THE IMPACT OF ECONOMIC DEVELOPMENT ON WATER RESOURCE USE

By

ROBERT RAY FLETCHER

Bachelor of Science
University of Wyoming
Laramie, Wyoming
1963

Master of Science
University of Wyoming
Laramie, Wyoming
1965

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF PHILOSOPHY
May, 1971

THE IMPACT OF ECONOMIC DEVELOPMENT

ON WATER RESOURCE USE

Thesis Approved:

Daniel D. Badger
Thesis Adviser

Dean F. Schreiner

Richard W. Schermerhorn

Lyle D. Broemeling

D. D. Durham
Dean of the Graduate College

ACKNOWLEDGEMENTS

Sincere appreciation is extended to Dr. Daniel D. Badger, Graduate Committee Chairman, for his guidance and encouragement which made possible the completion of this dissertation. A debt of gratitude is owed Dr. Dean F. Schreiner for advice and assistance concerning the technical aspects of this study. I appreciate the guidance received from my other committee members, Dr. Richard W. Schermerhorn and Dr. Lyle D. Bromeling.

Special thanks are extended to Dr. Vernon R. Eidman for his counsel and guidance during the earlier stages of my graduate program at Oklahoma State University. Others especially helpful in various aspects of the study include Mr. James C. Atherton, Mr. John J. Pinney, Jr. and Mr. Larry D. Sand. I am appreciative of my fellow graduate students for their suggestions and encouragement throughout my graduate program.

I am grateful to the Economic Research Service, United States Department of Agriculture, for financial assistance provided for graduate study.

I wish to express my appreciation to Mrs. Suzanne Moon for her typing excellence with regard to the many preliminary drafts and the final copy of this dissertation.

Finally, I am most deeply grateful to my wife, Carole, and children, Dale and Diane, for their patience, encouragement, sacrifices and faith throughout my entire graduate program.

TABLE OF CONTENTS

LIST OF TABLES

Table		Page

Table | Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Background for This Study

Droughts, increasing demands for municipal, industrial and recreational water, and pollution of existing water supplies have focused increasing attention on water as an economic good. Water is no longer free for the taking, since it is not always available in the desired quantity of acceptable quality for a particular use. As a result, comprehensive economic analysis at the state and regional level has gained prominence with public policy decision makers in the past decade. Included in state and regional economic development planning are programs focusing on water resource development. These programs involve an expanding federal-state relationship in river basin planning.

In his message to Congress on Natural Resources in 1961, President Kennedy accepted the comprehensive river basin planning goal recommended by the Senate Select Committee on Natural Resources, headed by the late Senator Robert S. Kerr. This was the inception of the present policy guides for water and related land resources studies commonly referred to as Senate Document 97 [40].

The overall objective of the river basin planning is to provide the best combination of uses of water and related land resources to meet all foreseeable short and long-term needs. In view of these needs, full consideration is to be given to objectives such as national income, regional development, environmental quality, and well-being of the people [47]. Reasoned choices must be made between these objectives when they conflict. National and regional economic development is considered essential to the maintenance of national strength and the achievement of satisfactory levels of living. It is recognized that comprehensive water and related land resources planning is essential to economic growth and development.

Proper stewardship in the long-term interest of the nation's natural bounty may require the protection and rehabilitation of resources to insure availability for their best use when needed. Thus, consideration should be given to aesthetic and qualitative values of open space, wilderness areas, wild rivers, lakes, beaches, mountains and related land areas that could be maintained and used for recreational purposes. Current policy also emphasizes that areas of unique natural beauty and historical and scientific interest should be preserved and managed primarily for the inspiration, enjoyment and improvement of the "quality of life" of the people.

Well-being of all the people shall be the overriding determinant in considering the best use of water and related land resources. Hardship and basic needs of particular groups within the general public shall be of concern, but care shall be taken to avoid resource use and development for the benefit of a few or the disadvantage of many.

River basins are usually the most appropriate geographical units for planning the use and development of water and related land resources. Four types of river basin studies evolved from the guidelines established in Senate Document 97. Type I or comprehensive framework studies develop framework plans or strategies for development of water resources of the major water resource regions in the United States. Type II or comprehensive detailed studies are designed to locate specific projects and certain water management measures needed in the near future. They may be installed under existing or new authorities. Type III studies are for developing individual water project plans.

Type IV river basin studies are generally conducted by a state water resource agency in cooperation with the United States Department of Agriculture. In some Type IV studies the cooperation is with other Federal agencies. In the Great Plains, Type IV river basin studies have been conducted by State Water Resources Agencies in cooperation with the Soil Conservation Service, the Forest Service and the Economic Research Service of the United States Department of Agriculture.

An Example of State Water Planning

The Kansas "State Water Plan Act" enacted by the State Legislature [37] provides a major policy statement regarding the development of a State Water Plan and State financial participation in water resources projects and programs. The State Water Plan requires the Kansas Water Resource Board to formulate and adopt long-range goals and objectives for the development, utilization and disposal of water, based on (1) careful consideration and estimates of the water resources of the state and (2) the present and projected water use and needs of the people of Kansas.

The above legislation provided for state financial participation in water development projects. Any public corporation shall be eligible for state financial assistance covering a part of the costs of lands, easements, and rights-of-ways necessary for the development of water resources projects if such projects provide benefits beyond the boundary of the public corporation. The Board may also recommend the inclusion of conservation storage features for water supply purposes in any proposed water development project of any public corporation. Such storage may be provided at state expense if, in the opinion of the Board, the water will be needed within the state in the future. For the purpose of providing the legislature with information as to probable future program costs on a continuing basis, the Act stipulates that the Board shall annually project future costs of water management projects for a 25 year period.

The Kansas Water Resources Board is currently making a water resources study of the state to develop a data system capable of providing the state legislature required information on water supply and future water needs. The Board requested the United States Department of Agriculture to cooperate in a study of the Kansas portion of the Arkansas River Basin.

Participation in the study by the Department of Agriculture is under the provisions of Section 6, Public Law 566, as amended. The River Basin Planning Staff of the Natural Resource Economic Division is the ERS representative on river basin studies. The research reported herein partially fulfills the ERS responsibility for estimating the economic impact of water resource development in the area relating to the need for future water requirements. Much of the basic data used in this study are from the unpublished ERS economic base study of the study area.

The General Problem

This study is based on a 54 county area in southern Kansas that approximates the Arkansas River Basin drainage area of Kansas (Figure 1). This area which includes about 28.2 million acres was considered a logical area for a water resources study.

It has a common drainage, the Arkansas River, and it consists of county political subdivisions that allow for the collection of consistent economic data. The general problem is to determine whether planned and proposed water resource development will meet the needs of the level of economic development projected for southern Kansas for 1980, 1990 and 2000. Not only quantity or availability of water, but the quality of water from various sources must be considered. Information relates to: (1) what are the existing water and related land resource problems, and (2) what are the potential problems that may be expected to occur in the future? After identifying potential problem areas, policy measures can be prescribed to reduce adverse effects these problems may have on the people and the economy of the area.

Planning Water Use Requirements

In planning for future economic development, private industrial groups and governmental agencies need estimates of present and future water supplies that are expected to prevail in the area. The western part of the study area depends primarily on ground water for domestic and municipal water supplies. Irrigation has been increasing rapidly in southwestern Kansas since the mid 1950's and is drawing on ground water reserves. The level of irrigation is projected to increase rapidly in the near future.

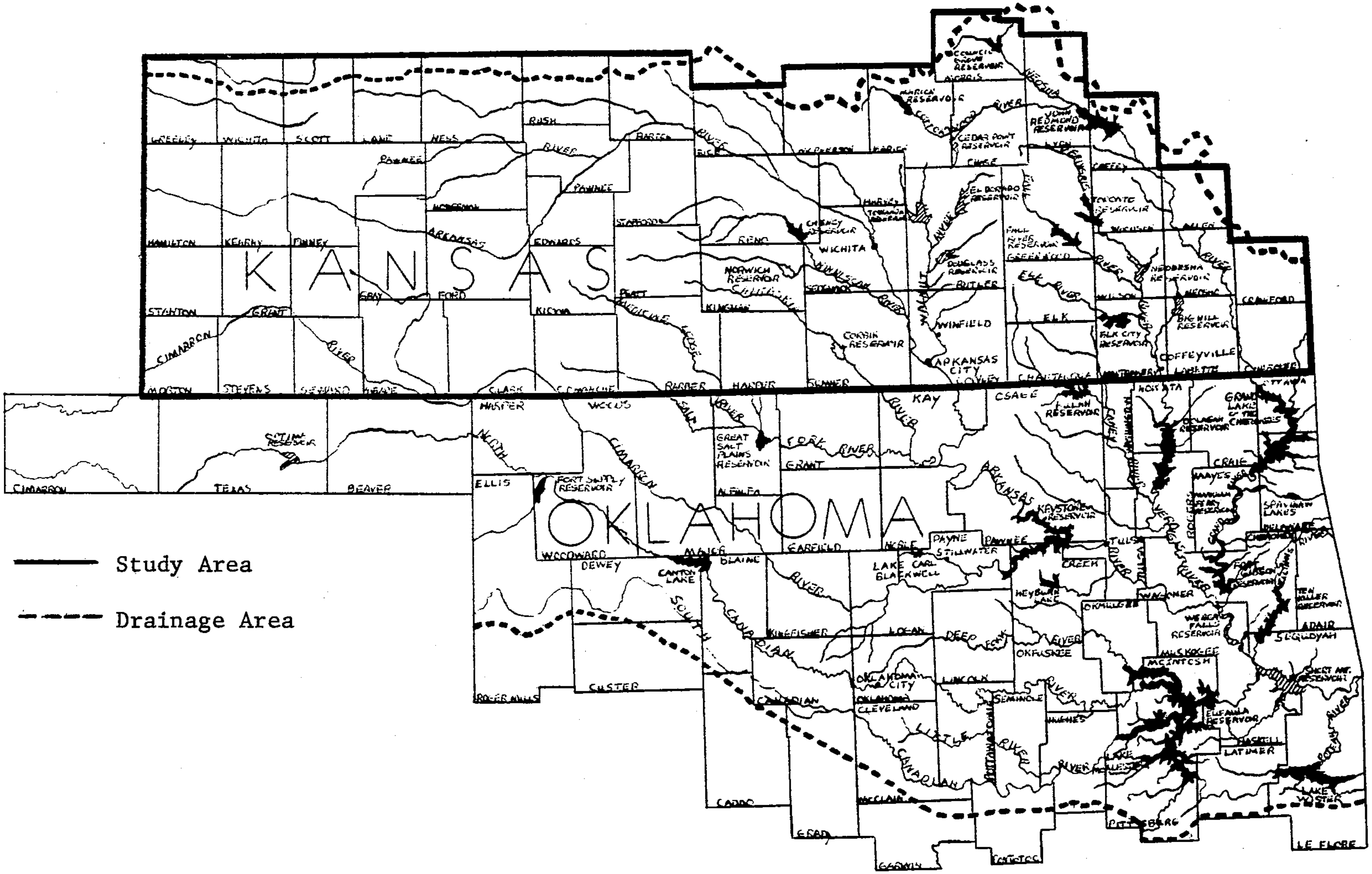

Figure 1. Arkansas River Basin Drainage Area in Kansas and Oklahoma
and the 54 County Study Area in Southern Kansas

The eastern part of the study area primarily uses surface water. The quality of ground water in the eastern part of Kansas is not always satisfactory for human consumption. Many rural water districts have been organized to supply domestic water for rural residents. An intensive small watershed development program has been carried out in parts of the area for upstream flood protection. The Corps of Engineers has constructed several major reservoirs in the area.

Both the Corps of Engineers and the Bureau of Reclamation are conducting studies in southern Kansas to determine where feasible construction sites exist. The Kansas Water Resources Board is making estimates of future water supply, taking into account the depletion of existing ground water and the construction of reservoirs that are considered to be economically feasible.

Planning An Alternative Urbanization Design

In his 1970 State-of-the-Union message, President Nixon advocated development of a "national growth policy" that would consider the "urban population crunch" and rural development as part of the same problem. President Nixon stated [33]:

> What rural America needs most is a new kind of assistance. It needs to be dealt with, not as a separate nation, but as part of an overall growth policy for all America. We must create a new rural environment that will not only stem the migration to urban centers, but reverse it.

One hypothesis to maintain a better rural-urban population balance, as our nation continues to grow, is the development of new cities in rural areas. A new city may be defined as either creating a completely new city in a virgin rural area or superimposing an industrial development complex around or near an existing small town in a rural area. The second alternative may be the most efficient alternative for the Arkansas River Basin in the near future. This approach would provide a base for a new city to build on in terms of established but underutilized railroads, highways, and communications network facilities.

The long-range planning objective would be to develop a new city on the edge of an existing small town. This would be necessary to prevent the present town from becoming the nucleus of the new city which would then be subject to internal decay as is being experienced in many of our larger cities at the present time. With well-planned early zoning laws, the original town would eventually be reconstructed as a suburb of the new city.

Several existing towns in southeast Kansas could be sited as logical locations or base points in which to build a new city. Three such towns are Arkansas City, Coffeyville and Winfield, each being serviced by three railroads with agency stations and having adequate north-south and east-west highway networks. All three towns are also on or near one of the alternative navigation proposals for extending the Arkansas River navigation project from Port Catoosa (Tulsa) into Kansas.

It is hypothesized that the development of a new city (which will be called "Port Fabs") will reduce outmigration from the area. New job opportunities will be available for former area residents who have been forced to seek employment in the larger cities outside of the area. It is further hypothesized that other city dwellers will be attracted to the area by aesthetics and the improved natural environment. Being located in southeast Kansas, Port Fabs can offer accessability to adequate water-based recreation and clean air and water.

Shorter commuting time means less tension or frayed nerves and a greater amount of leisure time to enjoy the recreational facilities and the total natural environment the area has to offer.

The Specific Problem

The specific problem of this study was to develop a methodological framework to estimate economy income and employment multipliers, water multipliers, and water requirements for a projected level of economic development in southern Kansas in 1980, 1990 and 2000. The results of this study will provide the Kansas Water Resources Board an information network that will enable them to project the need for water of acceptable quality in southern Kansas for the next 30 years. The quantity of good quality water required in future time periods is the basis for Board estimates of future costs of water management projects and programs as decided by the state legislature.

The Corps of Engineers has proposed extending the Arkansas River Navigation project into Kansas. What are the implications of this type of development on the economic structure of the area? Who would benefit from a new source of transportation? How would water transportation affect the industrial mix of the study area? How would changes in the economy affect the demand for water? These are the types of questions that need to be investigated in long-range planning.

Extension of the Arkansas River Navigation project in conjunction with other policy decisions could stimulate the development of a new city in a rural area near the waterway. If this happens, what industries can the area support? What effect would this have on the future labor force? With the present emphasis on rural-urban balance the possibility of creating a new city in the study area is not unrealistic. Prior research in water resources would aid the policy makers in evaluating proposed sites for new cities. This type of evaluation is considered in this study.

A solution is sought in terms of an information network on the economic interrelationships and water requirements of the study area. The unknown of the problem is formulated as the economic structure and processes of the southern Kansas economy. The data are in terms of production requirements and transactions within the area. There are no predetermined or specified conditions to the problem which must be met.

Objectives of the Study

The objectives of this study center around the development of an economic information system to describe the present and projected economic structure and the relationship to water requirements. Application of the model is then applied to a portion of the Arkansas River Basin.

The interindustry approach to data collection and analysis as developed by Emerson was selected for this study [12]. The primary objective of the study is to describe the interindustry structure of a portion of a river basin and to show how this economic information can be used in conjunction with other data to project the future need for water. This requires projecting future conditions expected to prevail in the area which relate to the need for land and water resource development; such as the availability of resources, production, population, employment and income.

The specific objectives of the study are as follows:

1. To develop an input-output model for the study area, based on 1965 data.

2. To develop the technical relationships, including the input-output coefficients, employment output coefficients and water requirements coefficients to describe specified production processes in the study area in the base year 1965.

3. To project final demand, labor productivity, and direct water requirements by sectors for 1980, 1990 and 2000 and to forecast employment, population, income and total water requirements from the projections sited above.

4. To develop a hypothetical city in a strategic site relative to a major waterway and estimate the impact on employment, population, income and water requirements of the study area.

5. To make recommendations to water resources planners working in the study area and in similar areas.

The results of this research will add to the existing knowledge about the interindustry relationship in a subregional economy because of their affect on water usage. The analytical techniques should aid public policy decision makers in assessing the needs for and affects of water resource development programs.

CHAPTER II

DESCRIPTION OF THE STUDY AREA

Geographic Characteristics

In conducting comprehensive economic analysis of a region, it is necessary to have a descriptive background of the physical and economic condition of the area. This information aids in formulating the model, evaluating the results and making recommendations for policy makers.

The study area is located in the heart of the plains states and is usually thought of as being very flat. Most of the land is flat to gently rolling, sloping from west to east. There are many hills and picturesque valleys in the area with some steep slopes along the valley walls. The Kansas Flint Hills, famous for beef cattle production, crosses the east central portion of the area from north to south.

In the eastern half of the area the topography is somewhat erratic but in the western part, the increase in elevation is about 10 to 15 feet per mile. The highest point in the area is just over 4,000 feet at the Colorado border. The lowest point is under 700 feet and is located in the Verdigris stream bed on the Oklahoma border [19, p. 2].

Located in the center of the contiguous 48 states, the area has a continental climate characterized by well-defined seasons with rapid weather changes [19, p. 9]. Weather is affected by the Rocky Mountains to the west and the Gulf of Mexico to the south. The mountains decrease the moisture content of the air from the Pacific Ocean while the Gulf coastal air stream is the major source of the moisture which moves northward across the area.

Average annual precipitation ranges from over 40 inches in the southeastern corner of the area to 16 inches in the extreme western area along the Colorado border.

> Distribution of rainfall through the year is extremely favorable for crop production, since, on an average, about 75 percent of the year's total falls in the crop growing season, April to September [19, p. 10].

Agriculture is the industry affected most by climatic conditions. The differences in rainfall, temperature, and length of growing season are reflected in the type of farming observed in moving from east to west across the study area. A descriptive analysis of the resources will be helpful in describing the structure of the economy.

Water

Supply

Precipitation is the primary source of water in the Kansas portion of the Arkansas River Basin. To this is added the stream flow into the area from adjacent states and the slow movement of a very small amount of water in ground water reservoirs that extend across the state boundary. Almost 99 percent of the gross amount of water available to the basin comes from precipitation which falls upstream within the study area. Of this total, 85 to 90 percent is consumed by evaporation and transpiration from plants. Most of the remainder runs off and enters the tributary network of the Arkansas River. A small portion moves downward through the soil and creates ground water supplies.

Because of higher precipitation, the eastern section of the study area has much more water in streams than does the west while geologic deposits allow greater quantities of water to be stored underground in the western and south central sections. The average annual precipitation produces an even greater variation in surface runoff. The amount of water which finds its way into streams ranges from less than one-tenth of an inch per year in the west to over 10 inches in the southeast. This accounts for the more numerous and larger streams in eastern Kansas and Oklahoma.

Average annual streamflow contributed by streams entering the Arkansas River drainage area in Kansas is approximately 0.2 million acre feet (MAF). The maximum annual inflow was 1.5 MAF in 1951 and the minimum annual inflow was 0.1 MAF in 1956 [19, p. 53].

Average annual outflow from the study area is 5.1 MAF. The extremes were 16.2 MAF in 1951 and 0.9 in 1956. On the average, 4.9 MAF of runoff are generated within the study area.

Development

Because of the wide variation in the amount of surface runoff, it is necessary to provide storage in reservoirs to assure an adequate annual supply for the people and industry within the area. The few natural lakes in Kansas are very small. Most are sink holes which were formed by collapse of the underlying geologic structures. A few lakes have been created on the floodplain of major rivers when the stream changed its channel and left an oxbow lake behind. The largest natural lake in the area has a surface area of about 130 acres and a maximum depth of less than 10 feet.

The largest lakes in the study area are the man-made impoundments formed behind dams built by the U.S. Corps of Engineers and U.S. Bureau of Reclamation. These reservoirs store water for flood protection, irrigation, municipal and industrial water supply and other uses. The size, number and distribution of federal reservoirs have added a new element to outdoor recreation (Figure 1).

The boom in federal reservoir construction in the study area is of recent origin. As of 1957, only six federal reservoirs had been completed in the state. Only one of these, Fall River Reservoir, was located in the Arkansas River drainage basin. Since 1957, five additional major reservoirs have been completed in the study area. In addition, seven more have been authorized and others are currently under study.

Different facilities for water storage, such as mill dams, channel dams, and farm ponds, have been constructed. Cities needing more stable water supplies, have constructed water supply reservoirs so there are now a multitude of small lakes and ponds in the state. In addition to the local government and water district reservoirs in the study area, several State Fish and Game Lakes have been constructed averaging from 50 to 100 acres in surface area and from 500 to 2,000 acre-feet of storage. Approximately 215 reservoirs have also been constructed in the area by watershed districts in cooperation with the U.S. Soil Conservation Service. The primary purpose of these flood retarding structures is to provide upstream flood control of the agricultural valleys.

Recreation

Americans continue to turn to the outdoors for recreation, relaxation and rewarding use of leisure time [48, p. 4-6-1]. About one-fourth of all outdoor recreation will continue to be dependent on various types of water and related land resources. Small watershed structures provide unlimited potential for water-based recreation in the central and eastern parts of the study area. The main problem is providing accessability to the people who wish to use these facilities. The need for good water-based recreational facilities is going to continue to increase. Persons working in water resource planning and development should be constantly aware of the demands and potential for development in the area. This information should be passed on to the policy decision makers so that systematic development can keep pace with the increasing demand.

Water Quality

Abundant supplies of clean water are necessary to support our way of life. Clean, safe water is necessary for drinking, bathing, swimming, fishing, water skiing, etc. Water used for irrigation cannot be too salty and should be reasonably free of disease-causing organisms. Quality requirements for industrial cooling water are generally not very stringent but some industrial processes require water of a higher quality than is necessary for drinking water. Almost all water uses have desirable or minimum quality requirements below which the water has reduced or little economic value [20, p. 7].

As the industrial sector increases output to meet the demands of a growing market, new construction and expansion of existing facilities will require more water to support the growth in production. "The new water demand will be met in part by increased withdrawals, but in larger part by improved methods of water management" [48, p. 4-2-3]. Water withdrawals are a function of the recirculation rate which in turn is influenced by the availability of water, water quality requirements, water costs, and water treatment costs [48, p. 4-2-4]. The quantity of water recycled for industrial use in the study area is expected to increase. This will result primarily from efforts to maintain higher water quality standards than from inadequate water supplies or the cost of fresh water withdrawals.

A discussion of water quality control as it relates to planning would be incomplete without mentioning the problem of sedimentation. "By far the greatest quantity of pollutants in surface water is the sediment produced by erosion of the land" [2, p. 5]. The increasing emphasis on <u>environmental quality</u> often underestimates or completely omits the sediment problem.

> ...Industrialization with its rapidly increasing coating of our land with concrete streets, highways, airports, and business districts, and the scraping of cover from suburban lands for sub-divisions result in more runoff, faster runoff, and subsequently higher levels of sediment in our streams, lakes, and man-made ponds and reservoirs [2, p. 9].

Planning aspects relating to water quality control should receive an additional amount of attention as the economy expands and water requirements are increased. The proper time to control water pollution and maintain water quality standards is when new industries locate in an area and existing firms expand their physical facilities. Municipalities should plan for adequate sewage and waste treatment facilities to accommodate future economic development.

Economic and Social Characteristics

General

Before examining the current structure of the study area economy, it will be useful to outline some of the major changes that have resulted from differential growth rates in Kansas. Total Kansas personal income increased by 252 percent from 1950 to 1967 (Table I). This was below the national increase of 276 percent but above the plains states' average increase of 239 percent for the same period.

Employment expanded from 721,000 in 1950 to 836,000 in 1967. During the past decade, except for 1966 and 1967, the state experienced net outmigration. This means that the natural increase in population was greater than the actual increase.

Growth, decline and instability have characterized individual industries within the state and study area. Aerospace, located in the Wichita area, has been the most unstable industry in the state. Employment decreased from 48,000 in 1957 to 30,000 in 1961 to 27,000 in 1963. Then it increased over 40,000 in 1967 only to decrease again in 1968.

Despite the gyrations in the areospace industry, durable goods manufacturing has been expanding with the result that total manufacturing activity in the state has increased. Non-durable goods manufacturing, however, has been declining. These decreases have been primarily in the food processing sector, an historically important industry to the Kansas economy. Employment in food processing decreased by more than 17 percent from 1958 to 1968. Less than one half as many persons are engaged in farming at the present time as 20 years ago.

TABLE I

PERSONAL INCOME DATA FOR KANSAS, THE PLAINS STATES, AND THE UNITED STATES, 1950-1967

Years	Kansas	Plains	United States	Percent Change In Total Personal Income			Kansas As A Percent Of	
				Kansas	Plains	United States	U.S. Total Personal Income	Plains Total Personal Income
	(Millions of Dollars)							
1950	2,765	20,135	226,214	--	--	--	1.2	13.7
1951	3,077	21,912	253,233	11.3	8.8	12.0	1.2	14.0
1952	3,524	23,016	269,767	14.5	5.0	6.5	1.3	15.3
1953	3,434	23,435	285,458	-2.6	1.8	6.2	1.2	14.6
1954	3,597	24,233	287,613	4.7	3.4	0.7	1.2	14.8
1955	3,626	24,763	308,265	0.8	2.2	7.2	1.2	14.6
1956	3,804	26,075	330,481	4.9	5.3	7.2	1.1	14.6
1957	4,006	27,859	348,426	5.3	6.8	5.4	1.1	14.4
1958	4,441	29,543	358,474	10.8	6.0	2.9	1.2	15.0
1959	4,483	30,235	380,963	0.9	2.3	6.3	1.2	14.8
1960	4,712	31,871	398,725	5.1	5.4	4.7	1.2	14.8
1961	4,941	32,924	414,411	4.8	3.3	3.9	1.2	15.0
1962	5,177	35,002	440,192	4.8	6.3	6.2	1.2	14.8
1963	5,319	36,374	463,053	2.7	3.9	5.2	1.1	14.6
1964	5,572	37,958	494,913	4.7	4.3	6.8	1.1	14.7
1965	6,001	41,844	534,816	7.7	10.2	8.1	1.1	14.3
1966	6,561	45,355	580,483	8.5	8.4	8.5	1.1	14.4
1967	6,961	48,213	625,068	6.1	6.3	7.8	1.1	14.4

Source: Survey of Current Business, August, 1968, Office of Business Economics, U.S. Department of Commerce.

Between 1958 and 1968, farm employment declined by more than 37 percent.

As a result of widely varying industry growth rates, the structure of the Kansas economy has undergone substantial change. In 1958, over 17 percent of the state's employment was in farming; this ratio dropped to 10 percent by 1968. Manufacturing's share of total employment increased slightly from 15 to 17 percent during the same ten year period. Employment in services accounted for eight percent of total employment in 1958 and 11 percent in 1968. Government employment increased from 13 percent in 1958 to 18 percent in 1968.

An interesting comparative picture of the industries in southern Kansas was developed from data compiled in a U.S. Department of Commerce study (Table II) [42]. In addition to summarizing industry employment for 1950 and 1960, these data indicate the expansion of each industry if it had grown at the national average (national growth), if it had grown at the same rate that particular industry had grown nationally (industrial mix), and the extent to which the industry grew faster or slower than did the industry nationally (regional share). The net result of the table shows that southern Kansas industries grew more rapidly than those industries nationally, but the area had a high proportion of slow growth industries and, hence, had a slower overall growth rate than the nation.

Human Resources

Population characteristics are one indication of the transition a region has made through the various stages of economic development. The population declined from 1930 to 1940 but has increased slightly each

TABLE II

EMPLOYMENT AND COMPONENTS OF EMPLOYMENT CHANGE, SOUTHERN KANSAS, 1950-1960

Industry	Employment In		Components of Employment Change			
			Changes Related To			Total Change
	1950	1960	National Growth	Industrial Mix	Regional Share	
Agriculture	75,081	48,768	11,623	-40,504	2,568	-26,313
Forestry and Fisheries	60	55	9	-25	11	-5
Mining	10,791	11,238	1,670	-4,879	3,656	447
Contract Construction	25,776	22,553	3,990	-1,316	-5,897	-3,223
Food and Kindred Products	8,997	10,623	1,393	1,206	-973	1,626
Textile Mill Products	107	78	16	-41	-4	-29
Apparel	1,111	1,830	172	-72	619	719
Lumber, Wood Products, Furniture	1,018	789	158	-263	-124	-229
Printing and Publishing	4,077	5,429	631	732	-11	1,352
Chemicals and Allied Products	2,146	2,761	332	336	-53	615
Electrical and Other Machinery	3,886	6,803	602	1,209	1,106	2,917
Motor Vehicles and Equipment	454	621	70	-85	182	167
Other Transportation Equipment	12,914	33,742	1,999	11,214	7,615	20,828
Other and Miscellaneous	12,828	13,688	1,986	419	-1,545	860
Railroads and Railway Express	13,749	8,795	2,128	-6,554	-528	-4,954
Trucking and Warehousing	4,290	6,029	664	611	464	1,739
Other Transportation	3,102	3,191	480	-395	4	89
Communications	4,562	4,832	706	-1	-435	270
Utilities and Sanitary Service	6,154	7,307	953	-64	264	1,153
Wholesale Trade	12,661	13,337	1,960	-483	-801	676
Food and Dairy Product Stores	9,998	10,274	1,548	-1,746	474	276
Eating and Drinking Places	10,622	11,837	1,644	-961	532	1,215
Other Retail Trade	37,303	42,658	5,775	714	-1,134	5,355
Finance, Insurance and Real Estate	9,757	13,328	1,510	2,421	-360	3,571
Hotels and Other Personal Services	10,904	11,625	1,688	-1,220	253	721
Private Households	7,256	9,741	1,123	104	1,260	2,487
Business and Repair Services	8,807	8,555	1,363	632	-2,247	-252
Entertainment, Recreation Services	3,025	2,519	468	-418	-556	-506
Medical, Other Professional Services	29,593	50,046	4,581	12,572	3,300	20,453
Public Administration	12,019	15,792	1,861	1,430	482	3,773
Armed Forces	301	4,364	47	161	3,855	4,063
Industry Not Reported	6,748	11,301	1,045	13,097	-9,589	4,553
Total	350,097	393,509	54,195	-12,169	2,388	44,414

Source: U.S. Department of Commerce, Office of Business Economics, Growth Patterns in Employment by County 1940-1950 and 1950-1960, Volume 4 Plains, pp. 174-208.

decade since. The estimated total population for 1968 was 1,076,155 inhabitants.

Urban population in the study area increased during each ten year period since 1930. The proportion of the population classified as urban has also increased steadily. In 1930, 40.8 percent of the total inhabitants lived in cities or towns of 2,500 persons or more. By 1960, 62.1 percent of the population was classified as urban.

The rural population decreased steadily from 548,816 in 1930 to 401,031 in 1960. The rural farm population decreased from 326,642 in 1930 to 150,347 in 1960. During this same period, the rural non-farm population increased from 222,174 in 1930 to 250,684 in 1960.

Employment

Increased employment is necessary to sustain economic growth and development within an area. The type of employment as well as the number of jobs available influences the structure as well as the magnitude of the present and future population of the area. Individuals establish family and social ties as well as economic ties in their respective communities. They are reluctant to move from an area when employment is no longer available. This is especially true of older people and is one factor contributing to the "poverty pockets" in rural areas.

The economy of the area is predominantly based on agricultural production with the exception of the Wichita-Newton-Hutchinson industrial area. However, agricultural employment accounted for only 31 percent of total employment in 1940, 22 percent in 1950, and 13 percent in 1960 (Table III). Agricultural employment does not include employees

TABLE III

EMPLOYMENT AND PERCENTAGE CHANGE IN EMPLOYMENT BY INDUSTRY, SOUTHERN KANSAS, 1940, 1950 AND 1960

Industry	Employment			Change	
	1940	1950	1960	1940–1950	1950–1960
	(Number)	(Number)	(Number)	(Pct.)	(Pct.)
Agriculture	86,118	75,141	48,823	-12.7	-35.0
Agriculture	86,022	75,081	48,768	-12.7	-35.0
Forestry and Fisheries	96	60	55	-37.5	-8.3
Manufacturing	24,619	47,538	75,364	93.1	58.5
Food and Kindred Products	7,152	8,997	10,623	25.8	18.1
Textile Mill Products	49	107	78	118.4	-27.1
Apparel	532	1,111	1,830	108.8	64.7
Lumber, Wood Products, Furniture	725	1,018	789	40.4	-22.5
Printing and Publishing	3,419	4,077	5,429	19.3	33.2
Chemicals and Allied Products	1,202	2,146	2,761	78.5	28.7
Electrical and Other Machinery	1,547	3,886	6,803	151.2	75.1
Motor Vehicles and Equipment	181	454	621	150.8	36.8
Other Transportation Equipment	1,589	12,914	32,742	712.7	153.5
Other and Miscellaneous	8,223	12,828	13,688	56.0	6.7
Other Commodity Producing	24,220	36,868	38,155	53.1	4.5
Mining	12,204	10,791	11,238	-11.6	4.1
Contract Construction	12,016	25,776	22,553	114.5	-12.5
Armed Forces	0	301	4,364		1349.8
Distributive	75,481	102,441	108,260	35.7	5.7
Railroads and Railway Express	11,019	13,749	8,795	24.8	-36.0
Trucking and Warehousing	3,476	4,290	6,029	23.4	40.5
Other Transportation	2,261	3,102	3,191	37.2	2.9
Communications	2,796	4,562	4,832	63.2	5.9
Utilities and Sanitary Service	3,700	6,154	7,307	66.3	18.7
Wholesale Trade	9,714	12,661	13,337	30.3	5.3
Food and Dairy Product Stores	9,409	9,998	10,274	6.3	2.8
Eating and Drinking Places	6,839	10,622	11,837	55.3	11.4
Other Retail Trade	26,267	37,303	42,658	42.0	14.4
Service	70,074	81,361	111,606	16.1	37.2
Finance, Insurance and Real Estate	7,871	9,757	13,328	24.0	36.6
Hotels and Other Personal Services	10,729	10,904	11,625	1.6	6.6
Private Households	10,572	7,256	9,741	-31.4	34.3
Business and Repair Services	6,640	8,807	8,555	32.6	-2.9
Entertainment, Recreation Services	2,356	3,025	2,519	28.4	-16.7
Medical, Other Professional Services	23,393	29,593	50,046	26.5	69.1
Public Administration	8,513	12,019	15,792	41.2	31.4
Industry Not Reported	3,912	6,748	11,301	72.5	67.5
Total	284,424	350,097	393,409	23.1	12.4

Source: U.S. Department of Commerce, Office of Business Economics, Growth Patterns in Employment by County 1940-1950 and 1950-1960, pp. 174-208.

of agricultural supporting firms; they are classified as manufacturing, distributive or service industries.

Total employment increased in the study area between 1940 and 1950 and again between 1950 amd 1960. However, this increase was slightly below the national level for both time periods. Most of the increased employment has been in the Wichita industrial area where Sedgwick County employment has increased at nearly twice the national rate.

Agricultural employment in the study area has decreased at a slower rate than national agricultural employment. This can partially be attributed to the irrigation development in the western part of the study area and partially to off-farm work available to underemployed farmers near growing industrial centers.

Employment in the non-agricultural sectors within the study area did not increase proportionately to the national average for the same sectors. The average annual rate of increase in manufacturing employment within the study area was over twice the increase in manufacturing employment for the nation as a whole between 1940 and 1960. The increase in employment in the service sector of the study area was considerably below the national average between 1940 and 1950, but it was slightly higher between 1950 and 1960.

The general area of employment in which the study area has lagged (compared to the national average) has been the distributive sector. This has resulted from a slower rate of employment increase in the fields of communications, transportation and wholesaling within the study area.

Income

Per capita income in the study area was $1,753 in 1959 compared to $1,850 for the U.S. Median family income was also slightly below that for the U.S. The percent of families with income under $3,000 was only slightly higher for the study area than the U.S. This indicates the study area is only slightly below the U.S. with respect to money income. Per capita income in the study area increased to $2,430 in 1965.

People spend a large portion of their income for goods and services. The percent of these goods and services purchased within the local economy is directly related to the size of the study area. Each dollar of new money injected into the economy will induce additional spending, thus creating more jobs and increasing the level of income. New money is generated from the primary or basic industries such as agriculture, mining and manufacturing. Therefore, the total income of the area is related to the dollar output of these primary industries.

The Industrial Base

Agriculture is one of the major industries in southern Kansas. Cash crops are a major source of direct farm income and wheat is the major crop. Feed crops are also important to farm income as they are inputs to the livestock sector. Livestock and livestock products are of major economic importance in the study area. Over 60 percent of the cash receipts from farm marketings are contributed by the livestock sector. Beef cattle production, the dominant livestock enterprise within the study area, is expected to increase relative to other livestock enterprises in the future.

Value of mineral production in Kansas reached a record high in 1965 [16]. The principal minerals produced in order of value were petroleum, natural gas, helium, natural gas liquids and cement. Mineral fuels and related products comprised 86 percent of the total value, non-metals 13 percent and metals one percent [43].

Mineral resources provide the base for much of the interindustry activity in southern Kansas. The value of mineral production in 1965 totaled 405 million dollars. Over 70 percent of all minerals produced in Kansas in 1965 were produced in the study area.

Crude petroleum and natural gas are mined throughout the area with the western portion producing large quantities of natural gas. Most of the coal production is found in the eastern portion of the study area where six counties have pit mining operations in progress. A significant part of the mineral output is processed by Oklahoma industries into semi-finished and finished products for intra- and inter-state shipment and consumption.

Agricultural and mineral resources provide the primary inputs to the manufacturing sector. The majority of the industrial activity in southern Kansas centers around processing agricultural and mineral products.

Wichita is the industrial hub of the study area. Manufacturing tends to center around large urban centers taking advantage of transportation and distribution facilities, public utilities, labor supply and supporting service-type businesses located in a metropolitan center. The development of the Wichita area has contributed to small manufacturing plants locating in the surrounding vicinity. These include Emporia, Newton, Hutchinson and Hesston.

The government sector has assumed an increasingly important role in the southern Kansas economy. Federal farm programs have become an important source of income to farmers in the area. The extensive water resources development programs in both upstreams flood protection and controlling the flows of the major rivers have been federally sponsored.

Expenditures of the state and local governments are primarily concentrated in the areas of education, highway construction and public welfare. The trade sector (retail and wholesale outlets) is the largest private service sector. Sales of food stores are distributed according to population density. The activities of the remaining service type sectors tend to concentrate around the population centers. These include the transportation, communications and utilities, finance, insurance and real estate and the service sector. The service sector includes such business activities as auto repair, lodging, medical and health, business services and personal services. In this study, education is included in the service sector although in general it is a government financed enterprise.

Summary

Economic activity determines the level of population, employment and income present in the study area. It also determines the degree of governmental involvement and influences the quality of education, recreational facilities and other services available to the people.

Geographic conditions determine the agricultural practices that can be supported throughout the study area. The principal agricultural enterprises are the production of beef cattle and wheat. The area has large reserves of oil and natural gas. Raw materials from the agricultural and mining sectors provide the base for much of the economic activity of the area. Large quantities of resources from these sectors are processed in the manufacturing plants found mainly around the Wichita metropolitan complex. These plants demand goods and services from the service-type industries. Therefore, the importance of the agricultural and mining sectors is exemplified by the amount of economic activity created by the products from these primary sectors.

Descriptive information in this chapter will aid in formulating an input-output model for the study area. The empirical results of the model and forecasting performed in later chapters will be interpreted in light of the above information.

CHAPTER III

THE ANALYTICAL MODEL

Development of Input-Output Models

Regional economics investigates the interrelationships between owners of resources, producers of goods and services and consumers of finished products. Techniques employed in regional studies are designed to focus on the interactions between multiple decision units where a multiple decision unit reflects the collective responses of single decision units displaying similar productive and consumption patterns. Input-output analysis is the technique that has been selected to measure the interrelationships of the industrial sectors in the economy for this study.

An input-output model divides the economy into a number of industries or sectors and establishes the magnitude of the flows of products and services between these industries. These flows represent an industry's purchases from and sales to other industries, individuals, or government.

Three tables are basic to an input-output model: (1) the flow or transactions table, (2) the technical coefficients or direct requirements matrix and (3) the direct and indirect requirements or interdependence coefficients matrix. The flow table is the base of the model with the technical and interdependence coefficients derived directly from it.

The basic elements of input-output were conceived in the mid 1870's in Francois Quesnay's Tableau Economique [31]. The original tableau [29] emphasized the economic interdependence of intrafirm activities. Quesnay later published a modified version of his tableau [14] stressing the inter-workings of the economy of France in the form of circular flows.

The input-output technique remained dormant until it was revitalized by Leontief in the 1930's. Leontief refined the methodology in his analysis of the United States economy for 1919, 1929, and 1939 [25]. The 1939 model contained a more detailed transactions table and was used to analyze problems of economic adjustment following World War II [26].

The adaptation and design of input-output techniques for use in regional studies received a great deal of attention in the 1950's and 1960's. In the past two decades, substantial sophistication and expansion of the input-output technique has increased its usefulness for regional analyses, as evidenced by comprehensive bibliographies published on input-output research [4 and 34]. Therefore, the theoretical development will be omitted.

A fundamental problem in regional analysis has been the development of a model that adequately describes the economy of a sub-national region. The basic difference between a national and regional model centers around the concept of balance. The distribution of products in a national framework is only restricted by national production. National output and distribution are balanced within the national market with the exception of the foreign trade sector. In a regional model production and distribution of output are not required to balance within the region. In fact, total regional requirements for any sector or industry are rarely satisfied from regional production. Imports from outside the region are required when regional production is insufficient to meet regional demands. The source of satisfaction of regional demands is a problem of specification and must be delineated to achieve a balanced regional model.

Moore and Peterson conducted an input-output study for the state of Utah to explore the conceptual and empirical problems that arise when studying regional behavioral patterns [30]. The Utah model was constructed to account for relationships between Utah and the rest of the world as well as the intra-Utah economic interactions. Explicit account was made between goods produced within the state and goods imported to satisfy local demand. Structural relationships between Utah industrial output and inputs were designed to reflect unique regional production patterns. This was accomplished by adjusting the national coefficients to more accurately reflect the Utah economy.

Tables of direct requirements and direct and indirect requirements were computed from the Utah transactions table to reflect the inputs necessary to produce a unit of final demand for Utah industries. Output, income and employment multipliers were derived to indicate the impact on the Utah economy for changes in national demand and changes in Utah demand for goods and services.

A modified Leontief input-output model was used to develop the inter-industry model for Kansas [12]. The concepts set forth in the Utah study were used to adjust the Kansas model for the southern one-half of the state.

Data Requirements

A substantial number of observations are necessary to satisfy the data requirements of an input-output study. The number of data cells increases exponentially as the matrix is expanded. In addition, each data cell represents a summary of a few to several thousand data items. This enormous data appetite has created a variety of approaches that have been used in implementing regional input-output studies. Before presenting the methodology used in the southern Kansas study it will be useful to briefly examine the varied technique that has been set forth in regional analyses to understand the similarities and differences involved.

Regional input-output studies can be categorized as either (1) primary data studies or (2) secondary data studies. Primary data studies require survey data that are collected from individual firms and households within the region specifically for the development of an input-output matrix. A sampling procedure is designed for each industry to be surveyed. Primary data studies are generally considered to possess a higher degree of accuracy than secondary data studies. They are also much more costly in terms of data collection. The degree of accuracy is directly related to the quantity and quality of data collected.

Double entry bookkeeping techniques allows short cuts to be utilized in data collection. Any number in the transactions table represents both a sale from the producing sector and a purchase by a producing or consuming sector. An adequate index of economic activity may be compiled by gathering either sales or purchase data rather than both. When an input-output matrix is constructed using only sales data, it is referred to as a rows only technique. On the other hand, if only purchase data are collected, a columns only technique is employed. In practice some combination of the two are required to fulfill the data requirement of an input-output matrix.

Several techniques employing secondary data sources have been utilized in constructing regional input-output tables. The use of national coefficients to approximate regional interdependence has been used in many studies. Often times, the national coefficients are adjusted to the region under study. The adjustment process varies but the approach set forth by Moore and Peterson has been used extensively in constructing regional tables based on national coefficients.

> Location quotients, the Leontief-Stroud approach, and the production versus requirements approach have all been attempts at constructing regional input-output tables from secondary data. More secondary data studies than primary data ones have been undertaken because of their low cost. However, their validity remains unsubstantiated [12, p. 168].

The Kansas Model

A general description of the Kansas model will be given as background material as it is the basis of the model developed for the study area. The number of sectors included in the state model was limited by financial resources and the necessity to avoid disclosure of individual firm characteristics. The problem of disclosure is inversely related with the size of the study area.

"The Kansas economy was divided into 69 processing sectors, eight final demand sectors, and six final payments sectors" [12, p. 51]. The standard industrial classification was adopted for all industries except agriculture and maintenance and repair construction. Maintenance and repair construction was included as a "dummy" industry to separate current expenditures from capital expenditures in the construction industry. Farm sectors were classified on the basis of individual crop and livestock enterprises. Output of individual farms was allocated to the various crop and livestock sectors whereas the remaining industries were classified on an establishment bases (all of a firm's output is assigned to the sector of primary output).

The Kansas model is basically a primary data input-output study. Retail trade was the only sector that did not rely on survey data to some extent. A sampling procedure was designed to stratify firms by size and Standard Industrial Classification subsectors. An attempt was made to include all of the large firms in the sample. For example, all manufacturing firms employing over 25 persons, and accounting for 90 percent of total manufacturing output, were included in the sample survey.

Sales and purchases data were both obtained from firm interviews. Adjustments were needed to reconcile the differences that resulted from construction of matrices based on sales and purchases data. These differences were attributed to: (1) sampling errors, (2) variable response rates, and (3) differences in accounting periods [12, p. 169]. Data gathered and compiled by various state and federal agencies were used to supplement the samples and to check the accuracy of the information obtained by personal interviews. Output by sector was originally computed from published sources and adjusted on the basis of the survey data.

The Southern Kansas Model

The southern Kansas input-output model is designed to aid water resources planners in estimating the need for future water requirements necessary to meet projected levels of economic development. As resources were not available to collect primary data, it was necessary to use a secondary data approach. A starting point for constructing the southern Kansas transactions table consisted of adopting the scheme employed in the 1965 Kansas interindustry model. The Kansas model scheme is particularly appropriate in that it includes the study area and it is based on the standard industrial classification system. Many current information reporting systems are based on the standard industrial classification which will permit revision of the model as new data become available. It is also useful in that many other regional studies are based on the same classification which allows comparisons between studies to be made. The coefficients of the regional models can be compared with and adjusted from the national coefficients when appropriate.

A review of secondary data sources on output, employment and water requirements by industry resulted in aggregating the Kansas model into 13 intermediate processing sectors (Appendix A, Table XXIII). All of the endogenous sectors in the southern Kansas model were considered as endogenous sectors in the Kansas model with the exception of local government. Local government was considered endogenous in the southern Kansas model as the level of local government activity in the area is functionally related to other economic activity within the area. There are no definite guidelines as to what industries should be included in the endogenous sectors and which should be considered as exogenous sectors. This will depend upon the study and the individual researcher. In general, any sector that is highly dependent upon the activities of the other sectors is considered to be an endogenous sector for estimating the structural relationships within an economy.

Data Sources

As stated previously, one of the major problems in applying the input-output technique to regional economies is the acquisition and classification of appropriate data to accurately describe regional production patterns. Considering the alternatives available, the adoption of the Kansas model was deemed the most appropriate for the study area. The other alternatives would have been to apply the national coefficients directly or use some adjustment process to reflect differences between the national production pattern and those found in the study area.

The southern Kansas input-output model is estimated by applying the Moore-Peterson [30] adjustment process to the Kansas model. The transactions table was estimated indirectly by first estimating the direct requirement coefficients table. The procedure used was to first aggregate the state transactions table to the appropriate sectors desired in the regional model. Control totals of output by sector for the region were then applied to the direct requirements coefficients table to derive the transactions table for the study area.

The transactions table for the study area was then adjusted by estimating final demand for the study area independently of the transactions table estimate. These estimates were made for exports and all other final demand. If the new estimate of final demand was greater than the corresponding figure in the unadjusted regional model, it was assumed that sector was importing from the area in Kansas outside the study area. The model was balanced by reducing each number across the row by a fixed proportion. On the other hand if the estimated final demand was less than the figure in the unadjusted transactions table, it was assumed that sector was exporting to the northern part of the state. The model was then balanced by increasing exports by the required amount.

Control totals of gross output by sector were estimated from secondary data sources. For the agricultural sectors, the control totals were estimated from the Kansas Farm Facts [18]. Several sources of data were used to estimate the total output of the other sectors. To check the distribution of state output by sector between the northern and southern part of the state employment ratios were used to estimate the output for each area. Any differences between the level of output from the two procedures had to be reconciled. Some minor adjustments had to be made for time differences in published data.

The transactions table provides the basis for deriving the direct requirements coefficients table. The direct requirements table establishes the input structure required to produce one unit of output for each intermediate processing sector in the area. The direct and indirect requirements coefficients table which is computed directly from the direct requirements table, indicates the total inputs required by an intermediate processing (endogenous) sector to provide one unit of delivery to the final demand sectors.

Regional multipliers can be computed from the direct and indirect requirements table. Output, income and employment multipliers are computed with different combinations of sectors considered endogenous to the model. Twelve sectors (Table IX) are considered endogenous in all combinations within the model. Multipliers are computed for the twelve sectors (Model I). Model II computes the multipliers with local government endogenous to the model. Model III introduces households into the endogenous portion of the model. Data requirements necessary for calculating output and income multipliers are contained within the model. Calculations of employment multipliers require estimates of output employment ratios for each intermediate sector in the model. In this study, it was assumed the Kansas output employment ratios were representative of the study area.

The water multiplier as computed from the input-output model is defined as the change in total water requirements as a result of a one unit change in water usage in a particular sector. Water requirements are based on gallons of water required per dollar's worth of output.

The basic assumption in computing the water multipliers is that there is a linear relationship between water used and output in a sector. A change in output creates both direct and indirect effects on water requirements in a particular sector. The direct and indirect water requirements are computed by considering the repercussions on water usage in all sectors as a result of an initial change in final demand in one sector. The Type I water multiplier was calculated by dividing the direct and indirect water effects by the direct water requirements. Type II water multipliers include the induced effects of additional rounds of spending by households.

Two water requirement categories are included in the model -- withdrawal uses that remove water from its natural course and instream uses that do not. Hydroelectric power, which represents the direct water requirement for the transportation, communication and utilities sector is considered to be an instream water requirement. Water requirements for the remaining sectors are in the withdrawal water category.

It is desirable to know the interrelationship between the economic structure of the area and total water requirements for some purposes. The relationship between the economic structure of the area and water withdrawals is also important. This relationship is of special significance when analyzing the impact on water requirements for a change in output if the electrical input is imported from outside the area. Two categories of water requirements and water multipliers were estimated -- one considering instream water requirements and water withdrawals, the second considering only water withdrawals.

Irrigation water for crop production was not included in the model. Requirements from the crop sector can be met from either dryland or irrigated cropland production. Water requirements for irrigation were not assumed to have the same degree of interdependence in the economy as water requirements in other sectors as total crop production in the area could be produced from dryland farming operations.

This chapter has described the analytical model and data requirements necessary to analyze the interrelationships in the Kansas portion of the Arkansas River Basin economy. The empirical results of the 1965 base year model are presented in Chapter IV. The conventional input-output interrelationships and multipliers are computed for output, income and employment. However, the major emphasis is placed on developing the interrelationships between the economic structure of the area and water requirements. This included the calculations for water multipliers and the relationship between water requirements and man-years of employment in the area.

Chapter V utilizes the 1965 basic model to develop a forecasting model for long-range planning. This requires projecting final demand, output per man-year of labor, population-employment ratios, and water requirements for future time periods. Since consumer expenditures are expected to change over time a 1980 household consumption function was projected and held constant for 1990 and 2000. These projections in conjunction with the input-output model were used to forecast output, income, employment, population, and water requirements for the years 1980, 1990 and 2000.

Chapter VI applies the empirical results of the model using 1980 projections to estimate the economic impact of developing a new city in the Arkansas River Basin. The 1980 interrelationships are used to estimate the increase in output, income, employment, population, and water requirements that would occur in 1980 as a result of developing a new city based on 9 new industries employing 5,800 persons for delivery to final demand.

CHAPTER IV

EMPIRICAL RESULTS

The Southern Kansas Input-Output Tables

This chapter presents an empirical description and interpretation of the input-output tables and multipliers constructed for the study area. The transactions table is the base for any input-output study. The direct requirements coefficients table and the direct and indirect requirements coefficients table are derived directly from the transaction table.

The Transactions Table

The transactions table (Table IV) describes the flows of goods and services of producers and consumers in the study area. This table presents the dispersion of each sector's output among the intermediate purchasing sectors and the final demand sectors. Row entries indicate the dollar amount of product the producing sector (shown at the left hand side of the table) sells to the purchasing sector (shown in the column). The entries in each column of the transactions table represent the input structure of the individual producing and consuming sectors.

A verbal explanation of sector five, agricultural processing, will be used to further illustrate the transactions table. Reading across row five, agricultural processing sold $329,000 of product to the crops

TABLE IV

TRANSACTIONS TABLE, SOUTHERN KANSAS, 1965

Producing Sector	Purchasing Sector																		
	Crops	Livestock	Mining	Construction	Agri. Processing	Chemicals	Metal, Mach., Equip.	Other Mfg.	Trans., Comm., Util.	Trade	F.I.R.E.	Services	Local Govt.	Intermediate Totals	Households	Other Final Demand	Exports	Total Final Demand	Total Output
	(Thousands of Dollars)																		
1. Crops	15,071	127,600	—	—	84,921	20	2	606	—	303	—	—	—	228,523	3,050	93,901	71,075	168,026	396,549
2. Livestock	—	70,175	—	—	220,374	—	—	—	—	160	—	—	—	290,709	3,126	4,108	137,385	144,619	435,328
3. Mining	—	—	65,582	2,731	—	111,451	1	2,338	12,152	83	—	50	—	194,388	—	—	276,938	276,938	471,326
4. Construction	2,369	1,594	3,373	151,708	1,145	242	3,729	3,126	8,193	4,928	3,239	15,529	8,489	207,664	23,504	207,172	28,820	259,496	467,160
5. Agri. Processing	329	47,416	—	—	33,594	2,001	—	—	3	8,408	6,390	4,962	362	103,465	95,253	27,276	359,516	482,045	585,510
6. Chemicals	14,017	5,626	9,103	8,353	1,284	10,201	5,750	819	3,851	3,758	3,337	3,030	2,984	72,113	76,052	102,828	272,875	451,755	523,868
7. Metal, Mach., Equip.	4,381	832	7,393	15,606	5	822	24,308	2,872	2,985	305	7,773	3,144	564	70,990	1,693	293,878	478,018	773,589	844,579
8. Other Mfg.	1,092	—	4,339	19,500	4,924	2,349	3,495	6,779	3,513	7,849	12,254	7,292	6,677	80,063	19,450	8,611	124,679	152,740	232,803
9. Trans., Comm., Util.	6,007	2,349	8,136	5,493	8,416	16,332	17,937	6,285	49,521	25,788	11,929	24,541	6,809	189,543	91,265	16,884	105,992	214,141	403,684
10. Trade	23,275	16,043	13,837	7,318	23,595	4,404	8,697	2,626	4,526	48,135	4,039	17,435	4,955	178,885	262,846	27,764	47,754	338,364	517,249
11. F.I.R.E.	6,768	768	51,518	2,477	4,168	4,345	3,169	1,744	3,561	8,828	14,122	9,461	14,838	125,767	195,028	17,770	54,289	267,087	392,854
12. Services	19,062	11,350	5,352	7,030	1,746	542	2,258	1,072	7,079	24,914	11,777	25,167	119,698	237,047	231,490	133,813	22,802	388,105	625,152
13. Local Government	8,009	3,265	628	3,557	782	1,602	2,500	834	8,892	3,487	2,855	3,185	31,511	71,107	153,530	65,049	368	218,947	290,054
Intermediate Totals	100,380	287,018	169,261	223,773	384,954	154,311	71,846	29,101	104,276	136,946	77,715	113,796	196,887	2,050,264					
14. Households	185,086	72,215	57,214	88,670	59,335	53,336	298,741	68,084	137,316	244,183	200,833	362,444	64,570		182,570	250,421	260,451	693,442	2,585,469
15. Other Exogenous	49,510	21,852	178,699	33,090	20,647	131,941	84,169	19,978	95,338	63,818	50,711	65,303	2,589		604,932				
16. Imports	61,573	54,243	66,152	121,627	120,574	184,280	389,823	115,640	66,754	72,302	63,595	83,609	26,008		641,680				
Total	396,549	435,328	471,326	467,160	585,510	523,868	844,579	232,803	403,684	517,249	392,854	625,152	290,054		2,585,469				

sector and $47,416,000 of product to the livestock and livestock products sector. Agricultural processing did not make any direct sales to mining or construction. Due to specialization among firms within the sector, $33,594,000 of product was sold to other firms in the agricultural processing sector. The agricultural processing sector sold: $2,001,000 worth of product to chemicals and allied products; none to the metal, machinery and equipment sector; none to the other manufacturing sector; $3,000 to transportation, communication and utilities; $8,408,000 to the trade sector; $6,390,000 to the finance, insurance and real estate sector; $5,000,000 to the services sector; and $362,000 worth of product to the local government.

Total sales of the agricultural processing sector to the other sectors in the study area amounted to $103,465,000. The agricultural processing sector also sold $95,253,000 worth of product to households, $27,276,000 to other final demand and exported $359,516,000 worth of product. Total output of the agricultural processing sector was $585,510,000 in 1965.

Reading down column five gives the value of inputs the agricultural processing sector purchased from each of the other sectors. Agricultural processing purchased $84,921,000 of inputs from crops, $220,374,000 from livestock and livestock products and $1,145,000 from construction. The intersection of column five and row five indicates $33,594,000 of inputs were purchased from other firms in the agricultural processing sector. Agricultural processing purchased $1,284,000 worth of inputs from petroleum, chemicals and allied products, etc.

The column totals must equal the row totals which are defined as total output for the intermediate processing sectors. Output in this study was defined the same as output in the Kansas State Study [12]. Output for the crops, livestock, mining and manufacturing sectors was defined as the total value of production. Output for the construction sector was estimated from published data from the Bureau of the Census. The construction sector is one of the more difficult industry groups to define for an input-output study. For a more detailed definition of the construction sector see Emerson's study [12, pp. 57 and 177].

Transportation costs were allocated to the sector purchasing the inputs. Output for transportation was based on the transportation rate structures which would be applicable to the purchasing sector. Output for communication and utilities was based on actual charges. However, utilities operated by local units of government were not included in this sector, but were defined as part of the local government sector.

Output for the trade sector was defined on a gross margin basis with the exception of eating and drinking establishments. Eating and drinking establishments are considered to change the form of their product and were handled in the same manner as firms in the manufacturing sectors.

Output for banking and finance was defined as total income including interest income, investment income, rent and other miscellaneous incomes. Output from insurance was provided by the insurance commission. The insurance sector includes companies underwriting life, accident and health, and a multiplicity of non-life insurance risks as well as insurance agents and insurance services. Output from the insurance sector was defined as total income of the members listed above.

Output from the real estate sector was defined as total revenue of real estate agents and brokers. Total output for the F.I.R.E. sector is the sum of the output from banking and finance, insurance and real estate.

Output for the service sector is defined as income or revenue to service oriented firms. Education was included in the service sector and represents a large part of the sector output. Output from education was defined as the cost of providing the service. Output for the local government sector was also defined as the cost of providing local government services, and utilities if they were operated by a local government.

The Direct Requirements Table

The direct requirements table (Table V) was derived by dividing each column entry in the transactions table by the adjusted gross output of the column total. Each column entry in the table is an estimate of the direct requirements from the row sector per unit of output by the sector designated in the column title. Households and other final payments sectors are included in the calculations so, each column of direct requirements coefficients totals 1.0.

Entries in column one of Table V indicates that for every unit of output from the crops sector 0.04 units of crop inputs are purchased within the area, 0.04 units from chemicals, etc., and 0.47 units from local households. Total requirements of locally produced inputs accounts for 72 percent of the total input requirements and non-local accounts contributed 28 percent (16 percent from imports and 12 percent from other exogenous) of the total inputs to the crop sector. Each of

TABLE V

DIRECT REQUIREMENTS TABLE, SOUTHERN KANSAS, 1965

Producing Sector	Purchasing Sector													
	Crops	Livestock	Mining	Construction	Agri. Processing	Chemicals	Metal, Mach., Equip.	Other Mfg.	Transp., Comm., Util.	Trade	F.I.R.E.	Services	Local Govt.	Households
	(Dollars)													
1. Crops	.038005	.293112	--	--	.145038	.000038	.000002	.002603	--	.000586	--	--	--	.001180
2. Livestock	--	.161200	--	--	.376380	--	--	--	--	.000309	--	--	--	.001209
3. Mining	--	--	.139144	.005846	--	.212746	.000001	.010042	.030103	.000161	--	.000080	--	--
4. Construction	.005974	.003662	.007156	.324745	.001956	.000462	.004415	.013428	.020296	.009527	.008245	.024841	.029267	.009091
5. Agri. Processing	.000830	.108920	--	--	.057376	.003820	--	--	.000007	.016255	.016266	.007937	.001248	.036841
6. Chemicals	.035347	.012924	.019314	.017880	.002193	.019472	.006808	.003518	.009540	.007265	.008494	.004847	.010288	.029415
7. Metal, Mach., Equip.	.011048	.001911	.015686	.033406	.000008	.001569	.028781	.012337	.007394	.000590	.019786	.005029	.001945	.000655
8. Other Mfg.	.002754	--	.009206	.041742	.008410	.004484	.004138	.029119	.008702	.015175	.031192	.011664	.023020	.007523
9. Trans., Comm., Util.	.015148	.005396	.017262	.011758	.014374	.031176	.021238	.026997	.122673	.049856	.030365	.039256	.023475	.035299
10. Trade	.058694	.036853	.029358	.015665	.040298	.008407	.010297	.011280	.011212	.093060	.010281	.027889	.017083	.101663
11. F.I.R.E.	.017067	.001764	.109304	.005302	.007118	.008294	.003752	.007491	.008821	.017067	.035947	.015134	.051156	.075432
12. Services	.048070	.026072	.011355	.015048	.002982	.001035	.002673	.004604	.017536	.048166	.029978	.040258	.412674	.089535
13. Local Government	.020197	.007500	.001332	.007614	.001335	.003058	.002960	.003584	.022027	.006741	.007267	.005095	.108638	.059382
14. Households	.466742	.165886	.121389	.189807	.101339	.101812	.353718	.292453	.340157	.472080	.511215	.579769	.222614	.070614
15. Other Exogenous	.124852	.050197	.379141	.070833	.035263	.251859	.099658	.085815	.236170	.123380	.129084	.104459	.008926	.233974
16. Imports	.155272	.124603	.140353	.260354	.205930	.351768	.461559	.496729	.165362	.139782	.161880	.133742	.089666	.248187
Total	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

the other sectors can be interpreted in a similar manner. Entries across row one of Table V indicates the crop sector delivers 0.04 units of output to itself per unit of output. This is the same interpretation this cell had when looking at it as a column entry. The crops sector delivers 0.29 units of output to the livestock sector as inputs for a unit of output by the livestock sector, 0.14 units of output to the agricultural processing sector, etc.

The Direct and Indirect Requirements Table

The direct requirements table provides an estimate of the initial effect on the endogenous sectors of the economy for a one dollar change in total output of an individual sector. Inversion of an identity matrix minus the endogenous portion of the direct requirements matrix (the interdependence coefficients table) provides an estimate of the total generative or multiplier effect which results from a dollar change in final demand produced by each endogenous sector.

The column entries in the interdependence coefficients table (Table VI) gives the total direct plus indirect requirements from the sector named in the row per dollar of sales to final demand by the sector indicated in the column heading. In other words, the interdependence coefficients table estimates the additional output in sector j resulting from a one dollar change in final demand in the ith sector. Increased endogenous output in excess of the direct requirements is stimulated as changes in local input requirements generate additional rounds of transactions within endogenous sectors of the local economy. An example is given in Table VII which compares the column of direct requirements coefficients (Table V) with the column of interdependence

TABLE VI

DIRECT AND INDIRECT REQUIREMENTS TABLE, SOUTHERN KANSAS, 1965

Producing Sector	Purchasing Sector												
	Crops	Livestock	Mining	Construction	Agri. Processing	Chemicals	Metal, Mach., Equip.	Other Mfg.	Transp., Comm., Util.	Trade	F.I.R.E.	Services	Local Govt.
							(Dollars)						
1. Crops	1.040597	.405986	.001098	.000554	.322611	.001681	.000149	.002976	.000372	.006971	.005762	.003050	.002452
2. Livestock	.001614	1.258788	.001605	.000561	.503399	.002504	.000196	.000273	.000504	.009952	.008828	.004663	.003629
3. Mining	.011069	.009572	1.169471	.019055	.007259	.255363	.003013	.014723	.043907	.005623	.004704	.004208	.007452
4. Construction	.015445	.017030	.017242	1.486103	.014347	.006433	.008364	.022815	.038410	.021509	.017194	.041784	.071252
5. Agri. Processing	.003537	.148373	.003542	.001225	1.121796	.005563	.000426	.000597	.001108	.021268	.019660	.010363	.008054
6. Chemicals	.039802	.033800	.025610	.029042	.022905	1.026236	.007875	.005278	.013662	.010549	.010913	.007362	.017581
7. Metal, Mach., Equip.	.013878	.008992	.022921	.053029	.006521	.007371	1.030418	.014740	.011604	.003236	.022978	.008027	.009867
8. Other Mfg.	.007597	.006986	.017756	.066339	.014826	.009756	.005612	1.032368	.014485	.020967	.035909	.016444	.039443
9. Trans., Comm., Util.	.029140	.028560	.033551	.028698	.037361	.045285	.026888	.034802	1.146557	.068980	.041865	.051729	.060344
10. Trade	.072046	.088247	.041911	.029882	.094540	.019972	.012789	.015121	.018672	1.108643	.016597	.035369	.040828
11. F.I.R.E.	.024236	.016256	.134841	.013401	.019727	.039226	.005319	.011016	.018432	.023174	1.040500	.019091	.070700
12. Services	.068671	.070494	.023279	.032755	.046488	.009987	.006274	.009847	.036371	.063666	.039783	1.049961	.492086
13. Local Government	.025814	.022255	.004552	.014516	.015584	.005735	.004393	.005626	.029384	.011239	.010517	.008308	1.128037
Total	1.353442	2.115335	1.497375	1.775155	2.227361	1.435108	1.111712	1.170180	1.373465	1.375776	1.275208	1.260358	1.951725

TABLE VII

RESPONSE TO A ONE DOLLAR CHANGE IN FINAL DEMAND IN THE CROPS SECTOR OF THE SOUTHERN KANSAS ECONOMY, 1965

Sector	Direct Requirements	Direct and Indirect Requirements	Indirect Requirements
	(1)	(2)	(3)
1. Crops	.038005	.040597[a]	.002592
2. Livestock	.000000	.001614	.001614
3. Mining	.000000	.011069	.011069
4. Construction	.005974	.015445	.009471
5. Agri. Processing	.000830	.003537	.002707
6. Chemicals	.035347	.039802	.004455
7. Metal, Mach., Equip.	.011048	.013878	.002830
8. Other Mfg.	.002754	.007597	.004843
9. Trans., Comm., Util.	.015148	.029140	.013992
10. Trade	.058694	.072046	.013352
11. F.I.R.E.	.017067	.024236	.007169
12. Services	.048070	.068671	.020601
13. Local Government	.020197	.025814	.005617
Total	.253134	.353446	.100312

[a]Requirements net of the one dollar initial change in final demand.

coefficients (Table VI) for the crops sector.

A $1.00 increase in crop output for final demand requires that agricultural firms make $.25 of direct purchases of goods and services from all endogenous sectors in the economy. This is not the total increase in output of the endogenous sectors resulting from a $1.00 increase in crop sales to final demand. There will also be an indirect increase in output from the endogenous sectors in the amount of $.10. This is the increase created by all of the endogenous sectors to meet the increased output going to final demand in the crops sector. Sectors selling inputs to crops must in turn purchase additional inputs to meet increased sales to the crops sector.

This point can best be illustrated by observing one of the endogenous sectors. For example, the services sector will need to increase output by $.05 to meet the direct requirements for the crops sector to supply an additional $1.00 of output to final demand. The services sector also will need to purchase additional inputs from other endogenous sectors and supply output to these sectors for them to meet the increase demanded by the crops sector. Total increased output from the services sector for the crops sector to supply an additional dollar of output to final demand is approximately $.07, $.02 of which is indirect requirements. This same analysis can be applied to all of the endogenous sectors in the economy.

Up to this point, households have been considered as an exogenous variable in computing the interdependence coefficients. Consequently, output changes for a unit change in final demand estimated by the direct and indirect requirements coefficients do not include the generative effect of new rounds of local household expenditures. The household sector can be moved to the endogenous portion of the matrix to estimate the impact of local consumption expenditures for a unit change in final demand by sectors. Increases in output by the endogenous sectors increase payments to households in the form of wages, salaries, rents and retained earnings. These increased payments generate an additional demand for goods and services produced within the local economy. The inverted matrix of an identity matrix minus the technical coefficients matrix with the household sector included is referred to as the direct, indirect and induced coefficients matrix (Table VIII).

The induced effects of the households sector can be isolated by comparing the columns in Table VI with Table VIII. For example, the induced effect of a one dollar change in final demand of the crops sector amounts to $1.49 (2.843890 - 1.353442). The remaining 12 sectors can be interpreted in a similar fashion.

Input-Output Multipliers

Construction of the interdependence coefficients matrix has provided the mathematical manipulation necessary to measure the degree of interdependence between the sectors in the economy. The economic predictive devices or input-output multipliers are estimated directly from the interdependence coefficients matrix. Multipliers are useful for predicting the change in output, income and employment in the economy for a unit change in final demand for each producing sector. Final demand requirements for future time periods are based on projections of future population, income, employment, etc., associated with the anticipated levels of economic development within the economy. This

TABLE VIII

DIRECT, INDIRECT AND INDUCED REQUIREMENTS TABLE, SOUTHERN KANSAS, 1965

Producing Sector	Purchasing Sector													
	Crops	Livestock	Mining	Construction	Agri. Processing	Chemicals	Metal, Mach., Equip.	Other Mfg.	Trans., Comm., Util.	Trade	F.I.R.E.	Services	Local Govt.	Households
							(Dollars)							
1. Crops	1.054235	.418003	.007354	.009115	.332962	.006106	.008995	.010812	.010732	.020939	.019522	.018292	.017050	.022591
2. Livestock	.021707	1.276494	.010823	.013174	.518650	.009024	.013229	.011819	.015769	.030532	.029103	.027122	.025138	.033287
3. Mining	.021246	.018540	1.174140	.025444	.014984	.258665	.009614	.020571	.051638	.016047	.014973	.015583	.018346	.016859
4. Construction	.039808	.038498	.028419	1.501396	.032840	.014339	.024167	.036814	.056919	.046463	.041778	.069016	.097331	.040360
5. Agri. Processing	.045355	.185221	.022725	.027474	1.153537	.019132	.027549	.024625	.032877	.064098	.061856	.057104	.052817	.069275
6. Chemicals	.071543	.061769	.040170	.048966	.046997	1.036536	.028462	.023516	.037775	.043059	.042942	.042840	.051557	.052581
7. Metal, Mach., Equip.	.018820	.013347	.025188	.056131	.010272	.008974	1.033624	.017580	.015359	.008298	.027964	.013551	.015157	.008187
8. Other Mfg.	.024036	.021471	.025297	.076658	.027303	.015090	.016274	1.041813	.026974	.037804	.052497	.034818	.057039	.027232
9. Trans., Comm., Util.	.084718	.077534	.059047	.063585	.079547	.063320	.062937	.066737	1.188780	.125904	.097947	.113851	.119837	.092070
10. Trade	.183662	.186600	.093114	.099945	.179261	.056191	.085185	.079255	.103468	1.222963	.129226	.160127	.160306	.184903
11. F.I.R.E.	.104274	.086782	.171558	.063642	.080478	.065198	.057233	.057005	.079237	.105150	1.121263	.108552	.156374	.132589
12. Services	.190718	.178038	.079267	.109365	.139126	.049590	.085437	.079975	.129091	.188669	.162937	1.186379	.622729	.202183
13. Local Govt.	.089887	.078714	.033946	.054736	.064218	.026527	.045953	.042442	.078061	.076864	.075171	.079926	1.196623	.106144
14. Households	.893888	.787660	.410065	.561106	.678491	.290059	.579793	.513623	.679094	.915538	.901994	.999138	.956846	1.480810
Total	2.843890	3.428662	2.181107	2.710730	3.358662	1.918747	2.078447	2.026584	2.505772	2.902324	2.779173	2.926300	3.547149	2.469071

concept will be considered in greater detail in Chapter V.

The input-output multipliers are useful in estimating the effect of a change in demand for goods and services from a particular sector on total output, income or employment in the economy. Output multipliers indicate how area production will change in response to a final demand change in any one of the sectors. Income multipliers measure the change in area income resulting from an income change in one of the sectors. If employment changes by one worker in one of the sectors, the employment multiplier estimates the impact on employment in the total economy.

Output Multipliers

Output multipliers measure the output generated in the economy by a one dollar change in final demand for the goods or services of a particular sector. They are computed by simply summing the interdependence coefficients columns (Table VI) to obtain the output multiplier for each sector. For example, summing the crops column in Table VI indicates the output multiplier for the crops sector is 1.35. This indicates that a $1.00 change in final demand from the crops sector will cause a $1.35 change in output in the economy. Of the total change $1.04 is caused by interaction within the crops sector of which $1.00 is attributable to the direct change in final demand. The trade and services sectors are affected the most, each requiring a $0.07 change in output for a $1.00 change in final demand from the crops sector.

The output multipliers (for Model II, local government endogenous) computed from Table VI are listed in column (2) of Table IX. The agricultural processing sector has the largest output multiplier (2.23).

TABLE IX

OUTPUT MULTIPLIERS FOR THREE MODEL ASSUMPTIONS, SOUTHERN KANSAS, 1965

Sector	Model I 12 Endogenous Sectors	Model II 13 Endogenous Sectors	Model III Households Endogenous
	(1)	(2)	(3)
1. Crops	1.308778	1.353442	2.843890
2. Livestock	2.076831	2.115335	3.428662
3. Mining	1.489498	1.497375	2.181107
4. Construction	1.750040	1.775155	2.710730
5. Agri. Processing	2.200398	2.227361	3.358662
6. Chemicals	1.425184	1.435108	1.918747
7. Metal, Mach., Equip.	1.104114	1.111712	2.078447
8. Other Mfg.	1.160448	1.170180	2.026584
9. Trans., Comm., Util.	1.322624	1.373465	2.505772
10. Trade	1.356331	1.375776	2.902324
11. F.I.R.E.	1.257012	1.275208	2.779173
12. Services	1.245984	1.260358	2.926300
13. Local Government	--	1.951725	3.547149
14. Households	--	--	2.469071

The livestock sector has the second largest output multiplier (2.12) followed by local government, construction, etc.

If final demand for processed agricultural products increases by \$1.00 there will be a \$2.23 increase in total output in the area. The size of this multiplier indicates there is substantial interaction between agricultural processing and the other sectors in the area, especially the two agricultural producing sectors. A \$1.00 increase in output from the agricultural processing sector requires a \$.32 and a \$.50 increase from the crops and livestock sectors respectively (Table VI). Changes for the remaining sectors can be interpreted in a similar manner from the agricultural processing column in Table VI.

Columns 1 and 3 have been included in Table IX to show the effects of changing the basic model by excluding one of the original sectors (column 1) or including an additional sector (column 3). In Model I the multipliers were computed with the local government sector excluded. This allows the model to more accurately be compared with other regional models where local government is considered as an exogenous variable. The crops, livestock, and transportation, communications and utilities multipliers are affected the most due to this redefinition of the model.

Model III (column 3) of Table IX is the basic model with the household sector considered as an endogenous variable. This model is included to show the effect of the interactions between the household sector and the other sectors in the economy. This model will be considered in more detail under income multipliers.

Income Multipliers

The concept of input-output income multipliers as developed by Hirsch [15] measures the total change in income in an economy resulting from a $1.00 change in income in a particular sector. The underlying assumption of the income multiplier is that there is a certain amount of income generated with each change in output. A direct and indirect income effect is first estimated in calculating the income multiplier for each sector in the economy.

The direct income effect is the proportion of each $1.00 of output which goes to households in the form of wages, salaries, rents and retained earnings. The direct income effect is listed for each column sector in the household row of the direct coefficients table (Table V). The direct income effects are also presented in column (1) of Table X.

The table of direct requirements coefficients and the results of the two matrix inversions, one with households exogenous and one with households endogenous, can be used to analyze the impact of changes in final demand on household income in the local economy. The total change in household income for a one unit change in deliveries to final demand for each of the endogenous sectors can be separated into three components: (1) direct, (2) indirect, and (3) induced income effects.

The direct effects for household income results from an individual sector's immediate response to a unit change in final demand. Indirect income changes are created by output adjustments of all the endogenous sectors necessary to support the direct and indirect changes in deliveries to final demand. Induced changes in household income results from changes in household purchases of locally produced goods and services. The induced effects are computed by including the

TABLE X

INCOME MULTIPLIERS BY SECTORS FOR THE SOUTHERN KANSAS ECONOMY, 1965

Sector	Direct Effects	Direct, and Indirect Effects	Direct, Indirect, and Induced Effects	Income Multipliers	
				Type I	Type II
	(1)	(2)	(3)	(4)	(5)
1. Crops	.466742	.603648	.893888	1.293322	1.915164
2. Livestock	.165886	.531911	.787660	3.206488	4.748200
3. Mining	.121389	.276919	.410065	2.281253	3.378103
4. Construction	.189807	.378918	.561105	1.996331	2.956188
5. Agri. Processing	.101339	.458189	.678491	4.521347	6.695258
6. Chemicals	.101812	.195879	.290059	1.923923	2.848967
7. Metal, Mach., Equip.	.353718	.391537	.579793	1.106919	1.639138
8. Other Mfg.	.292453	.346853	.513623	1.186010	1.756257
9. Trans., Comm., Util.	.340157	.458596	.679094	1.348189	1.996413
10. Trade	.472080	.618268	.915538	1.309668	1.939370
11. F.I.R.E.	.511215	.609122	.901994	1.191518	1.764412
12. Services	.579769	.674724	.999138	1.163780	1.723337
13. Local Government	.222614	.646163	.956845	2.902617	4.298225

household sector in the endogenous portion of the input-output matrix.

The derivation of direct and indirect income effects per unit change in final demand implies that the level of consumption expenditures remain the same despite a postulated change in household income generated by the change in final demand [15]. Moving the household sector into the endogenous section of the matrix accounts for the fact that a change in household receipts initiates a change in the level of household expenditures. The change in household expenditures results in additional adjustments in output and consequently further changes in payments to local households. This change in local household payments resulting from adjustments in output to the intital change in household income is referred to as the induced income effects.

Two types of income multipliers were estimated for the southern Kansas economy. The Type I income multipliers estimate the direct and indirect income effect of a unit change in direct payments to households by sector. The induced income effect as well as the direct and indirect income effect are measured by the Type II income multipliers.

The Type I income multipliers in Table X indicate that a $1.00 change in household income resulting from a change in final demand from the crops sector will directly and indirectly generate a total of $1.29 income to the household sector. This estimate increases to $1.92 when induced output changes are included. The impact of income changes in each of the other sectors can be interpreted in a similar manner.

Caution should be exercised in interpreting and applying the income multipliers. It seems the Type I income multipliers are too conservative as they do not account for the additional purchasing power generated by increased household income. The Type II income multipliers may tend to overstate the total impact of an increase in income as they consider the marginal propensity to consume to be equal to the average propensity to consume for household consumption. The exact figure would appear to be somewhere between the two, but probably closer to the Type II estimate.

Employment Multipliers

The concept of the employment multipliers used in this study was developed by Moore and Peterson [30]. The employment multipliers define the change in total employment resulting from a one unit change in the labor force for a particular sector. The basic assumption underlying the employment multipliers is that a linear relationship exists between employment and output in all sectors.

The input-output employment multiplier is related to a change in output. A change in output creates a direct and indirect employment effect. The direct employment effect indicates the number of persons employed per year, per million dollars worth of output, in each sector (column 1, Table XI). The direct employment coefficient for the crops sector indicates that 62.6 man-years of labor were required to produce a million dollar's worth of crop output in 1965 in southern Kansas. The trade and services sectors with 154.4 and 126.9 respectively had the largest employment requirements per million dollars of output.

The direct and indirect employment effects are computed by considering the repercussions of a one million dollar change in final demand of one sector on total employment in the economy (column 2, Table XI). For example, a one million dollar increase in final demand of the crops sector will increase output in the crops sector by 1.04 million dollars

TABLE XI

EMPLOYMENT MULTIPLIERS BY SECTORS FOR THE SOUTHERN KANSAS ECONOMY, 1965

Sector	Direct Effects[a]	Direct, and Indirect Effects	Direct, Indirect, and Induced Effects	Employment Multipliers	
				Type I	Type II
	(1)	(2)	(3)	(4)	(5)
1. Crops	62.602	91.085	137.562	1.455	2.198
2. Livestock	55.716	125.671	166.625	2.256	2.991
3. Mining	50.253	77.321	98.642	1.539	1.963
4. Construction	33.395	68.157	97.331	2.041	2.914
5. Agri. Processing	15.787	91.964	127.242	5.825	8.060
6. Chemicals	11.835	24.704	49.786	2.932	4.207
7. Metal, Mach., Equip.	44.165	51.000	81.146	1.155	1.837
8. Other Mfg.	51.353	61.582	88.287	1.199	1.719
9. Trans., Comm., Util.	57.737	80.372	115.681	1.392	2.004
10. Trade	154.357	187.990	235.593	1.218	1.526
11. F.I.R.E.	29.630	46.232	93.131	1.560	3.143
12. Services	126.930	146.116	198.066	1.151	1.560
13. Local Government	39.206	124.474	174.224	3.175	4.444

[a]Man-years of labor required per million dollars of output.

and generate additional employment for 65.1 persons (62.602 x 1.04). As a result of this initial increase in final demand of the crops sector, the direct and indirect effect of the livestock sector will require output to increase by $1,614 and employment by 0.09 man-years. The total direct and indirect employment effect is obtained by summing the additional man-years required by each sector to supply the increased output required to meet the increase in final demand of any particular sector.

Type I employment multipliers are computed by dividing the direct employment effect (column 1) into the direct and indirect employment effect (column 2). Type II employment multipliers are computed by dividing the direct employment effect into the direct, indirect and induced effect (column 3). Each multiplier indicates the change in employment generated throughout the southern Kansas economy for a one unit employment change in the specified sector. Agricultural processing had the highest Type I employment multipliers (5.82) followed by local government, chemicals, construction, etc. Agricultural processing also had the highest Type II employment multipliers (8.06) followed by local government, chemicals, F.I.R.E., etc.

The main purpose in computing the employment multipliers was to explain the interrelationships between employment and the economic activity in the southern Kansas economy in 1965. That there is a linear relationship between employment and output is a valid assumption to explain the employment output relationships that exist at a given point in time. However, due to the presence of underemployed resources and unused capacity in some sectors, these relationships are not expected to remain constant over time. The following chapter will concentrate on employment-output ratios for future time periods based on expectations of technological change and the utilization of underemployed resources.

Water Multipliers

Water, a necessary input, is required either directly or indirectly in the production of all goods and services within the economy. Some industries, the generation of hydroelectric power is a good example, are intensive water users. Other industries such as the trade and services sectors require relatively small quantities of water. For planning purposes it is useful to know not only the income and employment effects of a change in final demand but also the water effects. Accordingly, the impact on water requirements have been computed for eight sectors in southern Kansas including the household sector. The initial step in computing the water-output relationships for the economy was to determine the direct water requirements per dollar's worth of output by sector. For the household sector the direct water requirement is in gallons of water per one dollar of personal income (output).

The Kansas Water Resources Board collected data by sectors on water used in 1965 [22]. Those data were used to compute the direct water requirements in gallons of water per dollar's worth of output (Table XII). Direct water requirements were estimated for seven sectors incorporated in the input-output model -- livestock; mining; agricultural processing; chemicals; metal, machinery and equipment; other manufacturing; and transportation, communication and utilities. In addition to the aforementioned sectors, water requirements were estimated for rural domestic and non-industrial municipal consumption. This

TABLE XII

WATER MULTIPLIERS BY WATER USING SECTORS FOR THE SOUTHERN KANSAS ECONOMY, 1965

Water Using Sector	Direct Effects[a]	Direct, and Indirect Effects	Direct, Indirect, and Induced Effects	Water Multipliers	
				Type I	Type II
	(1)	(2)	(3)	(4)	(5)
			Instream and Withdrawal Water Requirements		
2. Livestock	33.896	52.055	77.955	1.536	2.300
3. Mining	33.461	48.334	61.818	1.444	1.847
5. Agri. Processing	8.222	36.471	58.781	4.436	7.149
6. Chemicals	17.088	37.652	47.189	2.203	2.762
7. Metal, Mach., Equip.	3.527	10.654	29.719	3.021	8.426
8. Other Mfg.	12.959	22.702	39.591	1.752	3.055
9. Trans., Comm., Util.	249.163	287.644	309.974	1.154	1.244
14. Households	14.975	—	48.692	—	3.252
			Withdrawal Water Requirements		
2. Livestock	33.896	44.940	58.640	1.326	1.730
3. Mining	33.461	39.976	47.109	1.195	1.408
5. Agri. Processing	8.222	27.163	38.965	3.304	4.739
6. Chemicals	17.088	26.370	31.416	1.543	1.838
7. Metal, Mach., Equip.	3.527	3.956	14.040	1.122	3.981
8. Other Mfg.	12.959	14.032	22.966	1.083	1.772
14. Households	14.975	—	25.756	—	1.720

[a]Gallons of water required per dollar of output.

category included water used in the supporting or non-basic sectors of the economy as well as household consumption. The supporting sectors such as construction, trade, F.I.R.E., services and local government are more dependent upon the level of household activity than are the basic sectors such as agriculture, mining and manufacturing. Since water used in each of the supporting economic sectors could not be determined it was aggregated and included in the household sector. This appears to be a realistic approach as the level of activity in the supporting sectors is closely related to household income and expenditures. Henceforth in this study, the term water using sectors will refer to the sectors of the input-output model by number and name as follows:

2. Livestock
3. Mining
5. Agri. Processing
6. Chemicals
7. Metal, Mach., and Equip.
8. Other Manufacturing
9. Trans., Comm., and Util.[1]
14. Households

Once the direct water requirements have been estimated the direct and indirect water effects and water multipliers can be determined. The direct and indirect water effects are computed by multiplying the direct water requirements by the matrix of interdependence coefficients (Table VI). The Type I water multipliers are then computed by dividing the direct and indirect effects by the direct effects (column 2 ÷ column 1).

Type II water multipliers were also computed considering the induced effects of households (column 3 ÷ column 1). The Type I water

---

[1]Water requirements in sector (9) Trans., Comm., and Util. is defined as water required in the generation of hydroelectric power.

multipliers estimate the total water requirements necessary to sustain the increased economic activity in the area associated with a one gallon increase in the direct water requirement for a major water using sector. The Type II water multipliers include the induced effect of increased water required by the household sector for each additional one gallon direct water requirement by a water using sector. The Type II water multipliers include the induced effect of increased water required by the household sector for each additional one gallon direct water requirement by a water using sector.

Two categories of water multipliers were estimated.[2] The first category of water multipliers included both instream water requirements for the generation of hydroelectric power and withdrawal water requirements for the other water using sectors. The second category of water multipliers only includes withdrawal water requirements. Both categories of water multipliers are useful for analyzing economic development and water requirements in the region (Table XII).

The water multipliers can be used to analyze the effect of a change in final demand in any one of the water using sectors in the model on the amount of water required in the economy. From Table VIII we can read the effects (direct, indirect and induced) of each one dollar change in final demand on the production requirements of each of the other sectors. The water requirement change associated with a production change can be estimated by multiplying the production change by the direct water requirement for the appropriate sector. For example, row 5, column 2 of Table VIII indicates $.185221 worth of livestock

[2]Irrigation water for crop production was excluded in both water multiplier categories.

output is required per $1.00 delivery of agricultural processing to final demand. Since the livestock sector uses 33.896 gallons of water per dollar's worth of output, 6.278 additional gallons of water (33.896 x .185221) are required in this sector per $1.00 delivery of agricultural processing to final demand. Water requirement relationships associated with other sectors can be determined in a similar manner.

Water multipliers can be used to estimate total water requirements to support an additional job or man-year of employment in one of the major water using sectors. Direct water requirements have been estimated in terms of gallons of water required per one dollar of output. Output per man-year of employment can be calculated from the direct employment effects in Table XI. For example, it requires 15.787 man-years of labor to produce $1,000,000 of output in the agricultural processing sector. Therefore, each man-year equivalent produced $63,343 ($1,000,000 ÷ 15.787) of output in the agricultural processing sector. Since each one dollar of output requires 8.222 gallons of water, 520,806 gallons of water are required directly for each man-year of employment in the agricultural processing sector.

Total water requirements associated with each job in agricultural processing can be determined by multiplying the direct water requirements by the Type II water multiplier. Total instream and withdrawal water requirements needed to support one additional job in agricultural processing are 3,723,242 gallons of water and the total withdrawal requirements are 2,468,100 gallons of water (Table XIII). The same interpretation was used for the other water using sectors.

The procedure described above could be used to estimate the total water requirements per job for an individual firm in the area that may

TABLE XIII

WATER REQUIREMENTS PER MAN-YEAR OF EMPLOYMENT BY WATER USING SECTORS FOR THE SOUTHERN KANSAS ECONOMY, 1965

Water Using Sector	Output Per Man-Year of Employment	Direct Water Requirements Per Man-Year of Employment	Total Instream and Withdrawal Water Requirements Per Man-Year of Employment[a]	Total Withdrawal Water Requirements Per Man-Year of Employment[b]
	(Dollars)	(Gallons)	(Gallons)	(Gallons)
2. Livestock	17,948	608,365	1,399,240	1,052,471
3. Mining	19,899	665,840	1,229,806	937,503
5. Agri. Processing	63,343	520,806	3,723,242	2,468,100
6. Chemicals	84,495	1,443,850	3,987,914	2,653,796
7. Metal, Mach., Equip.	22,642	79,858	672,884	317,915
8. Other Mfg.	19,473	252,351	770,932	447,166
9. Trans., Comm., Util.	17,320	4,315,503	5,368,486	--

[a]Computed from instream and withdrawal Type II water multipliers (Table XII).

[b]Computed from withdrawal Type II water multipliers (Table XII).

have different output per job relationship and different direct water requirements than the sector average. The Type II water multiplier, which assumes the firm has the same economic interdependence as the sector average is the best estimate of estimating the total water requirements for the firm given the direct water requirements. This makes the water multipliers amenable for community or industrial development planning.

Summary

The empirical results were reported in the four input-output tables: (1) the transactions table, (2) the direct requirements table, (3) the direct and indirect requirements table, and (4) the direct, indirect and induced requirements table. The transactions table is the foundation of the model with the other three tables computed directly from it. The transactions table provides a double entry system of accounts as sales and purchases of each sector are incorporated in the table.

The direct requirements coefficients indicates the direct dependence of each sector on all other sectors. The direct and indirect requirements coefficients measure the total direct and indirect effect of a change in final demand, adding the induced effects measures the total impact including the increased consumer expenditures generated by the increased economic activity.

Four types of input-output multipliers were estimated. Included were output, income, employment and water multipliers with emphasis placed on the development of water multipliers. Two categories of water multipliers were estimated. The first category included instream and withdrawal water requirements and the second category included only withdrawal water requirements. These multipliers were based on 1965 data and are measures of interrelationships that existed in the economy at that time.

The base year multipliers are extremely useful for measuring the impact of a change in final demand in the short run, one to five years. However, additional assumptions and estimates of change are necessary to make more accurate estimates of the economic indicators for longer time periods. The application of the input-output model for long-range economic forecasting will be considered in the following chapter.

CHAPTER V

PROJECTIONS OF ECONOMIC DEVELOPMENT AND ASSOCIATED WATER REQUIREMENTS, 1980, 1990 AND 2000

Projections

Long-range planning and policy decisions require water resource commitments extending well into the future. Investment decisions in water resource development and capital outlays require estimates of future levels of economic activity. Economic forecasts are necessary in preparing a long-range development plan.

One of the objectives of this study was to project employment, population, income and water requirements for 1980, 1990 and 2000. Since the forecasts must be meaningful to reduce uncertainty, it is necessary to make forecasts from an organized forecasting system [13]. The decision maker must determine the forecasting method to be used. That is, he must decide what variables will effect the current conditions and project these variables by means of an appropriate technique.

The input-output model described in the previous chapter is the basis for developing an economic forecasting model. The input-output model consists of a set of simultaneous equations. Simultaneous equation models are composed of endogenous variables and exogenous variables. The endogenous variables are determined by the relationships found within the model and the value of the exogenous variables. The exogenous variables, determined by outside forces, act on the endogenous variables through the properties of the model [13]. Thus, manipulation of the exogenous variables can be used to change the state of the system.

The final demand sectors represent part of the exogenous variables in the input-output model. In order to use the input-output coefficients as a predicting device, it is necessary to estimate the final demand values for each of the appropriate time periods.

In addition to final demand, it was necessary to project other variables that are expected to change over time to complete the forecasting model. These include (1) output per man-year of employment, (2) consumer spending patterns or the household consumption function, (3) the population-employment ratios and (4) direct water requirements per one dollar of output (income) for the household sector. The explanation of these projections is given with their application throughout the chapter.

Final Demand

Estimates of final demand for the sectors in southern Kansas incorporated in the input-output model were made for 1980, 1990 and 2000. Final demand projections consist of three major components: (1) consumption of households within the area, (2) the level of state and federal government spending within the study area, and (3) export demand, which is determined by exports to the rest of the world.

The final demand projections for the study area were based on Emerson's preliminary final demand estimates for the state of Kansas [13]. The final demand estimates for the agricultural sectors were based on a procedure developed in an Iowa state study by Mayer and

Heady [28]. The Kansas final demand estimates for the agricultural sectors were adjusted in accordance with the results of a U.S. Department of Agriculture Analytical Programming Model used to estimate future agricultural production in the study area [13]. The final demand projections for the other sectors were derived by adjusting the state projections.

Final demand estimates for the area were first computed under the assumption that the ratio of final demand by sector in the southern Kansas model to the final demand in the state model would remain constant through time. These estimates were adjusted for changes that are expected to occur in the proportion of production that is expected to be produced in the study area in the future. The U.S. Department of Agriculture programming results were used to adjust the final demand projections for the crops sector.

For the purpose of this study, it was concluded that more consistent projections of output, employment and population could be made by considering households as an endogenous variable. Therefore, the projections of final demand do not include household consumption expenditures by sectors (Table XIV).

The final demand projections are based primarily on the expected allocation of output to the state and federal government and exports. For example, it was estimated that in 1980, southern Kansas will deliver $237,273,000 worth of crop output to the government, in the form of sales or program payments, and for exports. Gross private investment was considered in the construction sector and the metals, machinery and equipment sector which included high capital requiring industries such as motor vehicle manufacturing and aerospace. Projections of

TABLE XIV

PROJECTED TOTAL FINAL DEMAND FOR SOUTHERN KANSAS, HOUSEHOLD ENDOGENOUS, 1980, 1990 AND 2000

Sector	1980	1990	2000
		(Thousands of Dollars)	
1. Crops	237,273	268,220	324,063
2. Livestock	218,282	269,838	349,980
3. Mining	347,414	297,329	180,000
4. Construction	725,012	1,099,796	1,742,677
5. Agri. Processing	553,206	684,398	860,934
6. Chemicals	520,142	764,278	1,141,515
7. Metal, Mach., Equip.	1,437,780	2,552,571	4,526,722
8. Other Mfg.	251,523	367,354	523,258
9. Trans., Comm., Util.	225,927	327,519	502,654
10. Trade	161,412	237,917	361,056
11. F.I.R.E.	150,794	228,505	354,039
12. Services	335,823	523,153	814,272
13. Local Government	143,917	212,998	310,976
14. Households	711,207	936,623	1,261,999

final demand for households were the most difficult and subjective. This required estimating payments to the state and federal government in the form of taxes and the export of private capital for investment outside the area.

Output Per Man-Year of Labor

The input-output model can be used to project employment and ultimately population for a given level of final demand in a future time period. The additional coefficients necessary to project employment are in terms of labor productivity (dollar output per man-year of labor by sector).

Estimates of final demand in the state study assumed that development of technological process together with increased skills and capital formation will increase labor productivity nationally by approximately 2.9 percent per year [13, p. 17]. This estimate will vary by sector and geographic area. Therefore, it was necessary to estimate an output per employee coefficient for each sector within the model for each time period under consideration (Table XV).

One man-year of labor was required in domestic households for each $3,335,400 of personal income in the study area in 1965. This estimate was held constant for 1980, 1990 and 2000.

The Kansas study [13] was used as the initial starting point for determining labor productivity. Adjustments were then made in view of other studies [27 and 44].

In the "open end" input-output model consumer expenditures are usually treated as an exogenous variable. This convention arises from the nature of the endogenous sectors of the model. These sectors

TABLE XV

DOLLAR OUTPUT PER MAN-YEAR OF LABOR FOR SOUTHERN KANSAS, 1965, AND PROJECTED FOR 1980, 1990 AND 2000

Sector	1965	1980	1990	2000
	(1)	(2)	(3)	(4)
1. Crops	15,974	33,793	49,000	64,207
2. Livestock	17,948	32,540	46,858	61,175
3. Mining	19,899	40,152	68,258	96,364
4. Construction	29,945	80,846	111,360	141,874
5. Agri. Processing	63,343	85,270	105,820	126,370
6. Chemicals	84,495	147,863	190,109	232,356
7. Metal, Mach., Equip.	22,642	31,494	45,669	59,842
8. Other Mfg.	19,473	30,452	37,760	45,068
9. Trans., Comm., Util.	17,320	31,869	49,397	66,925
10. Trade	6,478	10,180	13,947	17,713
11. F.I.R.E.	33,750	50,961	62,436	73,910
12. Services	7,878	11,187	14,096	17,004
13. Local Government	25,506	36,224	45,642	55,060

produce goods and consume inputs from other sectors. If consumer expenditures are made endogenous, people become like machines requiring inputs in a constant manner and producing an output called labor. By making consumer expenditures exogenous, the assumption of constant consumer spending patterns can be circumvented [13].

Whether consumer expenditures are treated as exogenous or endogenous variables depends on what is being forecasted. When it is desired to forecast employment, consumer expenditures become endogenous [13]. Estimating future consumer spending patterns allows the assumption of constant spending patterns over time to be relaxed.

Output

The forecasting model relies on projected output as an intermediate step for projecting employment, population, income and water requirements. To maintain consistency and to eliminate the need for estimating future levels of consumer spending which implies a given increase in population, the household sector was considered endogenous in the model.

Output was projected under three assumptions: (1) households were considered endogenous using the 1965 consumption function, (2) households endogenous using the estimated 1980 consumption function, and (3) households exogenous using state projected household expenditures adjusted for the study area (Table XVI). The original computations were made with the household sector exogenous using the state final demand estimates adjusted for the study area. The household sector was then removed from the final demand sector.

TABLE XVI

PROJECTED OUTPUT BY SECTOR IN 1965 DOLLARS, SOUTHERN KANSAS, 1980, 1990 AND 2000

Sector	1980			1990			2000		
	Households Endogenous 1965 Consumption	Households Endogenous 1980 Consumption	Households Exogenous	Households Endogenous 1965 Consumption	Households Endogenous 1980 Consumption	Households Exogenous	Households Endogenous 1965 Consumption	Households Endogenous 1980 Consumption	Households Exogenous
					(Thousands of Dollars)				
1. Crops	586,983	585,287	579,544	714,566	712,127	693,809	913,714	910,080	868,724
2. Livestock	659,983	657,596	649,185	837,743	834,311	808,061	1,102,741	1,097,627	1,038,101
3. Mining	633,654	632,608	630,669	679,836	673,333	677,005	708,233	705,993	704,868
4. Construction	1,278,427	1,276,456	1,340,195	1,923,268	1,920,432	2,024,762	3,018,811	3,014,588	3,187,353
5. Agri. Processing	876,053	871,207	853,150	1,128,745	1,121,778	1,066,830	1,495,954	1,485,572	1,361,249
6. Chemicals	773,060	769,362	753,414	1,122,379	1,117,063	1,098,296	1,669,200	1,661,278	1,634,058
7. Metal, Mach., Equip.	1,579,298	1,578,770	1,584,900	2,767,995	2,767,233	2,778,715	4,867,030	4,865,899	4,886,162
8. Other Mfg.	442,529	441,302	458,036	644,239	642,475	670,529	939,234	936,605	977,068
9. Trans., Comm., Util.	712,487	709,532	747,645	1,032,140	1,027,891	1,090,943	1,560,453	1,554,119	1,664,055
10. Trade	908,540	905,366	1,043,459	1,294,884	1,290,321	1,512,185	1,914,212	1,907,414	2,261,585
11. F.I.R.E.	681,698	667,242	771,506	965,794	945,010	1,130,157	1,417,678	1,386,706	1,700,652
12. Services	1,152,674	1,151,341	1,310,105	1,690,689	1,688,772	1,988,076	2,539,488	2,536,630	3,030,679
13. Local Govt.	531,978	530,298	622,486	769,892	767,476	916,866	1,138,723	1,135,122	1,341,585
14. Households	4,385,936	4,343,220	—	6,305,827	6,244,413	—	9,396,695	9,305,179	—

The calculations were then made with the household sector endogenous and using the 1965 household consumption function. This procedure resulted in estimating higher levels of output for the basic sectors, crops, livestock and livestock products and mining as well as agricultural processing and the manufacturing of chemicals. The rest of the sectors showed a smaller output with this method of estimation. As the results of these two estimating procedures were inconsistent, measures were taken to determine where the inconsistencies occurred. It was hypothesized that the differences were due to: (1) changes in consumer spending patterns over time, which were not accounted for using the 1965 consumption function when households were considered endogenous, and (2) employment and population estimates assumed for the independent projections for household consumption were different from what the input-output model generates.

A 1980 consumption function for the study area was estimated by adjusting the state household expenditures by sectors [13]. This resulted in decreasing the household expenditures in all sectors, with the exception of trade, services and local government, which are expected to increase by 1980. The result was a slight decrease in the output of all sectors in the economy over the estimates using the 1965 consumption function. The change was less than one percent in all sectors except the F.I.R.E. sector, which decreased by 2.1 percent (Table XVI).

The direct, indirect and induced requirements table based on the projected 1980 household consumption function is presented in Appendix A, Table XXIV. The 1980 household consumption function and the Type II output multipliers derived from it are presented in Appendix B, Table XXV.

Type I output and income multipliers remain constant over time, but the Type II output and income multipliers are affected by the change in the projected household consumption function for 1980. No attempt was made to project consumer spending patterns beyond 1980. The 1980 consumption function was assumed constant for 1990 and 2000. Therefore, the Type II output and income multipliers projected for 1980 were assumed to apply to 1990 and 2000.

Projections have been made for output per man-year of labor by sector for 1980, 1990 and 2000. This implies a change in the direct labor requirements for each time period. Employment requirements and multipliers were computed for each time period and are presented in Appendix C.

Employment and Population

Employment was projected directly from the input-output model and the projected direct labor requirements. As constructed, the model accounts for all employment within the area with the exception of state and federal employment including military personnel. It was assumed that the state and federal government will employ five persons for each 100 persons employed in the remainder of the economy. This assumes no major changes in military installations or civilian government employment will occur. Employment projections by sector were computed for 1980, 1990 and 2000 (Table XVII).

Population was projected directly from the employment projections by applying a population-employment ratio. The 1965 population-employment ratio was computed directly by dividing the reported population in the area by the employment estimated from the model. The computed

TABLE XVII

PROJECTED EMPLOYMENT BY SECTOR,[a] BASED ON THE PROJECTED 1980 HOUSEHOLD CONSUMPTION FUNCTION, SOUTHERN KANSAS, 1980, 1990 AND 2000

Sector	1980	1990	2000
	(1)	(2)	(3)
1. Crops	17,320	14,533	14,174
2. Livestock	20,208	17,805	17,941
3. Mining	15,755	9,938	7,326
4. Construction	15,788	17,245	21,247
5. Agri. Processing	10,216	10,601	11,755
6. Chemicals	5,203	5,876	7,150
7. Metal, Mach., Equip.	50,126	60,594	81,314
8. Other Mfg.	14,491	17,015	20,782
9. Trans., Comm., Util.	22,264	20,808	23,222
10. Trade	88,936	92,516	107,685
11. F.I.R.E.	13,093	15,135	18,762
12. Services	102,917	119,805	149,179
13. Local Government	14,639	16,815	20,616
14. Households	1,303	1,873	2,792
15. State and Federal Govn.	19,613	21,028	25,197
Total	411,872	441,587	529,142

[a]Man-year equivalents.

ratio was 2.83 (1,064,015÷375,977). The estimated employment in the area using census accounting techniques would be 398,507 in 1965 assuming the 1960 reported participation rate of 2.67.

The employment estimates from the model are expected to be lower than employment reported in the census as the model computed employment on man-year equivalents. The OBE has projected employment and population for the 17 major water resource regions for the target years. The participation rate projected by the OBE was adjusted for the differences in accounting for employment. The adjusted population-employment ratios were estimated to be 2.75, 2.74 and 2.72 for 1980, 1990 and 2000 respectively. Applying these ratios to the projected employment gives a projected population of 1,132,648, 1,209,948 and 1,439,266 for 1980, 1990 and 2000, respectively.

Income

The total of the household row represents total personal income of southern Kansas residents. This corresponds to the U.S. Department of Commerce's definition of personal income. In 1965, total personal income for the study area was $2,585,469,000.

Per capita income for the study area in 1965 was $2,430 compared to $2,669 for the state of Kansas. In 1965, the per capita income of the study area was 91.04 percent of the state average per capita income. This compares with 91.21 percent in 1959 when the reported per capita income was $1,753 and $1,992 for the study area and the state, respectively.

Per capita income projected for the study area and the OBE projections for the state are compared (Table XVIII). The study area was projected to increase relative to the state in per capita income through 1990 and then decrease in 2000. This change in trend is not expected to actually occur between 1990 and 2000. It is reassuring, however, to find two independent sets of projections as close as these two are through 1990.

TABLE XVIII

PER CAPITA INCOME FOR KANSAS AND THE STUDY AREA FOR 1959, 1965, 1980, 1990, AND 2000, IN CONSTANT 1965 DOLLARS

Item	1959	1965	1980	1990	2000
Study Area	1,753	2,430	3,835	5,161	6,465
State of Kansas	1,922	2,669[a]	4,185[b]	5,482[b]	7,390[b]
The Study Area as a Percent of the State	91.21	91.04	91.64	94.14	87.48

[a]Estimated from the State Input-Output Model.

[b]Developed from _Preliminary Report on Economic Projections For Selected Geographic Areas, 1929 to 2020, Volume I_, Water Resources Council, Washington, D.C., March, 1968.

Water Requirements

Additional quantities of water will be needed to support the projected levels of production, employment and population in the study area. The economic forecasting model was used to estimate the water requirements necessary to sustain the projected levels of economic activity.

It was assumed that the quantity of water required to produce one dollar's worth of output is constant over time for the water using sectors contained in the input-output model with the exception of the household sector. Water requirements for the household sector are projected to increase by approximately two gallons per capita per day [24, p. 6]. This estimate receives support from the U.S. Water Resources Council report [48] which states that per capita water use is expected to increase slightly in the future. Since 99.7 gallons of water were required per capita per day for the household sector in 1965, it was estimated that 130, 150, and 170 gallons per capita per day will be required in 1980, 1990 and 2000 respectively.

The direct water requirements are defined as gallons of water required per one dollar's worth of output (income) in the household sector. Household direct water requirements for future time periods were calculated by determining the water requirements per capita per year and dividing the annual water requirements by the projected per capita income. For example, in 1980 the annual per capita water requirements were estimated to be 47,450 gallons (130 x 365) and per capita income was projected to be $3,835. Therefore, direct water requirements per one dollar of income is estimated to be 12.373 gallons (47,450 ÷ 3,835). This computational procedure estimates direct water requirements to be 10.608 in 1990 and 9.620 in 2000. Although per capita water requirements are projected to increase, it is by a lesser amount than the projected increase in per capita income. Therefore, the direct water requirements per dollar of personal income are projected to decrease over time.

The Type I water multipliers were assumed constant over time as the only projected change in direct water requirements was in the household sector. Water requirements and Type II water multipliers for 1980, 1990 and 2000 based on the 1980 household consumption function are presented in Appendix D.

The projected water requirements for the major water using sectors were calculated by multiplying the direct water requirements per dollar's worth of output times the projected output for future time periods listed in Table XV. Total water requirements, excluding irrigation, for the study area are projected to be 305,588; 419,732 and 607,318 million gallons for 1980, 1990 and 2000 respectively (Table XIX). Total water requirements are divided into instream and withdrawal water uses.

The Type II water multipliers (Appendix D) are the best estimates for analyzing the impact of a change in output on water requirements in the target years. The instream and withdrawal water requirements and multipliers assume a constant 1965 technical relationship between the generation of hydroelectric power and total production in the area. The second category of water requirements and multipliers are only based on water withdrawals. These estimates may be deemed more appropriate for some planning purposes.

The Need for Water Resource Planning

Future water requirements, as estimated by the economic forecasting model, indicate that present and planned sources of water supply will be adequate to meet the projected level of economic development in southern Kansas. However, this does not imply that problems do not

TABLE XIX

PROJECTED WATER REQUIREMENTS BY WATER USING SECTORS BASED ON THE PROJECTED 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS, 1980, 1990 AND 2000

Water Using Sector	1980	1990	2000
		(Million Gallons)	
2. Livestock[a]	22,290	28,280	37,205
3. Mining[a]	21,168	22,698	23,623
5. Agri. Processing[a]	7,163	9,223	12,214
6. Chemicals[a]	13,147	19,088	28,388
7. Metal, Mach., Equip.[a]	5,568	9,760	17,162
8. Other Mfg.[a]	5,719	8,326	12,137
9. Trans., Comm., Util.[b]	176,789	256,112	387,229
14. Households[a]	53,744	66,245	89,360
Total Withdrawal[a]	128,799	163,620	220,089
Total Instream[b]	176,789	256,112	387,229
Grand Total	305,588	419,732	607,318

[a]Withdrawal water requirements.

[b]Instream water requirements.

exist and future planning for water resource development is not necessary. On the contrary, water resource planning is a continuing process. As new technology and changes in consumer preferences alter the economic structure of the area the water requirements of the area will also be affected.

This study has concentrated on the overall effect of economic development in the southern Kansas economy on water requirements within the area. No attempt was made to project irrigation water requirements in the area, since the level of irrigation development was assumed to be independent of the economic structure and the levels of production in the area. However, the area will have sufficient water supplies to meet projected levels of irrigation according to estimates made by the state water board [21 and 23]. Heavy mining of ground water in the western part of the area is expected to deplete ground water reserves to the point where it will no longer be economically feasible to pump water for irrigation in small isolated areas. Additional planning is needed to determine when ground water will be depleted for irrigation purposes in specific localities and what course of action can be taken to prevent or reduce adverse economic effects this would have on local economies.

Disregarding specific programs to stimulate economic development in "poverty areas" in the eastern part of the study area, or the sparsely populated predominantly agricultural section in the western part of the study area, the majority of the increase in industrial activity would be expected to concentrate around the Wichita industrial complex. Long-range planning should concentrate on meeting the demands of the people in this area with respect to adequate water supplies for all purposes. This would include an adequate supply of municipal and industrial water of acceptable quality, proper planning for sewage and industrial waste disposal and adequate facilities to meet the demands for water-based recreation.

Summary

Long-range planning for water resources development requires projections of future economic activity in the study area. Projections of production, employment, population, income and water requirements were made for 1980, 1990 and 2000 by developing an economic forecasting model based on the empirical results of the input-output model reported in Chapter IV. The technical coefficients matrix employed in the forecasting model included the household sector. This eliminated the bias of developing a forecasting model to project employment and population that would have implicitly assumed a projected level of population if it had been necessary to project final demand including households. The projections of economic activity are directly dependent upon the projected final demand, which is used to estimate output. Changes in labor productivity were estimated to calculate employment from the projected output. A population-employment ratio was estimated and applied directly to the employment projections to calculate population for the study area in 1980, 1990 and 2000.

Total personal income is the estimated output of the household sector. Per capita personal income was calculated by dividing the total personal income by the projected population for each time period. The projected per capita income figures compare quite favorably with the OBE projected per capita income for the state of Kansas. This is encouraging in that it gives credulous support for the construction and assumptions of the forecasting model.

Future water requirements, as estimated by the forecasting model, indicate future supplies will be adequate to meet the increasing demand as a result of the projected level of economic development. Water resource planning in the area should concentrate on specific locations where water shortages may exist, but primary emphasis should probably be placed on water quality control and management, since the quantity of water available is not expected to be a limiting factor to economic development in the area.

CHAPTER VI

ECONOMIC IMPACT OF DEVELOPMENT OF A NEW CITY IN THE ARKANSAS RIVER BASIN

Problems of Outmigration

The problems of both rural and urban areas have been compounded by the overall outmigration of agricultural resources. "The worst is over for the farm-urban exodus, though much is yet to come" [46, p. 77]. "It is difficult to determine whether resources are being 'pushed' from rural America or are being 'pulled' toward urban America" [35, p. 2].

As evidenced by riots and current unrest in urban America, opportunities for improved well-being in the cities are not available to all. At the 1968 National Manpower Conference [46], it was clearly documented that solutions to problems in the cities must be accompanied by new efforts in rural communities to improve the overall problem. Urban and rural planners must strive to coordinate and work toward establishing a long-range development plan to solve the problem of population imbalance which presently exists between urban and rural areas. These areas are not unrelated and neither can solve its problems without due consideration of the other.

There is a general consensus of opinion that policies need to be prescribed and programs implemented that will reduce or <u>reverse</u> the rural to urban migration. However, there are no definite ideas as to what measures should be taken to accomplish this in the most economically feasible and socially acceptable manner. It is possible, in some areas at least, that economics and social acceptability may be in direct conflict.

The philosophies of people are continually changing concerning which area -- urban or rural -- provides the better living conditions. The general philosophy now appears to be changing -- as a minimum toward a "Rural Fundamentalism". It is more desirable to live in a rural area where the family realizes a higher level of community involvement as well as enjoying the aesthetic values attached to environmental quality, i.e., open space, natural beauty, and clean air and water. This is evidenced by the commuting of thousands of people from new homes in rural areas of Oklahoma and Kansas to nearby cities to work. These people have moved out of the cities for a "richer environment" for their families.

As a maximum, the philosophy is toward "anti-megopolism", i.e., to avoid the multimillion population cities and seek cities of sufficient size to offer the cultural and educational services demanded and still allow for a way of life closer to nature.

On the other hand, many of the current rural problems are related to the massive rural to urban population shift of the 1950's and 1960's. That increase in rural to urban migration suggests three important implications for rural America: (1) it appears that many rural areas are nearing a standstill in terms of economic growth and development, (2) rural areas have regressed in terms of well-being, and (3) each year large numbers of rural youth migrate to the cities seeking job opportunities or higher educational opportunities that are not available in their local communities. Very few of these young people return to their native communities for productive employment simply because the job opportunities for college trained youth are not available.

People remaining in rural areas to work generally receive lower per capita income, and have higher rates of unemployment or underemployment. It appears likely they also have less opportunity for achievement than their counterparts in the metropolitan areas.

> Agreement is reasonably sound that if rural America's most scarce resource, its youth, is outmigrating in its most productive years, the dreams for rural area development can scarcely become reality [35, p. 1].

Alternative Approaches to a Balanced Economic Growth in the United States

As our population increases we will have to build somewhere. The question is where? It has been stated [38, p. 19]:

> ...in what is left of this century, we must build as much as has been built in the whole nation altogether since the white man came. The "Columbus Challenge" it has been called. By the year 2000 ... nearly half of our people will live in houses or apartments not yet started and on land not yet broken.

Employment opportunities must be provided to attract more people back into rural areas in our heartland. If the present rural to urban migration pattern continues unabated, it is conceivable that by the year 2000 our nation could consist of a solid metropolitan perimeter along the east and west coasts, the southern Gulf coastal area and from the Great Lakes to the eastern seaboard. This would be synonymous to a centrifugal force throwing people to the outer periphery, leaving the interior of our country in a "partial vacuum", in the sense of population density.

Numerous theories have been proposed to reduce the poverty problem in both rural and urban areas. Most of the theories have been aimed at "treating the symptoms" rather than "curing the disease". In the past, problems have been identified as either rural or urban with the interaction between the two being a missing or weak link in both research and poverty oriented programs.

Tweeten ranks federal poverty programs by the social benefit-cost ratio method and states that one of the major priorities is to attract industry to depressed rural areas with Federal grants, loans and tax concessions. He suggests that substantial investment tax credits or grants should be the principal tool to attract industry and to create viable cities in depressed rural areas and to encourage decentralization in America [39, p. 84].

All of the published material on planning for future economic development either explicitly states or hints at the need for decentralization of industry. Industrialization in rural areas is appealing as it inhibits outmigration and community deterioration. One of the basic hazards to this approach is that it can divert immediate attention from the more basic problems such as planning for adequate health and educational facilities and in general preparing the populus for a harmonious community involvement.

Assumptions Relative to Developing a New City in Mid-America

Based on the assumptions of the forecasting model developed in the two preceding chapters, the population of the study area will be 1,439,266 by the year 2000. The potential population in the year 2000 would be 1,576,696 through natural increase based on the 1965 population estimate of 1,064,015. This natural increase estimate assumes the area will average 21.0 births and 9.7 deaths per 1,000 persons per year with a zero net migration for the area.

Based on these assumptions, the area will lose 137,430 (1,576,696 - 1,439,266) persons by the year 2000 due to net outmigration. It would be desirable to create sufficient employment opportunities to retain most or all of these people in the area, or possibly even to reverse the trend to the point where some immigration would occur.

If historic trends continue, the outmigration will be primarily the younger segment of the labor force seeking employment in the larger metropolitan areas. The problems of poverty, inadequate education, urban congestion, and the lack of job opportunities in rural areas have been recognized as critical barriers to the overall development of the nation [35].

Inland seaports, where appropriate, may be the stimulus needed by industrial and community developers to develop the natural and human resources within their regions. One writer states the [49, p. 1]:

> ...absence of navigable waterways, and distance from major consuming centers have limited the amount of settlement based on non-agricultural industries in the Great Plains.

If inland waterways can stimulate industrial development in presently sparsely populated areas, the Arkansas River Navigation Project offers new hope to many.

Navigation along the Arkansas River was opened to Little Rock, Arkansas in 1968, was extended to Fort Smith in 1970, and is expected to reach the Port of Catoosa at Tulsa, Oklahoma by early 1971. The U.S. Army Corps of Engineers, builders of the project, is studying three alternative routes to extend the navigation canal into Kansas. This would provide southern Kansas water transportation to the sea and access to 14,000 miles of navigable rivers and canals [36]. Adequate planning in conjunction with development of this inland waterway promises relief from some of the population pressures that are threatening to overwhelm major U.S. urban areas [36, p. 92].

The Arkansas River Navigation Project will have some impact on the southern Kansas economy even it if is terminated at Tulsa, Oklahoma. However, assuming that it is extended on into Kansas, the impact will be of a greater magnitude. Additional reservoirs will be constructed to assure adequate supplies of water for navigation during low flow periods. These will be multiple purpose reservoirs which will provide additional flood protection, recreational facilities, hydroelectric power and good quality water that can be used for municipal and industrial purposes. Upstream watershed development projects have enhanced water quality in major reservoirs by reducing sediment flow.

What is the impact on the study area, assuming the planning and development process will require nearly ten years, and further assuming a major city (Port Fabs) will be constructed in the Arkansas River Basin? The results of the forecasting model described in the preceding chapter will be used to estimate the impact of such a hypothetical but not unrealistic development.

Realizing the limitations of input-output as a forecasting technique, it is the best method of systematically evaluating what can be expected under proposed or hypothetical conditions of development. Systematic projections coupled with imagination are necessary to develop guidelines that could be influential in directing national and regional development policies.

Basis of Employment for Development of Port Fabs

Let us assume industry can be attracted to the area through government spending or private capital. Some indication of future industrial needs were gleaned from a U.S. Department of Labor publication [44]. Industrial development will indirectly affect the basic agricultural and mining sectors (located in the area but not in Port Fabs) through the inputs required by other sectors.

To demonstrate the use of the input-output model in estimating the impact on the area of developing Port Fabs, it was assumed there will be 9 new industries employing 5,800 people for delivery to final demand in 1980. The 9 industries represent 4 sectors in the input-output model (Table XX).

Due to the static nature of the input-output model, the analysis assumed the new industries in Port Fabs will have the same input structure the sectors had in 1965. The industries were aggregated into the sectors that were assumed to best represent their input structure.

Meat Packing Plant

Both per capita and total meat consumption is expected to increase, stimulated by population growth and increased per capita income.

> Extensive improvement in handling and processing are being introduced, especially in new plants being built near areas of concentrated livestock feeding... [44, p. 114].

Either increased broiler production in the "general area" or the increasing number and size of feed lots supplying fed beef animals could stimulate a new meat processing plant. This would probably result in closing some of the existing plants and the total employment increase would be relatively small. It was assumed a new processing plant would create 500 new jobs by 1980.

TABLE XX

PROPOSED NEW INDUSTRIES AND EMPLOYMENT FOR DELIVERY TO FINAL DEMAND BY SECTORS IN PORT FABS, 1980

Sector	New Industries	Employment
5. Agri. Processing	1. Meat Packing Plant	500
	2. Malt Liquors Industry	300
6. Chemicals	1. Synthetic Materials and Plastic Products	1,500
7. Metal, Mach., Equip.	1. Motor Vehicles and Farm Machinery	1,000
8. Other Mfg.	1. Modular Building Construction	1,000
	2. Electrical Equipment and Instruments	1,000
	3. Apparel	300
	4. Containers	100
	5. Recreational Equipment	100
	Total Employment	5,800

Malt Liquors Industry

Beer consumption will likely continue to increase. New plants will be built, old plants modernized and obsolete ones closed. This area, having a central location and a good transportation network, would be a favorable location for replacing an obsolete brewery. It was assumed that an efficient size plant in this area would employ 300 persons by 1980.

Synthetic Materials and Plastic Products

> Introduction of new and improved synthetic materials and products is expected to continue at a rapid pace. Processing innovations include larger, faster, more continuous equipment, new combinations of molding and forming techniques, and foamed-in-place and ultrasonic joining techniques [44, p. 172].

It seems reasonable that new industries adapting new technology will locate in new areas having the natural resources available, a potential labor supply, and low transportation rates.

The product of such an industry would be an important input to modular home construction. New and improved plastic pipe and other plastic products have unlimited potential as substitutes for existing inputs in many industries. It was assumed that by 1980 an industry of this type would employ 1,500 additional workers.

Motor Vehicles and Farm Machinery

Some non-automobile vehicle manufacturing industries are located in the area at the present time. These industries could expand or new industries may move in. Being a central geographical location, one of the large automobile manufacturers could conceivably locate an assembly plant in the area. Geographically, however, this area is more logically suited to manufacturing of farm machinery. Cheaper water-based transportation[1] for importing raw materials would be quite an inducement for establishing a new farm machinery plant. The raw materials,

---

[1]Also it is highly likely that both truck and rail rates will decrease for all basic products being moved into and out of the area, due to the competitive influence of the navigation project.

minerals, are available in the surrounding areas to support a new steel mill if a sufficient market for their product were created. It was assumed that a relatively small specialized farm machinery manufacturing firm would be established employing 1,000 people in Port Fabs by 1980.

Modular Buildings

There will be an increasing demand for building construction in the form of housing, office buildings, service centers and industrial complexes. Prefabricated components or complete modular construction for houses is assumed to result from new technologies. The labor force will be available. However, local supply of other inputs is unknown as it is hypothesized technology will change. Lightweight metals and plastics or other synthetics will likely be substituted for wood. A cheap source of transportation, navigation, will allow these prefabricated modular structures to be moved long distances at relatively low costs. This type of industry was assumed to employ 1,000 persons by 1980.

Electrical Equipment and Instruments

The demand for electrical components, and instruments as well as the assembled equipment, is projected to increase. This area has an advantage for this type of industry as it relies heavily on areospace manufacturing at the present time. As the areospace industry is susceptible to a high degree of fluctuation, increased electronic manufacturing for private industry could stabalize the economy as well as add to it. It was assumed that this industry would employ 1,000 additional workers by 1980.

Apparel and Containers

Despite recent trends toward larger firms, larger capital expenditures, and development of automatic equipment, apparel manufacturing will remain one of the least mechanized of the manufacturing industries. Small apparel manufacturing companies are gradually shifting to the central part of the U.S. A good example of this movement is the hosiery plant at Pawnee, Oklahoma. This is a small specialized company employing approximately 320 persons, the majority of which are women. These plants attempt to purchase as many inputs as possible locally and contribute to local community activity.

The primary inputs which this type of industry needs, that are not available locally, are packaging and shipping containers for the finished products. Local support is being given to attract such a firm into the area. It was assumed that a small specialized apparel plant would locate in the area employing 300 people, and a container manufacturing firm would be attracted to the area and employ 100 persons by 1980.

Recreational Equipment

Population increases, increased leisure time, and rising per capita income all are going to increase the demand for outdoor recreation. Many small manufacturing firms are presently manufacturing camping trailers in the area. The central geographical location also makes this an ideal area for future supplies of "all-terrain vehicles", snow mobiles and golf carts, along with accessory recreational equipment. It was assumed new recreational oriented firms will employ 100 additional persons in the area by 1980.

The Impact of the Proposed Development

Final Demand

The impact of establishing the proposed industries can be measured through the application of the input-output multipliers. Increased industrial production for final demand was estimated in terms of employment. Additional deliveries to final demand by sector, as a result of the new firms, were calculated by applying the direct employment requirements to the projected dollar output per man-year of labor for 1980 (Table XV). For example, the estimated dollar output per man-year of labor was projected to be $85,270 in sector 5 (agricultural processing) in 1980. The two new industries employing 800 persons will generate $68,216,000 of additional output in agricultural processing. Calculating the total additional final demand of the other sectors with increased production the total direct increase in area final demand was projected to be $398,676,000 in 1980 (Table XXI).

Output

Increased output by sector for the area that would accrue from the development of Port Fabs was calculated by multiplying the projected increase in final demand by the matrix of interdependence coefficients based on the 1980 household consumption function (Appendix A, Table XXIII). Total output per sector in the Arkansas River Basin in 1980, assuming development of the new city, is the sum of the output generated directly from the new city and the projected 1980 output without the development. Net increase in output per sector was used to estimate the impact on employment and water requirements per sector resulting from the new city development (Table XXII).

TABLE XXI

PROJECTED INCREASED FINAL DEMAND FROM PROPOSED NEW INDUSTRIES IN PORT FABS, 1980

Sector	Output per Man-Year In 1980	New Employees	Total Delivery To Final Demand
	(Dollars)	(Number)	(Dollars)
5. Agri. Processing	85,270	800	68,216,000
6. Chemicals	147,863	1,500	221,794,000
7. Metal, Mach., Equip.	31,494	2,000	62,988,000
8. Other Mfg.	30,452	1,500	45,678,000
Total		5,800	398,676,000

An alternative approach to estimating the increase in total output in 1980, as a result of developing Port Fabs, would be to sum the products of the projected final demand times the Type II output multipliers based on the 1980 household consumption function (Appendix B, Table XXV). This approach resulted in the same total output, but it does not allocate the increased output to the various sectors contained within the model.

It was assumed that increased output by sector (Table XXII) required by the new industries in Port Fabs would be met from additional

TABLE XXII

THE IMPACT OF DEVELOPING NINE NEW INDUSTRIES IN PORT FABS ON THE ARKANSAS RIVER BASIN, 1980

Sector	Increased Output	Increased Employment	Increased Water Requirements
	(Thous. of Dol.)	(Man-Years)	(Mil. Gal.)
1. Crops	25,062	742	--
2. Livestock	38,662	1,188	1,311
3. Mining	59,897	1,492	2,004
4. Construction	8,546	106	--
5. Agri. Processing	85,605	1,004	704
6. Chemicals	235,827	1,595	4,030
7. Metal, Mach., Equip.	68,580	2,177	242
8. Other Mfg.	53,775	1,766	697
9. Trans., Comm., Util.	26,368	827	6,570[a]
10. Trade	33,554	3,296	--
11. F.I.R.E.	25,597	502	--
12. Services	29,472	2,634	--
13. Local Government	15,032	415	--
14. Households	168,937	51	2,090
Total	874,914	17,795	17,648

[a]Instream water requirements, water requirements in the other sectors are withdrawal water requirements.

output from all sectors in the study area. However, in reality some of the increased output may be met by reducing the percentage of output some of the sectors are presently exporting. Development of a new city will change the industrial mix of the study area. This could result in enterprise substitutions, particularly in the agricultural sectors. These factors would influence the impact on the study area, but they are not expected to affect the projected output, employment or population of the new city since the increased output from the agricultural and mining sectors were assumed to be located in the study area but outside of Port Fabs.

Employment and Population

Employment multipliers can be used to estimate total employment that can be expected as a direct, indirect, and induced effects of establishing the proposed new industries in Port Fabs. Type II employment multipliers, based on the projected 1980 employment output ratios and the 1980 household consumption function, were the more appropriate since the development is expected to occur in 1980 (Appendix C, Table XXVII).

The estimated direct employment for the new industries producing for final demand will be 5,800 full-time employees (Table XXI). The total employment in the area generated by the direct employment will be 17,795 full-time job equivalents (Table XXII). This does not consider any change in the state and federal government sector.

If all of the new firms are located in one central location, Port Fabs, then most of the supporting industries would be expected to locate there also. However, some of the service and trade sectors in established trade centers such as Wichita and Arkansas City would supply some of the trade and services needed. The impact on the agricultural and mining sectors will occur where the basic inputs are being produced.

The indirect and induced employment resulting from the 9 new industries creates 11,995 (17,795 - 5,800) new jobs. If we assume 75 percent or 8,996 of these new jobs are located in Port Fabs, this would result in 14,796 new jobs (8,996 + 5,800). The addition of 740 state and federal employees, based on the earlier assumption of 5 state and federal employees for each 100 other employees, would result in total employment for 15,536 persons in Port Fabs in 1980.

Using the population-employment ratio of 2.75 the total population of the new city would be 42,724 (15,536 x 2.75) by 1980. The total increase in population in the study area including Port Fabs and assuming 740 additional state and federal employees would be 50,977 (18,537 x 2.75) by 1980. No attempt has been made to estimate the spill-over effect of employment outside the area generated by increased imports needed by the new industries. It seems logical that such a hypothetical city would increase in population to approximately 75,000 by 1990 and 100,000 by the year 2000.

<u>Income</u>

The direct, indirect and induced income effects computed from the 1980 household consumption function were used to estimate the impact of increased output on area income. These effects indicate the total income generated for a one dollar increase in sector output. The generative effect for a one dollar increase in output is (Appendix B, Table

XXVI) 0.671883, 0.287234, 0.574146 and 0.508621 for sectors 5, 6, 7 and 8 respectively. Applying these estimates to the final demand figures (Table XXI) indicates that $168,937,000 of additional income to households will be realized in the area. The same figure appears in the household sector of Table XXII as increased personal income. This income estimate does not include the personal income for the additional 740 state and federal employees assumed to be located in the new city.

Water Requirements

The Type II water multipliers based on the 1980 household consumption function (Appendix D, Table XXX) were used to estimate the water requirements to support the increased output in 1980 created from developing Port Fabs. Two approaches were used to estimate the additional water requirements to demonstrate the usefulness and versatility of the water multipliers.

Since the industrial base of the new city was based on 9 industries in 4 sectors employing 5,800 people for delivery to final demand, water requirements were first estimated on the basis of water requirements per job, man-year of labor, by sector in 1980. Estimates were made for the two water categories: (1) instream and withdrawal water requirements and (2) withdrawal water requirements. For example, to estimate the water requirements generated by the 800 new employees in sector 5 (agricultural processing) the following procedure was used: multiply the output per man-year of labor in 1980 ($85,270) times the direct water requirement per one dollar of output (8.222) times the 1980 Type II water multiplier for instream and withdrawal water requirements (6.906233) times the number of new employees (800). This estimates the total instream and withdrawal water requirements generated by the 800 new jobs in agricultural processing will be 3,873 million gallons of water in 1980. Using this procedure, the projected employment in the 4 sectors will require 17,647 million gallons of water in 1980.

Withdrawal water requirements can be estimated by substituting the 1980 Type II withdrawal water multiplier for the 1980 instream and withdrawal water multiplier. This estimates withdrawal water requirements for agricultural processing to be 2,530 million gallons in 1980. Total withdrawal water requirements for the 9 new industries in the 4 sectors were estimated to be 11,078 million gallons of water in 1980.

An alternative approach was to estimate water requirements from the projected final demand. This requires multiplying final demand times the direct water requirements times the appropriate Type II water multiplier.

Although the water multipliers are useful to estimate the total water requirements generated by increased output, they do not allocate the indirect and induced water requirements among the water using sectors. The sector allocations were made by multiplying the increased output due to the development by the direct water requirements for the water using sectors (Table XXII).

Existing and planned reservoirs in the area will be capable of meeting the increased future water requirements with good quality water. If a water transmission system is required between the original source and the new city, it would be capable of providing water for rural water districts which are rapidly increasing in number in this area due to an inadequate ground water supply [24, p. 4].

Will New Cities Work?

The future of "new cities" which could include existing small towns in viable areas or areas of future promise, will depend upon the attitudes of the people and actions of our policy decision makers at all levels of government. Whether a city grows of "natural causes", without government programs, depends less on how big it is and more on where it is located, the industrial base and infrastructure. If a city relies heavily on local retailing with only a little small time industry, it will tend to deteriorate. If it relies mainly on manufacturing it will tend to become middle-sized, i.e., in the 100,000 to 500,000 range [11, p. 26].

If in addition to several medium-sized manufacturing firms with a good industrial mix, the new city also has a mix of other activities such as wholesaling, transportation, education, government, health services, etc., it can become a viable growth center.

As a Nation, we can direct growth.

> In short, we can steer growth instead of letting it run wild, which is precisely the objective of the deliberations on a "national urban growth policy" now going on in Washington [11, p. 27].

In the past, growth has been stimulated by thousands of individual personal and business decisions arrived at for economic or personal reasons. Public policy has had very little to do with where growth occurred. At the present time, it is possible through zoning laws to forbid a businessman to build in a particular location, but he cannot be told where he must build. Neither will individuals in a free society accept being told where they must work or live to find work.

So what alternatives are available to steer urban growth toward rural areas? Such guidance could be done by inducement and persuasion. Many persuasive means have been suggested. The federal government could give tax credits, low interest loans or direct payments as incentives to attract industries to locate in a particular area. These grants, loans, tax credits and tax deferrals could be used to encourage appropriate kinds of new developments, i.e., to induce an industrial mix conducive to economic growth. The government could also direct its own projects and its own purchasing into growth areas.

For their part, the states could use similar inducements such as state industrial bonds and tax incentives. More importantly, however, they could pass laws enabling local governments to take steps that would make their localities attractive and suitable for growth. This would include early municipal planning and zoning laws. Consideration should also be given to consolidating small counties or townships and improving arrangements whereby municipalities could annex adjacent areas so they could be properly zoned for long-range planning.

Summary

If our national government desires to reduce or reverse the migration to our largest metropolitan areas, long-range policy programs must be enacted through the democratic process. Extensive research, education and planning will be needed, requiring tremendous capital outlays. The present trend in urban expansion can be circumvented by the creation of new cities, directed growth of small existing towns and renewal of our older cities. Which of these alternatives or combination of them is the most socially acceptable and economically feasible is yet to be determined through further research.

None of these alternatives will come into play without a systematically planned stimulus. If present trends continue unabated, what will take place "naturally" has been described as follows [11, p. 28]:

1. The biggest cities will grow bigger and the smallest will erode further, making life more difficult and more expensive in both.

2. More people will pack up and leave places where there are no jobs in order to seek jobs in the cities where, meanwhile, the jobs already have packed up and moved to the suburbs.

3. Sprawl will continue, smearing waste and disorder across the land.

In planning for new cities or the expansion of existing small towns, it is important to consider the base of both natural and human resources. We must strive to maintain high water quality standards and the "wholesome environment" where people wish to live and work if the opportunity is available. The new cities concept is one alternative to making this dream a reality for millions of Americans.

The input-output model and the economic forecasting model were used to estimate the economic impact in 1980 as a result of developing a new city in the Arkansas River Basin. The industrial base of the new city included 9 new industrial firms, in 4 of the input-output sectors, employing 5,800 persons for delivery to final demand.

Output of the area was estimated to increase by $874,914,000; employment by 17,795 jobs; and total water requirements by 17,648 million gallons in 1980. Population increase in the area was estimated to be 50,977 persons due to developing the new city. It was estimated that the population of the new city would be 42,724 in 1980.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Summary

Increasing demand for water of acceptable quality is placing greater emphasis on research and planning of our Nation's water resources. In planning for future economic development, research is needed to analyze the need for and impact of water resources in major river basins. This research is most relevant when done on the basis of a selected sub-basin region, such as a portion of the Arkansas River Basin.

The overall objective of this study was to develop an economic information system to describe present and projected levels of economic development and water requirements in a developing region. The specific objectives were to: (1) develop an input-output model for the study area based on 1965 data, (2) develop the technical relationships to describe specified production processes in 1965, (3) project employment, population, income and total water requirements for 1980, 1990 and 2000, (4) estimate the impact of developing a hypothetical city in the study area and (5) make recommendations for water resources planners working in the study area and similar areas.

Empirical results of the 1965 model were recorded in the input-output tables in Chapter IV. The transactions table, which provides a double entry system of accounts, is the foundation of the model with the other tables derived directly from it. Four classifications of input-output multipliers were estimated: output, income, employment, and water multipliers, with emphasis being placed on development of water multipliers. Two categories of water multipliers were estimated: instream and withdrawal water requirements, and withdrawal water requirements only. Type I multipliers (households exogenous) and Type II multipliers (households endogenous) were computed for each multiplier classification listed above. These multipliers were based on 1965 data and are measures of interrelationships which existed in the economy at that time.

Projections of production, employment, population, income and water requirements were made for 1980, 1990 and 2000 by developing an economic forecasting model based on the 1965 input-output model. However, a 1980 household consumption function was estimated to replace 1965 consumption patterns. This eliminated the bias of developing a forecasting model to project employment and population that would have implicitly assumed a projected level of population had it been necessary to project final demand including households. Projections of economic development are directly dependent upon the projected levels of final demand which were used to estimate future levels of output. Changes in labor productivity were estimated to calculate employment from projected output. Population-employment ratios were estimated and applied directly to the employment projections to calculate population for the study area in 1980, 1990 and 2000.

Final demand, labor productivity and population-employment ratios were projected as exogenous variables in the forecasting model. Water requirements per dollar of output were assumed constant over time with the exception of the household sector. Water requirements for the household sector were assumed to increase from the estimated 100 gallons per capita per day in 1965 to 130, 150 and 170 for the years 1980, 1990 and 2000 respectively.

Water requirements were incorporated in the input-output model to estimate water multipliers for direct application in water resources planning. The water multipliers are useful in estimating the total quantity of water required in the area as a result of establishing a new plant; e.g., a livestock processing plant.

The direct water requirements per sector and the water multipliers are only applicable to the study area or an area with a similar economy. These estimates will change over time as a result of (1) changes in technology which will affect the direct water requirements directly and (2) technological changes that will be reflected in the interdependence coefficients of the input-output model. This stresses the need for continual data collection and revision of the projections. Projections from the forecasting model are the best estimates of future economic activity and water requirements that are available at the present time for the Arkansas River Basin. They will be used for long-range water resources planning by the Kansas Water Resources Board. As conditions change and better data are available these projections will need to be up-dated.

The empirical results were applied to estimate the economic impact of new industries on output, income, employment and water requirements if a new city was developed in a rural area in the Arkansas River Basin by 1980. This demonstrated the applicability of the analytical model for planning purposes.

If historical trends continue the population of the study area will increase, but at a rate less than the national average. The natural rate of population increase (births in excess of deaths) would generate a larger population than was projected for the future time periods. The area is projected to lose 137,430 people by the year 2000 due to net outmigration. Some new stimulus is needed to provide employment and motivate people to remain in the area. Such a stimulus would be a new city such as Port Fabs where a good industrial mix is clustered in one area. Attracting new industries to rural areas is one approach to curtail the rural to urban migration movement. Developing a new city in the study area would be one alternative. At the present time this approach to revitalizing rural America is gaining in political support and social acceptability. However, no attempt was made to estimate the economic efficiency of the new city concept.

Conclusions

Conclusions and recommendations are best illustrated in view of the specific objectives of the study. Output multipliers measure the change in output in the economy as a result of a one dollar change in delivery to final demand in a sector. The agricultural processing sector Type I output multiplier (2.28) was the largest, followed by livestock (2.12), local government, etc. Local government had the largest Type II output multiplier (3.55), followed by agricultural processing (3.36), livestock, etc.

Income multipliers measure the total change in income in the economy resulting from a $1.00 change in income in a particular sector. Agricultural processing also had the largest income multipliers with a

Type I multiplier of 4.52 and a Type II multiplier of 6.70. The livestock sector ranked second with Type I and Type II income multipliers of 3.21 and 4.75 respectively. Local government ranked third for both types of income multipliers.

Employment multipliers define the change in total employment in the area resulting from a one unit change in the labor force for a particular sector. The agricultural processing sector had the largest Type I employment multiplier (5.82) and the largest Type II employment multiplier (8.06). Local government had the second largest Type I (3.18) and Type II (4.44) employment multipliers followed by the chemicals sector.

Water multipliers define the change in total water requirements in the economy as a result of a one gallon change in direct water requirements in a water using sector. Type I and Type II water multipliers were estimated for two water use categories (1) instream and withdrawal and (2) withdrawal only. The agricultural processing sector had the largest Type I water multipliers, 4.44 for the instream and withdrawal category, and 3.30 for the withdrawal category. However, the metal, machinery and equipment sector had the largest Type II water multiplier (8.43) for the instream and withdrawal category, but agricultural processing had the largest Type II water multiplier (4.74) for the withdrawal category.

Water multipliers were used to estimate total water requirements to support an additional job or man-year of employment in the water using sectors. It was estimated that each additional job in the agricultural processing sector would increase output by $63,343 and require 3,723,242 gallons of instream and withdrawal water of which 2,468,100 gallons are withdrawal water requirements.

The agricultural processing sector had either the largest or second largest multipliers for all of the multiplier classifications estimated. This was due to the definition of sectors, the industrial mix, and the interdependence between sectors in the study area. These conclusions would not necessarily apply if any of the above conditions were to be altered.

Employment in the study area was projected to be 411,872 man-year equivalents in 1980, 441,587 in 1990 and 529,142 in 2000. Applying the population-employment ratios to the employment figures, the population in the region was projected to be 1,132,648, 1,209,948 and 1,439,266 for the target years.

Future per capita income for the study area was calculated from output for the household sector (total personal income) in the forecasting model and the above population projections. Per capita income was estimated to be $3,835, $5,161 and $6,465 for the target years in constant 1965 dollars.

Total annual water requirements, excluding irrigation, for the study area were projected to be 305,588, 419,732 and 607,318 million gallons for the target years. Only 128,799, 163,620 and 220,089 million gallons were projected to be withdrawal water requirements with the balance projected as instream water requirements.

If by 1980 a new city is developed around 9 small industries employing 5,800 workers for delivery to final demand, the total impact would create 18,537 new jobs in the study area. It was assumed that 15,536 new jobs would be located in the new city, Port Fabs. The impact of developing Port Fabs assumed the increased output, employment, income, population and water requirements to be the net increases above the projected 1980 levels without the new city.

The increase in population of the study area was projected to be 50,977 in 1980 with 42,724 people projected to be living in Port Fabs. It seems logical that Port Fabs would increase in population to approximately 75,000 by 1990 and 100,000 by the year 2000.

Total personal income that would be realized in the study area in 1980 as a result of developing Port Fabs was estimated at $168,937,000. This does not include the income for 740 state and federal employees considered exogenous to the forecasting model.

Total instream and withdrawal water requirements and withdrawal water requirements were estimated to support the development of Port Fabs in 1980. Total water requirements were estimated to be 17,647 million gallons with 11,078 million gallons being withdrawal water requirements.

The results of this study will be useful to industrial and community organizations as well as local, state and federal agencies working in water resources planning and regional development. The forecasting model can be used to project future economic conditions and water requirements for the study area or similar areas for alternative assumptions with respect to final demand estimates. The water multipliers and water requirements per man-year of employment, reported herein, is particularly valuable for estimating the total water requirements associated with locating new industries in the Arkansas River Basin. Water multipliers will be useful to industrial developers in determining an optimum industrial mix for an area with a limited water supply. Although the empirical results of this study are for the Kansas portion of the Arkansas River Basin, the water multipliers are the best estimates available at the present time for other areas with a similar economic structure.

The results will be of particular interest to the Kansas Water Resources Board, as they indicate an adequate water supply will be available for future economic development. But, strong emphasis needs to be placed on maintaining water quality standards and water distribution systems. If the national objective is to maintain the rural-urban balance, people in rural areas must be assured of an adequate supply of good quality water. The results of this study indicates additional emphasis needs to be placed on developing rural water districts in the Arkansas River Basin where ground water is not always suitable for human consumption.

Limitations of the Study

The methodology developed is limited to estimating the water requirements or the actual quantity of water required to produce a given quantity of output. The source of the water, such as ground, stream and natural or man-made lakes, was not considered since adequate data were not available to differentiate the source of water used for most industries. This limits the applications of the results, but not the methodology, for areas where extensive waste water recycling processes are being used. This limitation could be avoided by defining the direct water requirements as "fresh water" or water used for the first time by an individual firm.

The model was constructed to estimate water requirements for eight sectors. This means firms with large variations in water requirements have been aggregated into a sector and the average water requirements have been used. This limits the application of the model for analyzing the impact on total water requirements for an individual firm locating in the area. This limitation can be circumvented by estimating the direct water requirements for the firm under consideration.

The usefulness of the model is further limited by the exclusion of a water-based recreation sector. It is felt that due to the large-scale water resource development already completed and/or planned for the Arkansas River Basin, water-based recreation will be a primary stimulant for small new industries to locate in the area. Good examples are manufacturers of boats and boat trailers, camping trailers, and other camping and sporting goods. Sufficient data are not presently distinguishable for the recreation sector to establish the technical relationship between recreation and other sectors in the economy.

The results of this study are limited to a portion of the Arkansas River Basin and do not apply to areas with different economic structures. However, the results may be applicable to other geographic areas with similar economic structures. It is felt the results of this study are relevant to other sub-basins in the Arkansas River Basin.

Recommendations for Further Study

As our Nation continues to grow, additional emphasis will be placed on long-range planning for organized national economic development. Increased emphasis will be placed on aesthetics and environmental quality. The source of good quality water supplies will become more important.

This study has developed methodology that will be useful to water resources planners. As stated earlier, planning is a continuing process and revisions must be made in any economic study at periodic intervals. At the present time, we have insufficient data on water supplies, water requirements, water consumption, and water technology such as the reconstitution or purification for reuse and recycling. Additional research is needed to fill these gaps.

National and regional studies concentrating on economic development and growth centers should consider the implications of increased water requirements. It would be desirable to have a water requirements study conducted for each of the major river basins in the United States.

Further research is needed in the area of actual water use. Better data are needed on the source of water withdrawals, the consumptive use of water, water returned to streams, surface storage, and ground water storage, and instream use for generating hydroelectric power, navigation and water-based recreation.

Concentrated industrial development in rural areas will greatly influence both water requirements and water distribution systems. Planners need to know where the people will be located to successfully plan for systematic water resource development.

It is recommended that future regional studies considering the implications of water requirements include a sector for recreation, preferably water and related land based outdoor recreation, if data are available. Consideration should also be given to including a sector on navigation as opposed to aggregating all modes of transportation into one sector, or as in this study, including it with communications and utilities. One alternative would be to develop a sector for instream water usage, which could include water-based recreation, hydroelectric generating and navigation.

It is recommended that future studies analyzing the economic impact of developing a new city, or industrial development in a rural area, use a more detailed approach. One approach would be to incorporate the model developed in this study in a simulation model capable of simulating the rate of growth and the impact on the economy for specified time intervals. Application of the methodology developed in this study to future research is only limited by data availability, resources in terms of money and manpower, and the imagination of the researcher.

A SELECTED BIBLIOGRAPHY

[1] Advisory Commission on Intergovernmental Relations. Urban and Rural America: Policies for Future Growth, A-32 Washington: April, 1968.

[2] Badger, Daniel D. Environmental Considerations Affecting Water Resource Development Projects. Paper presented at SCS Watershed Economics Workshop, Oklahoma State University, Stillwater, May, 1970.

[3] Barna, Tibor (ed.). The Structural Interdependence of the Economy. Proceedings of the International Conference on Input-Output Analysis. New York: John Wiley and Sons, Inc., 1956.

[4] Bourque, Philip J., and Millicent Cox. An Inventory of Regional Input-Output Studies in the United States. Seattle: University of Washington, Occasional Paper No. 22, 1970.

[5] Cameron, B. "The Production Function Leontief Models." Review of Economic Studies, XX, No. 1 (1953), pp. 62-69.

[6] "Can New Cities Remake America?" Changing Times, Vol. 24, No. 5 (May, 1970), pp. 19-22.

[7] Carter, Harold O. "Input-Output -- Uses and Problems in Regional Analysis for Agriculture." Regional Economic Development. Proceedings of the Methodology Workshop, Denver, 1966. Stillwater: Department of Agricultural Economics, Oklahoma State University, 1966.

[8] Center for Regional Studies. Kansas Statistical Abstract, 1966. Lawrence: University of Kansas, 1966.

[9] ____________________________. Kansas Statistical Abstract, 1968. Lawrence: University of Kansas, 1968.

[10] Chenery, Hollis B., and Paul G. Clark. Interindustry Economics. New York: John Wiley and Sons, Inc., 1959.

[11] "Does the Smaller City Have a Future?" Changing Times, Vol. 24, No. 6 (June, 1970), pp. 25-28.

[12] Emerson, M. Jarvin. The Interindustry Structure of the Kansas Economy. Manhattan: Office of Economic Analysis and Kansas Department of Economic Development Planning Division Report No. 21, 1969.

[13] Emerson, M. Jarvin, and Leonard Atencio. "Economic Projections of the Kansas Economy." (Preliminary rough draft subject to change, Manhattan, Kansas, 1970).

[14] Fellner, William. Emergence and Content of Modern Economic Analysis. New York: McGraw-Hill, 1960.

[15] Hirsch, Werner Z. "Interindustry Relations of a Metropolitan Area." The Review of Economics and Statistics, XLI (November, 1959), pp. 360-369.

[16] Hornbaker, Allison, and Ronald G. Hardy. Kansas Mineral Industry, 1967. Lawrence: University of Kansas, State Geological Survey Special Distribution Publication 35, January, 1968.

[17] Jansma, John D. "Secondary Effects of Upstream Watershed Development: Roger Mills County, Oklahoma." (Unpublished Ph.D. Thesis, Oklahoma State University, 1964).

[18] Kansas State Board of Agriculture. Farm Facts 1965-1966. Topeka: 1966.

[19] Kansas Water Resources Board. A Kansas Water Atlas. Topeka: 1967.

[20] ______________________________. A Study of Water Quality Control Needs. Topeka: September, 1967, Report No. 16(d).

[21] ______________________________. Future Irrigation Water Demands. Topeka: December, 1969, Bulletin No. 11.

[22] ______________________________. Industrial, Municipal and Rural Domestic Water Demands. Topeka: 1967, Report No. 16(g).

[23] ______________________________. Irrigation in Kansas. Topeka: September, 1967, Report No. 16(e).

[24] ______________________________. Planning for Plenty -- The Management of Kansas Water, 2nd ed. Topeka: May, 1966.

[25] Leontief, Wassily W. The Structure of American Economy, 1919-1939, 2nd ed. New York: Oxford University Press, 1951.

[26] ____________________, and Members of the Harvard Economics Research Department Project. Studies in the Structure of the American Economy. New York: Oxford University Press, 1953.

[27] Maki, Wilbur R. Projections of Iowa's Economy and People in 1974. Ames: Iowa Agricultural Experiment Station Special Report No. 41, 1965.

[28] Mayer, Leo V., and Earl O. Heady. Projected State and Regional Resource Requirements for Agriculture in the United States in 1980. Ames: Iowa Agricultural Experiment Station Research Bulletin 568, June, 1969.

[29] Miernyk, William H. The Elements of Input-Output Analysis. New York: Random House, 1965.

[30] Moore, Frederick T., and James W. Peterson. "Regional Analysis: An Interindustry Model of Utah." The Review of Economics and Statistics, XXXVII (November, 1955), pp. 368-381.

[31] Newman, Philip C., Arthur D. Gayer, and Milton H. Spencer. Source Readings in Economic Thought. New York: W. W. Norton and Company, 1965.

[32] Polya, G. How to Solve It, 2nd ed. Garden City, New York: Doubleday and Company, Inc., 1957.

[33] Richter, Jay. "Don't Hold Your Breath Waiting on New Towns." Farmland, Vol. 37, No. 9 (May 15, 1970), p. 16.

[34] Riley, V., and R. J. Allen. Interindustry Economics Studies. Bibliographic Reference Series No. 4 (Maryland, May, 1955).

[35] Sand, Larry D. "An Analysis of Economic Development Problems in a Rural Poverty Region: Southeast Oklahoma." (Unpublished Manuscript, Oklahoma State University, 1969).

[36] "Seaports for an Inland Empire." U.S. News and World Report, XLVIII, No. 21 (May 25, 1970), pp. 90-92.

[37] Shurtz, Earl B. Kansas Water Law. Topeka: Kansas Water Resources Board Report No. 16(f), September, 1967.

[38] "Tomorrow's Cities: Go Up, Spread Out or Start Over?" Chainging Times, Vol. 24, No. 4 (April, 1970), pp. 19-22.

[39] Tweeten, Luther G. Rural Poverty: Incidence, Causes and Cures. Processed Series P-590. Stillwater: Oklahoma State University, July, 1968.

[40] U.S. Congress, Senate. Policies, Standards, and Procedures in the Formulation, Evaluation and Review Plans for Use and Development of Water and Related Land Resources. Document No. 97, 82nd Congress, 2d Session, 1962.

[41] U.S. Department of Agriculture, Economic Research Service. Population-Migration Report, Vol. 1, Part 2. Washington: May, 1965.

[42] U.S. Department of Commerce, Office of Business Economics. Growth Patterns in Employment by County 1940-1950 and 1950-1960, Vol. 4 Plains. Washington: Government Printing Office, 1965.

[43] U.S. Department of the Interior. The Mineral Industry of Kansas. Washington: Government Printing Office, 1968.

[44] U.S. Department of Labor, Bureau of Labor Statistics. Technological Trends in Major American Industries. Washington: Government Printing Office, February, 1966.

[45] U.S. Extension Service. Statistics for Kansas Counties. Manhattan: Kansas State University, Department of Economics and Sociology.

[46] U.S. Senate, Subcommittee on Government Research, The Ford Foundation, and Oklahoma State University College of Business, Manpower Research and Training Center. The Rural to Urban Population Shift -- A National Problem. Committee Print, 90th Congress, 2d Session, of the National Manpower Conference for the U.S. Senate, Committee on Government Operations, at Oklahoma State University, May 17-18, 1968. Washington: Government Printing Office, 1968.

[47] U.S. Water Resources Council. Procedures for Evaluation of Water and Related Land Resource Projects. Washington: Government Printing Office, June, 1969.

[48] ________________________. The Nation's Water Resources. Washington: Government Printing Office, 1968.

[49] Voelker Stanley W. Migration and Poverty in the Great Plains. Illustrated talk presented at the Annual Meeting of the Great Plains Inter-Religious Commission, Oklahoma City, Oklahoma, July 29, 1969.

APPENDIX A

TABLE XXIII

INTERMEDIATE PROCESSING SECTORS IN THE SOUTHERN KANSAS MODEL AND THEIR COMPONENTS IN THE KANSAS MODEL

Sectors in Southern Kansas Model	Sectors in Kansas Model
1. Crops	Corn, sorghum, wheat, other grains, soybeans, hay and other agricultural products
2. Livestock and Livestock Products	Dairy products, poultry and poultry products, cattle and hogs
3. Mining	Crude oil and natural gas, oil and gas field services, nonmetallic mining and other mining
4. Construction	Maintenance and repair, building construction, heavy construction and special trade construction
5. Agricultural Processing	Meat products, dairy products, grain mill products and other food and kindred products
6. Chemicals and Allied Products	Industrial chemicals, agricultural chemicals, other chemicals, petroleum and coal products and rubber and plastics
7. Metals, Machinery, and Equipment	Primary metals, fabricated metals, other fabricated metal products, farm machinery, construction machinery, food products machinery, electrical machinery, other machinery, motor vehicles and aerospace
8. Other Manufacturing	Apparel, paper and allied products, printing and publishing, cement and concrete, other stone and clay, trailer coaches, other transportation equipment and other manufacturing
9. Transportation, Communications and Utilities	Railroad transportation, motor freight, other transportation, communications and utilities
10. Trade	Groceries, farm products, machinery and equipment, other wholesale trade, farm equipment dealers, gasoline service stations, eating and drinking and other retail trade
11. Finance, Insurance and Real Estate (F.I.R.E.)	Banking, other finance and insurance and real estate
12. Services	Agricultural services, lodging services, personal services, business services, medical and health services, other services and education
13. Local Government	Local Government

TALBE XXIV

DIRECT, INDIRECT AND INDUCED REQUIREMENTS TABLE BASED ON THE PROJECTED 1980 HOUSEHOLD CONSUMPTION FUNCTION, SOUTHERN KANSAS, 1980

Producing Sector	Purchasing Sector													
	Crops	Livestock	Mining	Construction	Agri. Processing	Chemicals	Metal, Mach., Equip.	Other Mfg.	Trans., Comm., Util.	Trade	F.I.R.E.	Services	Local Govt.	Households
							(Dollars)							
1. Crops	1.053889	.417698	.007195	.008898	.332700	.005994	.008770	.010613	.010469	.020585	.019174	.017906	.016680	.022019
2. Livestock	.021221	1.276065	.010599	.012868	.518281	.008866	.012913	.011540	.015399	.030034	.028612	.026579	.024617	.032481
3. Mining	.021033	.018352	1.174042	.025310	.014822	.258596	.009476	.020448	.051476	.015828	.014758	.015345	.018118	.016506
4. Construction	.039406	.038144	.028235	1.501144	.032535	.014208	.023906	.036583	.056614	.046051	.041373	.068567	.096901	.039695
5. Agri. Processing	.044367	.184350	.022272	.026854	1.152787	.018812	.026909	.024058	.032126	.063087	.060860	.056000	.051760	.067638
6. Chemicals	.070789	.061105	.039825	.048493	.046425	1.036291	.027974	.023083	.037203	.042287	.042181	.041998	.050750	.051333
7. Metal, Mach., Equip.	.018712	.013252	.025139	.056064	.010191	.008939	1.033554	.017518	.015277	.008187	.027856	.013431	.015042	.008009
8. Other Mfg.	.023786	.021251	.025182	.076501	.027114	.015009	.016112	1.041669	.026784	.037548	.052245	.034538	.056771	.026818
9. Trans., Comm., Util.	.084116	.077003	.058771	.063207	.079090	.063125	.062546	.066391	1.188323	.125287	.097339	.113178	.119192	.091073
10. Trade	.183015	.186030	.092818	.099539	.178770	.055981	.084766	.078884	.102977	1.222300	.128573	.159404	.159614	.183832
11. F.I.R.E.	.101328	.084186	.170206	.061792	.078242	.064242	.055322	.055312	.076999	.102133	1.118290	.105259	.153221	.127709
12. Services	.190446	.177798	.079142	.109195	.138920	.049502	.085260	.079819	.128885	.188391	.162663	1.186075	.622438	.201732
13. Local Govt.	.089545	.078412	.033788	.054521	.063958	.026416	.045730	.042245	.077801	.076513	.074825	.079543	1.196257	.105576
14. Households	.885183	.779989	.406071	.555641	.671883	.287235	.574146	.508621	.672480	.906622	.893210	.989407	.947527	1.466389
Total	2.826836	3.413635	2.173285	2.700027	3.345718	1.913216	2.067384	2.016784	2.492813	2.884853	2.761959	2.907230	3.528888	2.440810

APPENDIX B

TABLE XXV

PROJECTED 1980 HOUSEHOLD CONSUMPTION FUNCTION AND TYPE II OUTPUT MULTIPLIERS, SOUTHERN KANSAS, 1980

Sector	Type II Output Multipliers	1980 Household Consumption Function
	(Dollars)	(Dollars)
1. Crops	2.826836	.001140
2. Livestock	3.413635	.001180
3. Mining	2.173285	.000000
4. Construction	2.700027	.008954
5. Agri. Processing	3.345718	.036284
6. Chemicals	1.913216	.028953
7. Metal, Mach., Equip.	2.067384	.000646
8. Other Mfg.	2.016784	.007492
9. Trans., Comm., Util.	2.492813	.035279
10. Trade	2.884853	.102171
11. F.I.R.E.	2.761959	.073062
12. Services	2.907230	.090476
13. Local Government	3.528888	.059688
14. Households	2.440810	.064730

TABLE XXVI

PROJECTED INCOME MULTIPLIERS BASED ON THE 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS

Sector	Direct Effects	Direct and Indirect Effects	Direct, Indirect, and Induced Effects	Income Multipliers	
				Type I	Type II
	(1)	(2)	(3)	(4)	(5)
1. Crops	.466742	.603648	.885182	1.293322	1.896513
2. Livestock	.165886	.531911	.779989	3.206488	4.701956
3. Mining	.121389	.276919	.406071	2.281253	3.345203
4. Construction	.189807	.378918	.555641	1.996331	2.927399
5. Agri. Processing	.101339	.458189	.671883	4.521347	6.630051
6. Chemicals	.101812	.195879	.287234	1.923923	2.821222
7. Metal, Mach., Equip.	.353718	.391537	.574146	1.106919	1.623174
8. Other Mfg.	.292453	.346853	.508621	1.186010	1.739153
9. Trans., Comm., Util.	.340157	.458596	.672480	1.348189	1.976970
10. Trade	.472080	.618268	.906621	1.309668	1.920482
11. F.I.R.E.	.511215	.609122	.893210	1.191518	1.747229
12. Services	.579769	.674724	.989407	1.163780	1.706553
13. Local Government	.222614	.646163	.947527	2.902617	4.256365

APPENDIX C

TABLE XXVII

PROJECTED EMPLOYMENT MULTIPLIERS BASED ON THE 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS, 1980

Sector	Direct Effects	Direct and Indirect Effects	Direct, Indirect, and Induced Effects	Employment Multipliers	
				Type I	Type II
	(1)	(2)	(3)	(4)	(5)
1. Crops	29.592	47.628	77.591	1.610	2.622
2. Livestock	30.731	70.430	96.832	2.292	3.151
3. Mining	24.905	40.968	54.714	1.645	2.197
4. Construction	12.369	30.390	49.198	2.457	3.978
5. Agri. Processing	11.727	54.811	77.554	4.674	6.613
6. Chemicals	6.763	19.330	29.052	2.858	4.296
7. Metal, Mach., Equip.	31.750	36.034	55.468	1.135	1.747
8. Other Mfg.	32.838	38.986	56.202	1.187	1.712
9. Trans., Comm., Util.	31.378	44.779	67.542	1.427	2.152
10. Trade	98.232	119.555	150.243	1.217	1.529
11. F.I.R.E.	19.623	30.193	60.427	1.539	3.079
12. Services	89.389	101.378	134.868	1.134	1.509
13. Local Government	27.606	85.492	117.565	3.097	4.259

TABLE XXVIII

PROJECTED EMPLOYMENT MULTIPLIERS BASED ON THE 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS, 1990

Sector	Direct Effects	Direct and Indirect Effects	Direct, Indirect, and Induced Effects	Employment Multipliers	
				Type I	Type II
	(1)	(2)	(3)	(4)	(5)
1. Crops	20.408	33.900	56.640	1.661	2.775
2. Livestock	21.341	50.058	70.096	2.346	3.284
3. Mining	14.650	26.079	36.511	1.780	2.492
4. Construction	8.980	22.310	36.584	2.484	4.074
5. Agri. Processing	9.450	40.309	57.569	4.266	6.092
6. Chemicals	5.260	13.568	20.947	2.579	3.982
7. Metal, Mach., Equip.	21.897	24.971	39.720	1.140	1.814
8. Other Mfg.	26.483	30.970	44.036	1.169	1.663
9. Trans., Comm., Util.	20.244	29.795	47.071	1.472	2.325
10. Trade	71.700	87.533	110.823	1.221	1.546
11. F.I.R.E.	16.016	23.981	46.927	1.497	2.930
12. Services	70.942	79.904	105.320	1.126	1.484
13. Local Government	21.910	67.212	91.553	3.068	4.178

TABLE XXIX

PROJECTED EMPLOYMENT MULTIPLIERS BASED ON THE 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS, 2000

Sector	Direct Effects	Direct and Indirect Effects	Direct, Indirect, and Induced Effects	Employment Multipliers	
				Type I	Type II
	(1)	(2)	(3)	(4)	(5)
1. Crops	15.575	26.395	44.805	1.695	2.877
2. Livestock	16.346	38.922	55.145	2.381	3.374
3. Mining	10.377	19.359	27.805	1.866	2.679
4. Construction	7.048	17.670	29.226	2.507	4.147
5. Agri. Processing	7.913	32.022	45.996	4.047	5.813
6. Chemicals	4.304	10.589	16.563	2.460	3.848
7. Metal, Mach., Equip.	16.711	19.121	31.062	1.144	1.859
8. Other Mfg.	22.189	25.749	36.328	1.160	1.637
9. Trans., Comm., Util.	14.942	22.431	36.418	1.501	2.437
10. Trade	56.456	69.096	87.952	1.224	1.558
11. F.I.R.E.	13.530	19.958	38.536	1.475	2.848
12. Services	58.810	66.002	86.580	1.122	1.472
13. Local Government	18.162	55.447	75.154	3.053	4.138

TABLE XXX

PROJECTED WATER MULTIPLIERS BASED ON THE 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS, 1980

Water Using Sector	Direct Effects	Direct, Indirect, and Induced Effects	1980 Type II Water Multipliers
		(Gallons)	
	Instream and Withdrawal Water Requirements		
2. Livestock	33.896	75.636	2.231
3. Mining	33.461	60.611	1.812
5. Agri. Processing	8.222	56.783	6.906
6. Chemicals	17.088	46.335	2.712
7. Metal, Mach., Equip.	3.527	28.011	7.942
8. Other Mfg.	12.959	38.079	2.938
9. Trans., Comm., Util.	249.163	307.974	1.236
14. Households	12.373	44.332	3.583
	Withdrawal Water Requirements		
2. Livestock	33.896	56.453	1.665
3. Mining	33.461	45.970	1.374
5. Agri. Processing	8.222	37.081	4.510
6. Chemicals	17.088	30.610	1.791
7. Metal, Mach., Equip.	3.527	12.430	3.524
8. Other Mfg.	12.959	21.540	1.662
14. Households	12.373	21.644	1.749

TABLE XXXI

PROJECTED WATER MULTIPLIERS BASED ON THE 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS, 1990

Water Using Sector	Direct Effects	Direct, Indirect, and Induced Effects	1990 Type II Water Multipliers
		(Gallons)	
	Instream and Withdrawal Water Requirements		
2. Livestock	33.896	74.259	2.191
3. Mining	33.461	59.894	1.790
5. Agri. Processing	8.222	55.597	6.762
6. Chemicals	17.088	45.828	2.682
7. Metal, Mach., Equip.	3.527	26.998	7.654
8. Other Mfg.	12.959	37.181	2.869
9. Trans., Comm., Util.	249.163	306.787	1.231
14. Households	10.608	41.744	3.935
	Withdrawal Water Requirements		
2. Livestock	33.896	55.076	1.623
3. Mining	33.461	45.254	1.352
5. Agri. Processing	8.222	35.895	4.366
6. Chemicals	17.088	30.103	1.762
7. Metal, Mach., Equip.	3.527	11.417	3.237
8. Other Mfg.	12.959	20.642	1.593
14. Households	10.608	19.056	1.796

TABLE XXXII

PROJECTED WATER MULTIPLIERS BASED ON THE 1980 HOUSEHOLD CONSUMPTION FUNCTION FOR SOUTHERN KANSAS, 2000

Water Using Sector	Direct Effects	Direct, Indirect, and Induced Effects	2000 Type II Water Multipliers
		(Gallons)	
	Instream and Withdrawal Water Requirements		
2, Livestock	33.896	73.488	2.168
3. Mining	33.461	59.493	1.778
5. Agri. Processing	8.222	54.933	6.681
6. Chemicals	17.088	45.544	2.665
7. Metal, Mach., Equip.	3.527	26.431	7.494
8. Other Mfg.	12.959	36.679	2.830
9. Trans., Comm., Util.	249.163	306.122	1.229
14. Households	9.620	40.295	4.189
	Withdrawal Water Requirements		
2. Livestock	33.896	54.306	1.602
3. Mining	33.461	44.852	1.340
5. Agri. Processing	8.222	35.231	4.285
6. Chemicals	17.088	29.819	1.745
7. Metal, Mach., Equip.	3.527	10.076	3.076
8. Other Mfg.	12.959	20.140	1.554
14. Households	9.620	17.608	1.830

VITA

Robert Ray Fletcher

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE IMPACT OF ECONOMIC DEVELOPMENT ON WATER RESOURCE USE

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Greybull, Wyoming, April 29, 1937, the son of Mr. and Mrs. Wallace R. Fletcher.

Education: Graduated from Greybull High School, Greybull, Wyoming, in May, 1955; received the Bachelor of Science degree from the University of Wyoming with a major in Agricultural Economics in May, 1963; received the Master of Science degree from the University of Wyoming with a major in Agricultural Economics in June, 1965; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in May, 1971.

Professional Experience: Graduate Research Assistant, Department of Agricultural Economics, University of Wyoming, 1963-1965; Fieldman Appraiser, Federal Land Bank, 1965-1966; Agricultural Economist, Economic Research Service, U.S. Department of Agriculture, 1966-1970.

Organizations: American Agricultural Economics Association; Western Agricultural Economics Association; Alpha Zeta; Gamma Sigma Delta.