the solution of the linear programming it was found that the combination of crops grown in the area is quite insensitive to price changes. That means prices received for the potato and sugar beet crops must increase to unrealistic proportions before they will replace all other crops in the area.

The function of outdoor recreation was limited to an empirical investigation of pheasant hunting in the region of Southwestern Idaho. The predictive model presented is a simple one based on three utility producing variables: (1) travel distance to recreation site, (2) irrigated cropland as the sites of recreation, (3) hunter success. It was found that the development of the 130, 000 acres of new irrigated land greatly increased the hunter activities in the directly affected counties and decreased in counties that became competitors with the new irrigated cropland. With the redistribution of hunter activities among the various counties the value of resources also changed (Table 6). The regional power function does represent a contribution that has been made in the past as support to water development. This has been pointed out in the presentation of the background report by the Idaho Water Resource Board and is summarized in the body of this report starting on page 25.

The objectives of the proposed study were set out in specific terms. The last objective was to combine the results of the specific functions of the multipurpose uses of water into an overall model for the area.

This last objective has not been accomplished, firstly, because much of the research effort was concentrated on the agricultural irrigation function; secondly, not enough research time was allocated to the ambitious undertaking of the overall model. Also data for some of the other functions did not develop as expected because the set of technical and economic coefficients needed in the overall model was not clearly specified at the outset of the study.

The purpose of the overall model was to apply the methodology to other similar areas within the State. Despite the lack of the overall model the results presented in the two reports should add to the knowledge of water resources development agencies and be of help in the decision making in the planning and management of the State's water resources.

PUBLICATIONS

1. Reid, Richard Lee, 1973. "The Analysis of Irrigated Agricultural Development, Mountain Home Division, Southwest Idaho Water Development Project", M. S. Thesis, Department of Agricultural Economics, University of Idaho, March.

2. Gotsch, William P., Jim C. Wrighley and Warren D. Reynolds, 1973. "Evaluation of the Regional Economic Benefits Resulting From a Water and Related Land Resource Development", Idaho Water Resource Board.