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ECONOMICS AND ADMINISTRATION  
OF WATER RESOURCES

by

K. C. Nobe

June 30, 1969

COLORADO WATER RESOURCES



RESEARCH INSTITUTE

**Colorado State University  
Fort Collins, Colorado**

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ECONOMICS AND ADMINISTRATION  
OF WATER RESOURCES

Partial Completion Report  
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TITLE: Economics and Administration of Water

June 30, 1969

by

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Colorado Water Resources Research Institute  
Colorado State University  
Fort Collins, Colorado

Norman A. Evans, Director

## ABSTRACT

### ECONOMICS AND ADMINISTRATION OF WATER RESOURCES

#### Role of Economic Base Study

A framework for evaluation of recent base studies was developed. Several studies were reviewed to determine the role and delineate cases of superior analysis. Studies were ranked to determine their ability to perform various functions associated with water development. Recommendations were made for planners engaged in resource development. The major role identified for the economic base study in water resource administration settings was to measure the effects of water resource development on the economic base of a region.

#### Evaluation of Special Study Contracts with State Water Board

The study focused on an evaluation of special study contracts entered into by the Colorado Water Conservation Board over a ten-year period, 1959-1960-1967-1968. The evaluation included an overall analysis of the Board's expenditures, a review of the individual contracts, an analysis of the contract procedure and an attempt to specify the nature of public benefits derived from these contracts.

#### Recreation Property Owner Liability

A discussion of owners' and possessors' rights, duties and liabilities permits recognition of potential problem areas in management and permissive use by recreationists of private property. Responsibilities to invitees, licensees, trespassers, and young children vary and may have a significant impact on financial liability for injury. Awareness of these matters is essential to both the provider and user in order to avoid the pitfalls of liability.

Nobe, K.C.

ECONOMICS AND ADMINISTRATION OF WATER RESOURCES

Partial Completion Report to Office of Water Resources Research,  
Department of Interior, June 30, 1969, 23 p.

KEYWORDS -- \*economic base study/regional analysis/water resources  
planning/\*contract evaluation/management and development/  
recreation/legal liabilities/\*recreation liabilities/  
liability insurance.

#### NOTE OF INTRODUCTION

This partial project completion report outlines four separate research efforts on water resources administration and related matters. The first study, "The Role of The Economic Base Study in Water Resources Administration" was reported on in a master's thesis by Thaine H. Allison, Jr., completed November, 1966. The second effort was a research project culminating in a Department of Economics, Colorado State University publication, NRE-1, entitled "Evaluation of Efficiency in Allocating Contract Research Funds by the Colorado Water Conservation Board." It was prepared by David R. Allardice and K. C. Nobe and published December, 1968.

The third study pertains to the recreational use of private property by the public. Three publications will emanate from the research. A report entitled "Liability and Limitations When Private Property in Colorado is Used for Outdoor Recreation" by George E. Radosevich and K. C. Nobe was published by the Department of Economics as NRE-3 in April , 1969. This report is also Colorado's contribution to the Great Plains Technical Committee Project No. 11 on the use of private property for recreational purposes. The Technical Committee will publish a regional report containing the laws of six Great Plains States on landowner liability when private property is used for outdoor recreation and will include information on Colorado, originally published as NRE-3. Colorado State University Experiment Station will publish a third and more comprehensive report entitled "Legal and Economic Aspects Limiting Liability When Private Property in Colorado is Used for Outdoor Recreation" by Radosevich and Nobe.

The fourth research project funded under OWRR Agreement No. 14-01-001-1625 is an attempt to determine direct monetary benefits from the development of an irrigation water supply to Grand Valley, Colorado, by the Bureau of Reclamation. The research was conducted by Gerry L. Varble, Master's Degree candidate, Department of Economics, Colorado State University. The thesis is scheduled for publication in July, 1969.

Each of the four research projects will be discussed in the following pages with copies of publications provided where possible.

THE ROLE OF THE ECONOMIC BASE STUDY IN  
WATER RESOURCE ADMINISTRATION

by Thaine H. Allison, Jr.

INTRODUCTION

Survey of the Problem

There are three arguments which establish a need for a study of the economic base study as a tool of economic analysis associated with water resource administration: (1) The EBS, in its various forms, has been used recently by federal, state, and local water agencies; (2) Confusion exists concerning its appropriate role and limitations; and (3) Based on recent legislation, there is high interest on the part of Congress for a type of study usually identified with the EBS concept.

It was hypothesized that the EBS could be a useful tool to analyze regional problems associated with water resource development. This hypothesis follows from a review of current base studies used to analyze various regional problems including base studies associated with water resource development.

Purpose of the Thesis

The overall objective of this thesis was to review the historical use of the EBS and to identify insofar as possible, the role, or roles, it has played in water resource administration. A related objective was to evaluate cases using the EBS and determine whether or not they gave superior analysis of regional problems. Based on the review and evaluation, a final objective was to recommend changes in the role

and means for strengthening the role of the base study in the economic analysis of water resource development.

This thesis cannot be viewed as an exhaustive statement of the role of the EBS in water resource administration. Current water policy is the result of interaction between various political and scientific forces. The EBS in its current form is an outgrowth of this interaction.

#### Plan of the Thesis

Chapter Two is a review of literature concerned with economic base studies. The EBS was first considered as a tool of regional analysis. Within this context, recent legislation and political action contributing to the general use of the EBS approach were discussed. The base study was related to Senate Document 97 and other available literature on public comprehensive planning. The EBS is a tool of regional analysis and has been extended in recent years. This aspect of the base study development was considered. Based on current use a composite definition of the term EBS has been suggested.

In Chapter Three a framework for evaluation of recent EBS's was developed. This ideal framework identifies the attributes required of an EBS in order to fulfill the information requirements of water resource economic analysis.

Chapter Four reviews and evaluates thirteen recent studies which are considered to be of the economic base type. The ideal framework developed in Chapter Three was used to determine if the EBS gave superior analysis for decision making problems associated with water resource development.

Chapter Five identifies conclusions developed from the critical review in Chapter Four. Studies were ranked according to their ability

to perform various functions associated with water development.

Recommendations for future planners engaged in resource development were suggested.

Chapter Six summarizes the thesis and makes recommendations for future research in conjunction with the EBS. Recent EBS's were formulated on the basis of administrative directives by federal and other public agencies. These administrative directives have resulted in agency manuals for conducting EBS's. Several of these manuals and their relationship to current base studies were reviewed (see Appendix A).

The Economic Base Study Defined as the Term is Used in Water Resource Administration

A review of the literature seems to indicate that the EBS is a study which analyzes the economic resource base of a region. The economic base of a region may be its natural resources, its employment opportunities, or its general economic activity. The important theme is that the EBS should identify this base. The base study analysis in water administration situations should be related to the water resource development process as water development relates to, or affects changes in the economic base.

There has been pressure by federal, state and local water agencies to know the role and function of EBS's and whether or not EBS's provide information to aid decision making. To consider this problem of role, several case studies have been reviewed to determine (1) under what circumstances EBS's aid decision makers, and (2) the role of the EBS in water resource administration.

The EBS is not capable of solving all problems associated with water development. It provides limited information and can only

facilitate the decision process; it does not substitute for the total economic analysis.

## SUMMARY AND RECOMMENDATIONS

### Summary

Recent activities of federal and other water resource development agencies have led to extensive employment of an EBS as a portion of the economic analysis associated with water resource development. It has been shown that confusion exists, both in the literature and in practice, concerning the role of the EBS. Confusion was also evidenced when attempting to determine the attributes and usefulness of the EBS model in water resource administration, based on current employment in project and study analysis and their respective reports.

It has been the objective of this thesis to identify the role of the base study and attempt to clarify the confusing situation which has developed in conjunction with economic base concepts. Historically, the theoretical EBS has been a study which identifies future patterns of economic activity through determination of the export base of a region. In many cases, this export base has been neglected.

The method used for analysis was to identify the attributes of EBS's as they are noted in the literature. Several studies were critically evaluated in terms of their objectives, functions, and quality. These critical evaluations gave rise to a number of conclusions concerning EBS's,

The EBS was defined as a study which attempts to measure the economic base of a region. The economic base of a region may be its natural resources, employment in particular types of production, or other economic activity. The EBS identifies the economic base,

analyzes interrelationships within the region, and determines the relationship of the region to the nation. Part of the EBS may be devoted to establishing projections about future magnitudes and relationships.

The critical evaluation of thirteen recently published studies was facilitated by an ideal framework which identified the capacity of an EBS to provide information for decision making. Each study was reviewed in terms of the framework and a ranking of study categories was achieved. Studies which were flexible, but designed for specific types of decision making problems, were found to be the highest quality. Studies which were more general, not oriented to specific decision situations, were of lesser quality. This ranking does not indicate that a particular study does not fulfill its limited objectives, but indicates that it only exhibits limited qualities which make it less useful to others concerned with the region.

#### Conclusions - Recommendations

One conclusion reached was that a particular source of confusion was a problem of distinguishing between the traditional EBS as a technique of regional analysis and the general EBS, a broad category of studies designed to study the economic base of a region in conjunction with water resource development. Current practices of various agencies undertaking EBS's could be facilitated by reviewing the publications and adopting some of the practices of the Corps of Engineers. The President's Water Resources Council has offered one of the most extensive guidelines and analyses for developing future EBS's.

The role of the EBS has been suggested here as a means to measure, insofar as practical, the economic base of a region as the economy relates to the development of water resources. There are several

opportunities for expanding the functions of EBS's. Expansion is possible, particularly in conjunction with economic justification analysis. The EBS may be used to identify projected situations with and without the project. Further, Senate Document 97 calls for a number of analyses which may be facilitated by an EBS.

Recommendations for Further Research

One set of problems, which this thesis was not able to consider, was a comparison between the various techniques and the analysis which each would provide in the same resource development setting. It would be possible to compare various techniques against the restraints imposed on the agency which must select a particular technique to undertake an EBS.

To facilitate this type analysis, a small river basin with existing hydrologic data and potential resource development alternatives could be used. Consideration could be given to changes in the level of resource development, changes in the economy, the interrelated impacts of these two sets of changes and the answers given by various means of measuring the economic base.

This type of analysis would allow the test of the following hypothesis: "Given that resources for investigation are limited, there is (there is not) a significant difference in the method which should be used to make an EBS." The relationship between employing one study over another and the proper weighting of the trade-offs between restraints and methods could be determined.

A second proposal would be to determine the effects of Senate Document 97 on agency administrative procedures associated with the EBS. These revisions should also be reflected in the analysis undertaken in more recent studies.

The third recommendation for further research involves regional economic changes over time. There are usually several years between the initiation of preliminary project analyses and project construction. It would be worthwhile to determine the types of changes which occur in a region and the impact of these changes on the EBS analysis, system design, and regional activity.

PUBLICATION

Allizon, Thaine Harrington, Jr., "The Role of the Economic Base Study in Water Resource Administration," Master's Thesis,  
Department of Economics, Colorado State University,  
December, 1966.

LEGAL AND ECONOMIC ASPECTS OF LIMITNG  
LIABILITY WHEN PRIVATE PROPERTY IS USED  
FOR OUTDOOR RECREATION

by George E. Radosevich and K. C. Nobe

This report is a brief explanation of the attached publication and a more detailed explanation of the subsequent Experiment Station bulletin on this subject to be printed.

Landowner liability is sufficiently connected to the use of water and surrounding land to make it a subject of importance in a series of studies undertaken under the category of Economics and Administration of Water Resources. The efficiency of water resources administration is highly dependent upon successful integration of land and water resources. Recent years have witnessed a growing demand for recreational facilities and landowners are realizing a land use heretofore relatively untapped in the western states. If owner liability can be minimized in the utilization of land and water, effective changes in resource use can be complimented.

OBJECTIVE

The objective of this study is to present landowners, recreationists and other interested persons with a summary of Colorado law and insurance information relevant to their interests as providers or participants of recreation. Through a detailed analysis of Colorado law, court cases and general law, information pertinent to these parties is presented in NRE-3 published in April 1969, the Experiment Station Bulletin to be

printed in July, 1969, and in the regional publication to be completed by the Great Plains Technical Committee in 1970.

Material presented in the latter two reports to be printed is similar to that in NRE-3. The only major addition is in the discussion on liability insurance. A ten-percent sampling of insurance companies licensed to transact business in Colorado were contacted with questionnaires. These questionnaires requested information pertaining to types of policies, extent of coverage and rates, available recreational activity insurance and rates, and suggestions for those landowners permitting the public to enter upon their property free of charge and those desiring to create a new use for their lands. The results of this investigation appear on the two tables following the list of publication.

#### CONCLUSIONS

Preliminary investigation of this topic revealed a genuine need for a summarization of the law on this topic. It is felt that the usefulness of these publications will not only be to property owners and recreationists, but legislators in the various states, and as a reference source for educators, administrators and managers. For this reason, footnoting in detail was followed to provide a ready reference to pertinent cases, statutory law and detailed texts.

PUBLICATIONS

Radosevich, George E. and Nobe, K. C., Liability and Limitations When Private Property in Colorado is Used for Outdoor Recreation, NRE-3, Department of Economics, Colorado State University, April, 1969.

Radosevich, George E. and Nobe, K. C., Legal and Economic Aspects of Limiting Liability When Private Property in Colorado is Used for Outdoor Recreation, Experiment Station Bulletin, Colorado State University (tentative publication date: July, 1969).

Radosevich, George E. and Nobe, K. C., Use of Private Property for Outdoor Recreation: Legal Rights and Liabilities, Extension Service Bulletin, Colorado State University (tentative publication date: July, 1969).

Citation to the Great Plains Technical Committee Project No. 11, publication is unknown as of yet. Projected publication date: 1970.

TABLE 1

LIABILITY INSURANCE INFORMATION AND RATES FOR EIGHTEEN COMPANIES  
PROVIDING COVERAGE IN COLORADO FOR FARM, RANCH  
AND RECREATIONAL OPERATIONS\*

Insurance Carrier	Type of Policy For Coverage	Policy Covers Invitees, Licensees, Trespassers, Animals & Equipment	User Injured by Other User Covered	RATES (All rates for \$500 Medical Coverage)						Coverage If Fee Charged	Insurance For Recreational Enterprise
				Acreage	\$25,000	\$50,000	\$100,000	\$300,000			
A	(2,3)	Yes	(b)	(2) 0-160 161-500 Over 500 (3)	18.00 20.00 25.00 8.00	20.34 22.60 28.25 9.04	22.50 25.00 31.25 10.00	28.44 31.60 39.50 12.64	(e)	None	
B	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
C	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
D	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
E	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
F	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
G	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
H	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
I	(2,3)	Yes	(b)	Same rates as for "A"					(e)	None	
J	(1,2,4)	Yes	No	Per Year	10.00	11.00	13.00				
K	(1,3)	Yes	No	10-160 161-500 Over 500	12.60 14.40 19.80	14.60 16.30 22.40	15.80 18.00 24.80	19.90 22.80 31.30	No(a) ---	Yes(c) None	
L	(4)	Yes	(b)	(c)							
M	(1,2,3,4)	Yes	(b)	Per Year(2)	14.00				Yes	Yes(c)	
		Yes	No	Per Year(3)	10.00				No	Yes(c)	
N	(2,5)	Yes	(b)	No rates provided							
O	(2)	---	--	0-160 161-500 Over 500	14.00 16.00 22.00		18.00 20.00 28.00	22.00 25.00 35.00	(e) (e)	None None	
P	(2)	Yes	(b)	At Following Limits: 5/10/5 25/50/5 50/100/25 100/300/25						Special Under-writing	
Q	(5)	Yes	Yes(c)	0-160 161-500 Over 500	11.60 9.00 10.00	15.20				None	
R	(5)	Yes	No	1-80 0-160 161-500 Over 500	9.00 15.00 17.00 14.00		18.20 17.00 19.00 23.00	25.40 22.40 17.00 26.00	(e)	None None	

\*Results from a 10% sampling of insurance companies doing business in Colorado.

CODE FOR NUMBERS AND LETTERS IN ( ).

- (1) Owners, Landlords and Tenants Liability Policy
- (2) Farmers Comprehensive Personal Liability Policy
- (3) Comprehensive Personal Liability Policy
- (4) Recreational Activity Coverage Policy
- (5) Comprehensive Public Liability Policy

- (a) \$35.00 more on a 5/10/5 policy for this additional coverage.
- (b) Only if landowner directed or supervised the tortfeasor's action.
- (c) Rates for recreational activities coverage on following chart.
- (d) "Premises Medical Coverage" will protect if insured granted permission to enter property.
- (e) Yes, if fee is nominal and not intended as a business pursuit, however, provision should be made in the policy for even nominal fee extraction.

TABLE 2

RECREATION LIABILITY INSURANCE RATES IN COLORADO  
FOR VARIOUS ACTIVITIES\*

ACTIVITY	INSURANCE CARRIER	RATING BASIS	5/10/5	RATES(1) 25/50/5	100/300/25
Guest Ranch:					
Hotel	J	per unit	\$ 2.69	\$ 3.92	\$ 4.50
Camp, Guiding, Outfitting	J	per \$100 receipts	.074	.108	.125
Guest Cabins	L	flat charge		114.00	133.00
Campsite for Trailers	L	per cabin		4.00	5.00
Campsites	L <sup>2</sup>	flat charge		18.00	20.00
Club (with swimming)	M <sup>5</sup>	60¢/100 campdays	25.00	(Medical Aid Available)	
Dance Halls:	M <sup>5</sup>	per 100 members	65.00		
With Charge	M	flat charge	125.00		
Without charge	M	flat charge	30.00		
Outfitters and Guides	L	flat charge		56.00	63.00
Saddle Animals	J <sup>3</sup>	per animal	19.00	25.00	28.00
	L	-----		12.00	15.00
Swimming Pools	M	per animal	19.00	45.00	53.00
	L <sup>4</sup>	flat charge	175.00		
Swimming Activities	M	flat charge	27.00		
Ice Skating Activities	M	flat charge	17.00		
Snowmobiles	L	per unit		10.00	12.00
Tote-gotes	L <sup>4</sup>	per unit		10.00	12.00
Toboggan Slides	M <sup>4</sup>	flat charge	100.00		
Float Trips	L <sup>3</sup>	1 boat		99.00	119.00
	L <sup>3</sup>	2 boats		136.00	157.00
	L <sup>3</sup>	3 boats		203.00	234.00
	L <sup>3</sup>	4 boats		270.00	311.00
Fishing Piers	M <sup>4</sup>	55¢/\$100 receipts	35.00		
Fishing Ponds & Lakes	M <sup>4</sup>	55¢/\$100 receipts	35.00		
Parks and Playgrounds	M	up to 5 acres	14.00		
Playground Equipment	M <sup>4</sup>	all types	20.00		
Picnic Grounds	M <sup>4</sup>	flat charge	30.00		
Public Beaches	M <sup>4</sup>	flat charge	125.00		
Lakes (private):					
With Swimming	M	flat charge	25.00		
Without Swimming	M	flat charge	15.00		
Rodeos:					
With Bleachers	L	flat charge		105.00	119.00
	M	500 or less seats	35.00		
Without Bleachers	L	Flat charge		68.00	78.00
Food Services	L	flat charge		25.00	31.00
Airstrips	L	flat charge		50.00	60.00

\*"Insurance Carrier" letters correspond to carriers on Table 1.

<sup>1</sup>Rates include B.I. (Bodily Injury) and P.D. (Property Damage).

<sup>2</sup>Annual premiums for all of "C" company rates.

<sup>3</sup>Actual number of animals or boats in use at one time.

<sup>4</sup>Commercially operated.

<sup>5</sup>Non-commercially operated.

EVALUATION OF EFFICIENCY IN ALLOCATING CONTRACT  
RESEARCH FUNDS BY THE COLORADO WATER  
CONSERVATION BOARD

by

David R. Allardice and Kenneth C. Nobe

INTRODUCTION

The Joint Budget Committee of the Colorado General Assembly in 1968 requested that the Colorado Water Conservation Board evaluate the results of water research and consulting contracts executed by the Board from the period fiscal year 1959 through fiscal year 1968. On June 24, 1968, the Economics Department of Colorado State University entered into an agreement with the Colorado Water Conservation Board to assist it in meeting the Joint Budget Committee request. This report is directed to that purpose.

Objectives

With reference to the contract of June 24, 1968, and in preliminary meetings with the Director of the Colorado Water Conservation Board, the Economics Department agreed to pursue the following primary objectives in its investigations: (1) to determine if the Board's contracts have met the specific purposes set forth therein; (2) to determine if said contracts have met the general objectives and duties of the Board; and (3) to estimate the direct and indirect benefits that the State of Colorado has received from such contracts.

A secondary objective was to document whether or not there have been significant changes in the nature or the objectives of the Board during the past ten years, and if so, whether such changes are

evident in their contracting procedures. It is significant that little or no precedent has been established for conducting a study of this nature. Thus, an overall objective of the research was to establish a suitable approach to evaluating the efficiency with which a major state water agency allocates its contract research funds.

Items Considered for Evaluation

The first major item to be considered was the structure of the Board's budgets over the past ten years. The analysis focused on the total value of the annual budgets, as well as the distribution of funds among the major responsibilities of the Board. Specific emphasis was placed on an analysis of the Board's "Investigative Studies" program. The reason for this is that this is the area in which most of the contracts are centered and where a significant share of its total budget is allocated.

The second major step was to analyze individual research contracts. This analysis includes consideration of the total number and value of the contracts, the distribution of the contracts through time, and whether or not any significant patterns have developed.

The next major phase of the research was to analyze the Board's contracting procedure. This analysis focused on the general mechanics of acquiring outside assistance via contracts. Points of interest are: How does the need for such contracts originate? How are the contracts allocated and what flexibility does the Board have in making this allocation? It has been intended that this portion of the study would include a detailed analysis of one individual contract that has been prevalent over time but a shortage of time and research funds precluded this type of analysis.

The last point to be considered was an analysis of the overall benefits derived from the contracts. More specifically, the effort focused on an attempt to identify the impact the Board's contracts have had on the Colorado economy. These benefits include both economic and noneconomic benefits. The short term nature of this study precluded a detailed analysis but an attempt was made to specify the general nature of such benefits. The end product of evaluating the contracts in this manner was a judgment as to whether or not the cost incurred by the Board for these contracts is less than the benefits received from the contracts rather than presentation of a complete benefit/cost analysis.

#### Investigative Procedure

The research effort involved a synthesis of a large amount of raw data concerning the Board's historical contracting pattern over the last ten-year period. The major portion of the data came from the individual contract specifications and terminal reports, budget reports of the Water Conservation Board, and discussions with various state officials.

A basic premise for conducting the contract review was that it is in the best interest of the State of Colorado and the Colorado Water Conservation Board to achieve the most efficient allocation of public research funds. This was kept in mind as the data were analyzed in hope that some indicators might be found that would aid or improve the present contracting procedure.

Once the relevant data were compiled into tables (see Appendix Tables 1-5), the first major aspect to be considered was an analysis

of the Water Conservation Board's annual expenditures. This analysis focused on three aspects: (1) the total budget, (2) the major budget elements, and (3) the Special Investigative Studies program. Major emphasis was given to an analysis of the Board's special investigative studies program.

The second major aspect under consideration was the review of the individual contracts entered into by the Board. The major portion of data collection involved a review of each contract let by the Board for the period of time from 1957-1958 to 1967-1968. Appendix Tables 6 and 7 were developed to show the distribution of research funds allocated to public institutions and private individuals. Appendix Table 8 sets forth the number and dollar amounts of all contracts let during the ten-year period under study.

The third major area of analysis was to review the overall contracting procedure of the Board. Items considered included: how contracts originate; how they are allocated; and how much flexibility does the Board have in making these allocations?

A hypothetical analysis of a ground water research study was undertaken in the third major section of analysis. This was done because there has been a recent major shift in emphasis toward ground water. Research on ground water now accounts for 65 percent of the total funds the Board has allocated to the Special Investigative Studies program. The approach focused on what it would cost the Board to carry on its ground water investigation under alternative methods. Four alternatives are available to the Board. They are: (1) contract the research with a private consulting firm; (2) contract with a public institution; (3) conduct the research internally; and (4) some combination of the three previously listed alternatives.

The final aspect of the study involved an analysis of what kind of benefits derived from past contracts. Due to time and data limitations, however, this effort has limited scope. The effort was directed primarily to an illustration of the kind of benefits obtained rather than to providing absolute or complete benefit compilations.

## CONCLUSIONS

The Board's ground water program was designed to accomplish two major objectives; to obtain data on the basic ground water resources of the state, and second, to determine how those water resources should be managed in connection with surface waters. In light of these objectives, it appears that the Board's ground water studies now play a major role in the management of the state water resources. In this regard, an expansion of this program has not led to abnormal increases in state expenditures.

It is also concluded that since irrigation leads either directly or indirectly to an expanded Colorado economy, the Board's modest expenditures on studies that helped foster this kind of growth are clearly justified.

The major recommendations based on this report may be explicitly stated as follows:

(1) The Board should strive towards a formal procedure in determining the allocation of their research funds. This should be done in such a manner so as to either minimize their costs or maximize their return from each individual contract. Consideration of two or more alternative approaches to data gathering in each case will help to achieve a high level of efficiency in that regard.

(2) The Board should strive for a clear statement of intent in formulating their various contracts. This will ensure the Board that the contracts will meet certain specified objectives and that the results will be acceptable to both the Board and the State of Colorado.

(3) It is suggested that the Board attempt to plan for possible future changes in emphasis by keeping abreast of changing needs and technological developments in regard to water resources. Directing some contract research to this subject periodically would be one way of meeting this objective.

PUBLICATION

Allardice, David R. and Nobe, K. C., Evaluation of Efficiency in Allocating Contract Research Funds by the Colorado Water Conservation Board, NRE-1, Department of Economics, Colorado State University, December, 1968.

Progress Report on a Sub-project,  
"Impact of Irrigation on the Farm Economy of Grand Valley, Colorado"

Key words: Economic impact analysis, irrigation systems development, input-output models.

The objective of the Grand Valley project is to determine direct monetary benefits from the development of an irrigation water supply for the area by the Bureau of Reclamation. Through the use of an input-output model technique and two bench marks in time (1959 and 1965), the study reveals the degree to which a developed irrigation system has contributed to changes in net farm incomes in the study area.

The data used to construct farm budgets for the 1959 and 1965 fiscal years have been obtained primarily from library sources. The findings and analysis of these data will be published in a Master's thesis from the Department of Economics, Colorado State University in July, 1969.

The statistical input-output tables have been completed. The Bureau of Reclamation in Grand Junction, Colorado is presently in the process of determining net farm incomes and upon completion will forward the tables to Gerald Varble, Master's degree candidate, for incorporation into his Master's thesis. Arrangement of other charts, graphs and necessary data is currently underway for inclusion in the thesis.