PROJECTED POPULATION, EMPLOYMENT, AND ECONOMIC OUTPUT IN COLORADO'S EASTERN HIGH PLAINS, 1979-2020

by

John R. McKean

February 1982

COLORADO WATER RESOURCES RESEARCH INSTITUTE

Colorado State University
Fort Collins, Colorado

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This report was prepared in partial fulfillment of the Colorado portion of a six-state study of the Ogallala Aquifer. Funding was provided by the U. S. Economic Development Administration through the firm of Camp Dresser and McKee, Inc.

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Norman A. Evans, Director

PREFACE

This publication is one of six technical reports prepared by Colorado State University, the Colorado Office of Energy Conservation, the Colorado Division of Water Resources, and the Colorado Department of Local Affairs as part of the six-state High Plains-Ogallala Aquifer Study. The study was authorized by Congress in 1976 under Public Law 92-587 to investigate the extent of groundwater depletion of the Ogallala Aquifer to project its future depletion to 2020 A.D. and the associated economic impacts upon the High Plains region of the United States and to develop recommendations for action to minimize economic disruption in the region.

The six technical reports listed below make up the Colorado portion of this study:

Technical Report No. 29. McKean, John, et al. An Economic Input-Output Study of the High Plains Region of Eastern Colorado.

Technical Report No. 30. McBroom, Emm. Energy Production and Use in Colorado's High Plains Region.

Technical Report No. 31. Burns, Robert. Community and Socio-Economic Analysis of Colorado's High Plains Region.

Technical Report No. 32. Longenbaugh, Robert. Hydrologic and Pumping Data for Colorado's Ogallala Aquifer Region, 1979.

Technical Report No. 33. McKean, John. Projected Population, Employment, and Economic Output in Colorado's Eastern Plains, 1979-2020.

Technical Report No. 34. Young, Robert, et al. Energy and Water Scarcity and the Irrigated Agricultural Economy of the Colorado High Plains: Direct Economic-Hydrologic Impact Analysis.

Copies of the Colorado technical reports may be purchased at $7.00 each from: Colorado Water Resources Research Institute, Bulletin Room, 171 Aylesworth Hall SW, Colorado State University, Fort Collins, Colorado, 80523 (Telephone: 303/491-6198). Prepayment requested for orders under $25.00. An abstract of any of the reports will be sent upon request.

In addition to these technical reports, a 12-page newspaper published in November 1982 summarizes research results for the Colorado portion of the study and describes possible options for action. Copies are available at no cost upon request from: Resource Analysis Section, Colorado Department of Agriculture, 1525 Sherman Street, Denver, Colorado, 80203, telephone (303) 866-3219.

The studies on which these reports are based were financed in part by the Economic Development Administration of the U. S. Department of Commerce under Contract No. EDA-78-2550 with the State of Colorado. The statements, findings, conclusions, recommendations, and other data contained therein are solely those of the authors and do not necessarily reflect the views of the Economic Development Administration or the U. S. Government in general.

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1. INTRODUCTION

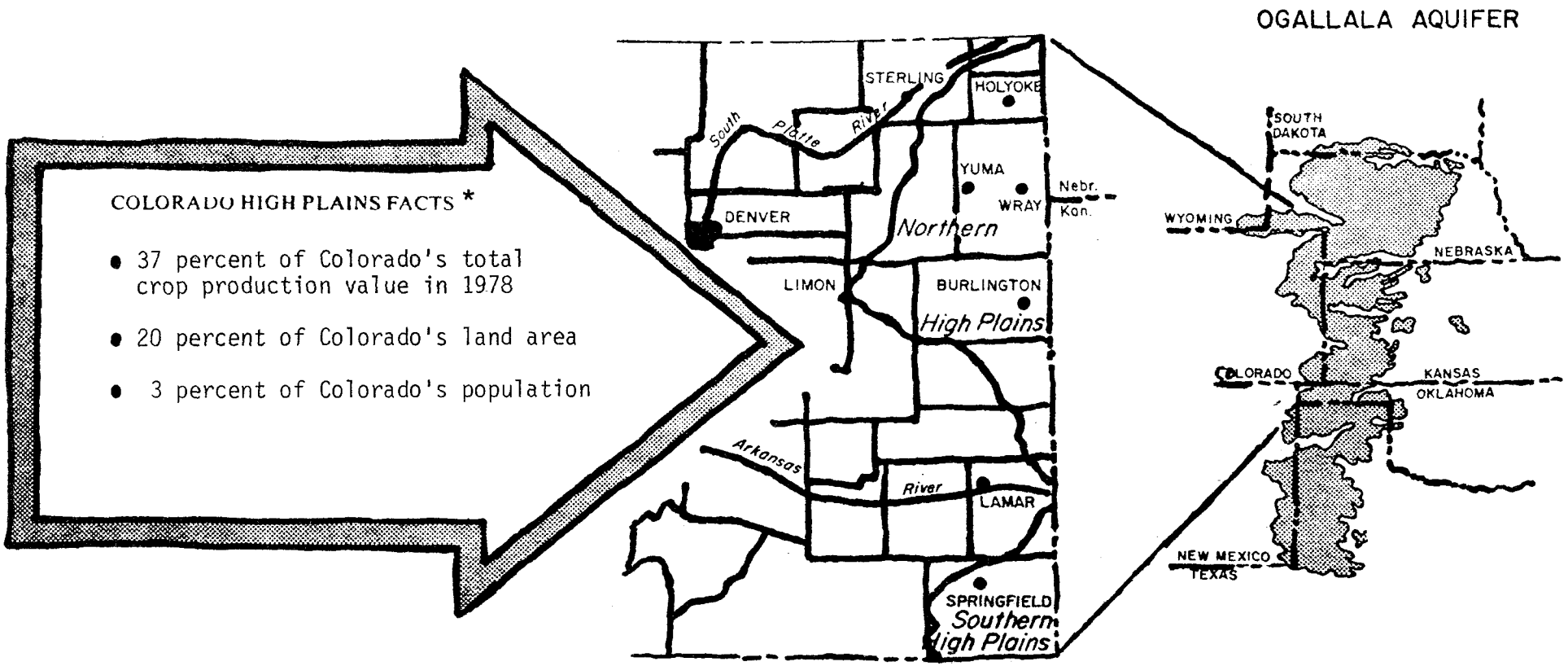
Extensive development of groundwater for crop irrigation has taken place on the western part of the Great Plains (the "High Plains") over the last 30 years. The source of water, the Ogallala Aquifer, is a layer of porous rock, water-bearing sand and gravel up to several hundred feet thick which underlies a large portion of the Great Plains from western Nebraska and eastern Colorado south to the Texas Panhandle, including parts of Kansas, Oklahoma, and New Mexico. Some 14 million acres are irrigated from the Ogallala in the six-state region, more than 20 percent of all irrigated croplands in the U. S. Figure 1 highlights the essential characteristics of the eleven-county aquifer region in Colorado.

Recent energy price increases combined with falling water tables of the aquifer have created concerns about the future viability of the irrigation-based economy of the High Plains. These concerns led the Congress in 1976 to fund an intensive study of the situation. The study is administered by the U. S. Economic Development Administration, advised by the High Plains Study Council composed of representatives from each of the six states. The general contractor for the project is a consortium of consulting firms called the High Plains Associates, consisting of Camp Dresser & McKee, Inc., as the lead organization with Black and Veatch, Inc., responsible for engineering and energy research, and Arthur D. Little, Inc., providing agricultural and economic forecasts. In Colorado, as in other states, a significant portion of the research has been subcontracted to the state land grant universities and various state agencies.* Direct agricultural and economic impacts,

*Colorado State University, the Colorado Division of Water Resources, the Colorado Department of Local Affairs, and the Colorado Office of Energy Conservation.

FIGURE 1

ELEVEN-COUNTY COLORADO HIGH PLAINS REGION



*Eleven-Colorado counties are included in this study of the direct plus indirect economic effects of alternative scenarios for irrigated agriculture. The counties are Baca, Cheyenne, Kiowa, Kit Carson, Lincoln, Logan, Phillips, Prowers, Sedgwick, Washington, and Yuma.

hydrologic impacts, and indirect regional economic impacts were studied at Colorado State University. The regional investigation has produced forecasts of economic and hydrologic conditions for 40 years under each of several policy scenarios. The policy scenarios include a BASELINE study, which assumes no new public policy initiatives, plus several alternative programs envisioning either water demand reduction or supply augmentation. A final PESSIMISTIC BASELINE scenario examines the impact under a less optimistic set of assumptions regarding energy costs, crop prices, and technological improvements.*

The purpose of this report is to describe the effects of these different scenarios upon the economy, employment, and population of the eleven-county area which contains the Colorado portion of the Ogallala region. This report relies heavily upon two other reports in this series: Energy and Water Scarcity and the Irrigated Agricultural Economy of the Colorado High Plains: Direct Economic Hydrologic Impact Analysis (24), which projects agricultural output and resource use for these scenarios, and An Input-Output Study of the High Plains Region of Eastern Colorado (26), which describes an economic model of the 11-county region with 1978 information. In turn, this report is the basis for social and community level impacts analyzed in Community and Socio-Economic Analysis of Colorado's High Plains Region (25).

This report first summarizes some past and present information about the 11-county region's economy, population, and land use; and then shows the projected effects of the policy scenarios upon the region's economy, employment, and population.

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*This description of the High Plains Ogallala Study is primarily from (24).

2. GENERAL FINDINGS OF THE PRODUCTION SCENARIOS

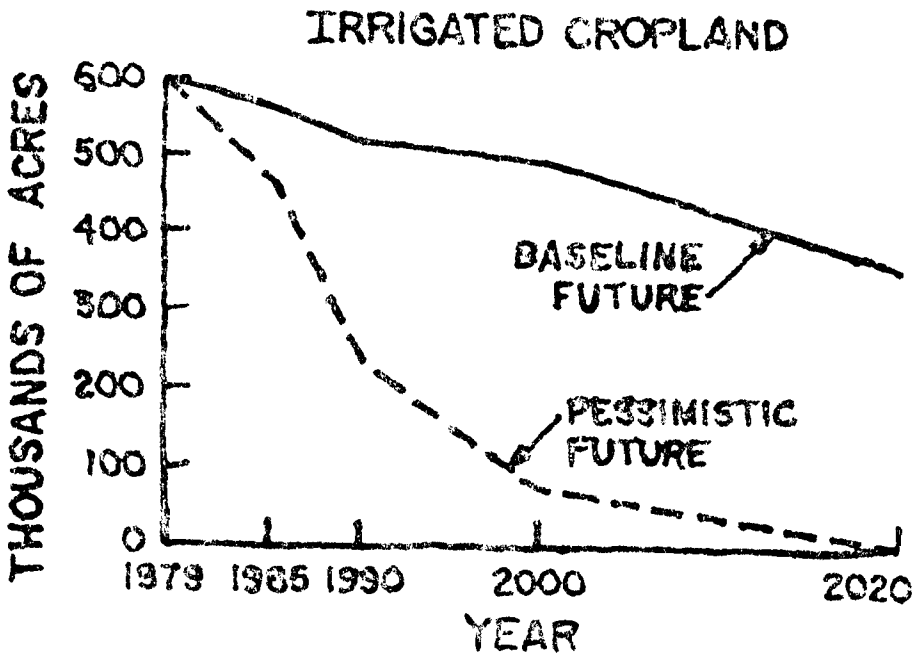
Agricultural production estimates are made for sets of assumptions designated as the BASELINE, and Scenarios 1 and 2--the EFFICIENCY and WATER RESTRICTION scenarios. Projections are also made of the results of providing additional irrigation water as described in Scenario 5. All these projections assume the same favorable yield increases and commodity price increases as the BASELINE--increases which may be unduly optimistic. Finally, a projection is made of the PESSIMISTIC BASELINE case, which assumes less favorable yield and price conditions.

The BASELINE projection forecasts a growing agricultural economic base in the Ogallala Aquifer area until the year 2000 with little growth thereafter. The PESSIMISTIC BASELINE projection forecasts declines in the agricultural economy of the Ogallala Aquifer area.

Figure 2 illustrates possible effects of changed assumptions on the future of irrigation from the Colorado Ogallala Aquifer. Under the PESSIMISTIC BASELINE scenarios irrigated cropland is projected to decline by 60 percent by 1990, by 90 percent in 2000, and to virtually disappear by 2020. The PESSIMISTIC BASELINE future occurs because of economic failure--inability to keep irrigating because it is unprofitable--even though water remains in the aquifer. In contrast, the BASELINE scenario's decline in irrigated acreage is mainly due to hydrologic failure--falling water levels in the aquifer.

By the year 2020, the value of crop output is 11.8 percent above the BASELINE if the EFFICIENCY policy is in effect. Employment in the Ogallala economy is 3.2 percent above its BASELINE level. The RESTRICTION policy allows crop output to exceed the BASELINE in 2020 by only 1.9 percent while

(FIGURE 2)



regional employment is 0.4 percent higher. The WATER TRANSFER policy 5A allows crop output to exceed the BASELINE by 28 percent and employment to rise by 8 percent. Under policy 5B, crop output in 2020 is 14.9 percent above the BASELINE while employment exceeds the BASELINE by 3.9 percent.

In contrast, the PESSIMISTIC BASELINE shows crop output falling over the 1979-2020 period by some 36 percent while the BASELINE shows output rising by 44.5 percent. By 2020, the value of crop output for the PESSIMISTIC BASELINE is 56 percent below the BASELINE while employment falls by 12 percent. It is interesting to note that the large secular decline in crop output under the PESSIMISTIC BASELINE is accompanied by a virtually constant regional employment level. Generally, regional employment reacts sluggishly to changes in policy. Percentage changes in employment generally are only about 1/4 to 1/5 as large as changes in the value of crop output. Some of the reasons for this outcome are explained on page 29.

3. HISTORICAL CHANGES IN THE ECONOMY AND POPULATION

Water from the Ogallala Aquifer was not used for irrigation in the High Plains until the drought years of the 1930's. At that time, farmers in northern Texas started sinking wells to bring water to the surface for irrigation. In 1952 Frank Zybach, of Strasburg, Colorado, developed the first successful center-pivot irrigation system. This system consists of sprinkler heads on a 1200-foot-long boom that pivots slowly around a well. Each system irrigates a circular area of about 130 acres in a quarter-section of land over a period of several days.

The center-pivot irrigation system made full irrigation economical in the High Plains of Colorado. Farmers began to take advantage of cheap natural gas and electricity to pump water from the Ogallala Formation. Slowly at first, then more rapidly, irrigated agriculture transformed the economy of the Colorado High Plains. By 1962, 525 wells had been sunk in the northern part of the Ogallala Aquifer in Colorado, to irrigate 56,000 acres. By 1980, this had increased tenfold to 600,000 acres irrigated by 4800 wells in the entire region. Table 1 shows the irrigated land in the eleven-county region. The totals shown in Table 1 include irrigation with non-Ogallala water. Figure 3 graphically illustrates the increasingly rapid growth of irrigation since 1955.

Currently the region's economy includes some oil and gas production and manufacturing, but is based almost entirely upon agriculture. The High Plains region produces an important, and still growing, share of the state's agricultural commodities. In 1978, the region produced $368 million worth of crops, 37 percent of the state total. Figure 4 illustrates the importance of the Ogallala Aquifer water to crop production in Colorado. Corn is the

TABLE 1

LAND UNDER IRRIGATION (ACRES)

COUNTY	1939	1949	1954	1959	1964	1969	1974	1978
BACA	3,021	1,371	5,073	20,987	56,910	63,246	85,594	74,347
CHEYENNE	0	0	355	501	3,567	8,727	17,467	24,872
KIOWA	104	20	2,345	1,884	5,127	9,779	12,217	6,039
KIT CARSON	0	1,530	4,396	18,946	56,576	87,906	124,259	144,712
LINCOLN	244	1,293	1,458	3,515	3,799	3,809	4,606	8,530
LOGAN	100,175	74,817	72,343	78,583	75,347	92,700	87,124	106,295
PHILLIPS	350	2,089	1,940	2,837	6,400	29,043	60,950	88,046
PROWERS	86,831	94,450	76,036	104,880	93,044	115,892	124,969	134,155
SEDGWICK	21,743	19,753	18,145	22,028	23,890	28,428	30,489	49,183
WASHINGTON	9,792	8,505	10,750	10,338	12,040	23,366	30,497	56,517
YUMA	2,727	1,586	5,117	11,133	20,175	89,200	173,101	265,044
11-COUNTY TOTAL	224,984	205,414	196,958	275,631	356,875	552,096	751,273	957,740
STATE TOTAL	3,220,685	2,872,348	2,262,921	2,684,757	2,690,018	2,894,984	2,873,692	3,458,031
STATE EXCLUDING THE 11-COUNTIES	2,995,701	2,666,934	2,065,963	2,409,126	2,333,143	2,342,888	2,122,419	2,500,291

SOURCE: Colorado Agricultural Statistics, Colorado Crop and Livestock Reporting Service, for the above shown years.

FIGURE 3

LAND UNDER IRRIGATION IN THE ELEVEN-COUNTY REGION

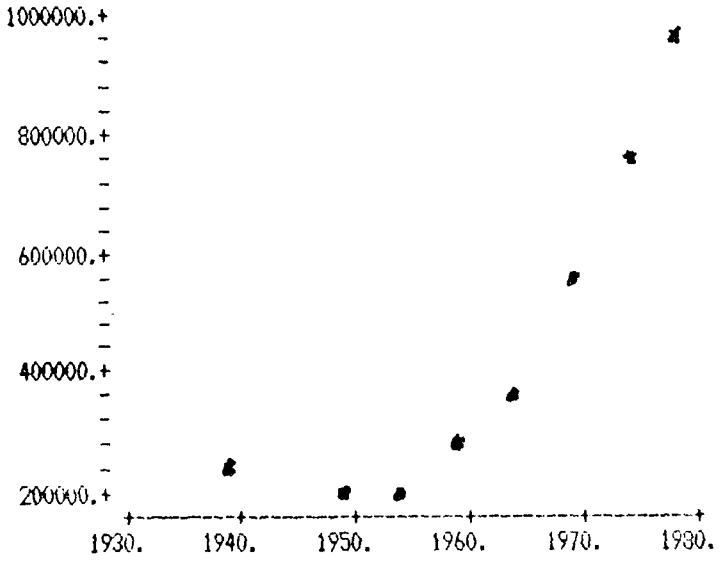
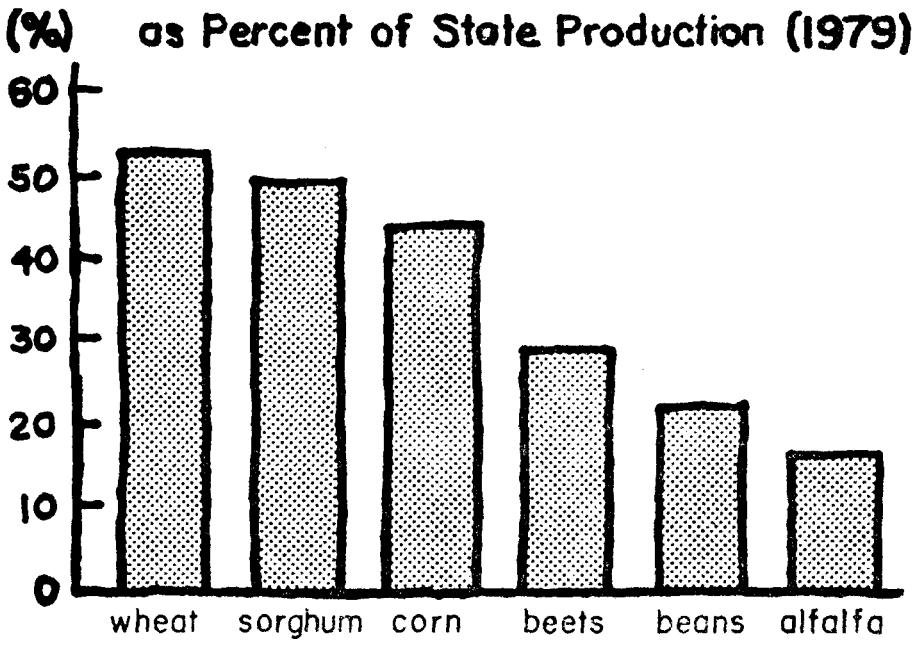


FIGURE 4

CROPS FROM OGALLALA AQUIFER WATER



SOURCE: Colorado Agricultural Statistics, Colorado Crop and Livestock Reporting Service, 1981.

chief irrigated crop in the region, while wheat is a principal dryland crop. Irrigation supports an intensive corn and cattle-feeding economy in the High Plains region with many small to medium-sized feedlots. But this intensive beef-producing economy has been based on a large su-ply of irrigation water, low-priced electricity and natural gas for irrigation pumping, and a strong demand for beef. All these factors are changing. Electric and natural gas power costs are increasing rapidly, and groundwater is being depleted. At the same time, crop prices and beef prices to farmers have remained stable or even declined slightly.

Farmers in the region are adapting to these changes. In the southern High Plains, farmers have shifted from raising corn to sorghum, which can be produced with little or no supplemental irrigation water. In the northern part of the region, sugar beet acreage is declining, as beets require large amounts of water. Wheat, which requires less water than corn, is being grown on increasing areas of irrigated land in the region. Less irrigation water is being applied to corn and other crops, even though this reduces yields.

The estimated population of the eleven-county High Plains region today is about 77,400 people--about 2.7 percent of the state's population. The population in much of the region has declined steadily. The eleven-county share of Colorado's population has fallen from 10 percent to less than 3 percent since 1930 (See Table 2).

Per capita income for the region is slightly below the state average, excluding Denver County. Community services are generally good in the larger towns of the Colorado High Plains. These larger towns are in the

TABLE 2

ELEVEN-COUNTY POPULATION vs. COLORADO

	1930	1940	1950	1960	1970	1980
Baca	10,570	6,207	7,964	6,310	5,674	5,419
Cheyenne	3,723	2,964	3,453	2,789	2,396	2,153
Kiowa	3,786	2,793	3,003	2,425	2,029	1,936
Kit Carson	9,725	7,512	8,600	6,957	7,530	7,599
Lincoln	7,850	5,882	5,909	5,310	4,836	4,663
Logan	19,946	18,370	17,187	20,302	18,852	19,800
Phillips	5,797	4,948	4,924	4,440	4,131	4,542
Prowers	14,762	12,304	14,836	13,296	13,258	13,070
Sedgwick	5,580	5,294	5,095	4,242	3,405	3,266
Washington	9,591	8,336	7,520	6,625	5,550	5,304
Yuma	13,613	12,102	10,827	8,912	8,544	9,682
TOTAL	104,943	86,712	89,318	81,608	76,205	77,434
THE STATE	1,035,791	1,123,296	1,325,089	1,753,947	2,209,596	2,888,834
% OF STATE POPULATION IN ELEVEN-COUNTY REGION	10.1	7.7	6.7	4.7	3.4	2.7

SOURCE: Census of Population, U.S. Department of Commerce, Bureau of the Census, Washington, D.C.

irrigated areas. In much of the unirrigated area, small, scattered populations live far from commercial and public services.

The High Plains region contains 20 school districts. Only the four largest school districts in the region have more than 500 pupils, and several have fewer than 200. Expenses per pupil are high because of long transportation distances and the small number of pupils per teacher.

Hospitals and clinics are well-distributed throughout the Colorado High Plains. Each of the seven towns in the region with more than 900 people has a hospital. However, the ratio of physicians to population in the region is below the state average.

4. THE METHOD USED TO ESTIMATE REGIONAL IMPACTS

The comprehensive interindustry production model developed by Nobel prize winner W. W. Leontief is appropriately designed to analyze the direct plus indirect effects of changes in irrigated crop output. This models strength is its capability to describe the interdependence existing among sectors of an economy and to demonstrate, sector by sector, the total consequences of any number of economic scenarios. The model is thus both descriptive and analytical. An interindustry model is constructed through the collection of extensive primary data, from firms and agencies within the region, and subsequent tabulation of the data in a form consistent with the interindustry framework. The analytical phase includes impact analysis, development of the various multipliers, and consistent forecasting under alternative resource development scenarios.

The purpose of the interindustry technique is to provide a detailed description of a regional economy and to develop a means for projecting future economic conditions. The input-output approach utilizes the following base data:

- An industry-by-industry sales and purchases distribution, measured in dollars;
- A measurement of each industry's purchases of labor, raw materials, and processed goods within the study region as opposed to imports from outside the region;
- Employment on an industry-by-industry basis in the study region.

In addition to the information provided directly by the base year data, the input-output model is used to generate provisional forecasts of industry-by-industry output, employment and population in future years. These provisional forecasts may be based upon expectations for change in the key economic sectors which have the greatest economic influence on the study region. For the eastern high plains, of course, the primary economic sectors are agricultural.

Nature of the Model

An interindustry model empirically illustrates the interdependent economic structure of the study region. The model provides an account of transactions for each sector of the economy. This involves a calculation of the input requirements of these sectors. Essentially, the model is a system of double-entry bookkeeping in which annual sales and purchases by each sector to and from all other sectors are accounted for and measured.

The model consists of two major components: (1) intermediate transactions are the purchase and sale of intermediate goods which are subject to further local processing and (2) final transactions include all purchases and sales from and to sectors that are external to the model

(i.e., to sectors not identified as intermediate or producing sectors). Final transactions would include, for example, sales from intermediate sectors to investment, governments, and exports and purchases by intermediate sectors from governments or imports.

The model is "driven" by final demand sectors: any particular sector's sales to state or federal government or exports. If these change, the model estimates the impacts of this change on the entire economy. These impacts, whether measured in terms of employment, income, or value of production, provide consistent estimates which mutually and simultaneously satisfy all requirements for intermediate and final production.

Once the empirical description of economic transactions has been developed for the Ogallala region, forecasting with the analytical technique requires only the specification of appropriate changes in exports by sector. The input-output methodology is simply to divide the industries of the regional economy into two groups: (1) businesses which service and supply inputs mainly to other businesses within the region, and (2) business firms which sell mainly to customers outside the region. The latter group of firms are often termed "basic" industries. "Basic" industries along with state and federal government, form the demands which determine the business activity of the local suppliers of raw materials, labor, and processed goods. The local economy is said to be "driven" by the growth of basic industry.* Thus, in order to project local business activity, it is important to determine the key economic sectors. These driving sectors will be the businesses which sell most of their output outside the region but purchase a significant share of their inputs inside the region. In

*The primary "basic" sectors in the eastern high plains are agricultural.

order to be of major importance, the businesses must also have a significant size and show expectations of volatility (high future growth or, possible, high rates of decline).

In order to determine the interindustry structure in a region and to identify the important driving sectors, a transactions table is constructed. This transactions table is a system of double-entry bookkeeping such that sales and purchases by each industry to and from each other industry (as well as labor, government, and exports) are accounted for and measured.

Two features of the input-output technique make it particularly desirable for the analysis of growth or decline in a regional economy. First, the technique provides information on sales and related variables (such as employment and income) on an industry-by-industry basis. This information is more detailed than that provided by most alternative techniques. Second, input-output projections of future business activity in the region are consistent. That is, the projected value of production by each sector is the minimum required to meet the needs of other industries in the region and projected exports. Inputs and outputs must be in accounting balance at all times. This simultaneous balancing of production to requirements among industries in the region provides much more realistic projections than isolated forecasts for individual industries.

Input-Output Projections

The input-output technique provides two forecasting tools: multipliers and development scenarios. A business transactions multiplier indicates how much business activity in dollars of transactions is generated within the region for each dollar of sales by a given industry to final demand. A multiplier will be large for an industry that purchases a large part of its

inputs from within the local economy. This is because the money which it earns from its sales will be spent again in the region.

Several types of multipliers may be calculated. The business transaction multiplier shows the total business spending within the region per dollar of additional sales to final demand by a given industry. An employment multiplier shows the total added employment in the region per dollar of additional sales to final demand by a given industry. An income multiplier shows the increase of personal income per dollar of additional sales to final demand by a given industry. Multipliers are often expressed in alternative forms such as, total change in employment per new employee in a given industry, or total change in personal income per dollar increase in payroll in a given industry.

The multipliers may all include direct, indirect, and induced effects. For example, if a "basic" industry such as irrigated corn, expands its sales to exports by $1000, it may spend $500 directly on locally produced goods. The producers of these local goods than are indirectly required to purchase some local goods and services to meet this additional demand. Induced impact refers to the assumption that labor hired by irrigated corn farms and by other sectors will respend a fixed proportion of its added income, stimulating further expansion of the regional economy. Thus, both local producers and local labor are assumed to respend locally part of their increased incomes which resulted from the increased exports of corn. The total effect is reflected in the multiplier.*

The second forecasting tool provided by the input-output technique is the projection of future business activity by sector. In addition to the

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*Business transaction multipliers and employment multipliers for the eleven-county economy are shown in the appendix.

projection of dollar sales for each sector, variables that rise proportionately with production also may be estimated. Employment, water use, population, and energy use are examples of such variables.

Projections of future economic activity are derived by focusing on the "basic" or driving industries. Examination of the size of the multipliers and the size and expected change of the basic industries reveal key sectors. For the eastern high plains, estimates of expected export change in agricultural sectors must be obtained in order to drive the input-output model. Scenarios for change in these sectors are derived from the report (24). The expected growth or decline estimates for the agricultural sectors and other key sectors are introduced into the interindustry model to generate new, consistent estimates of the value of sales for each industry. A more detailed explanation of the Ogallala Aquifer region interindustry model is contained in the report (26).

Population Projection

The interindustry model has the flexibility to be applied in many ways according to the needs of the research. Here, we assume that the region's population is determined primarily by employment--people do not migrate to the area for retirement or to attend school, for example. Employment-related population change can be projected by the interindustry model if employment for each industry and sector can be assumed proportional to the output of that sector and further that family size and workers per family are also constant over time. (Ideally, each sector would not only have a unique ratio of employment to output, but also each industry would have a unique ratio of population to worker.) After adjusting for natural population growth in the

region, the net migration implied by the projection of output change could also be determined. A computer model to allow economic analyses such as this which may be accessed interactively from remote terminals is currently available at Colorado State University (Department of Economics).

5. DESCRIPTION OF FARM PRODUCTION SCENARIOS*

Scenario 0. BASELINE

The BASELINE scenario assumes changes in producer costs, prices, and water use that are expected to occur without strong public policies or programs to improve agricultural conditions in the six-state study region.

The states participating in the High Plains-Ogallala study were required to project the results of five alternative sets of assumptions in addition to the BASELINE. These scenarios included action to mitigate the effects of increasing production costs--especially irrigation pumping costs--and declining water availability. For Colorado, these alternatives have been named and defined as follows:

Scenario 1. EFFICIENCY

This scenario is based on the assumption that less energy can be required for irrigation than is used in the BASELINE. Costs are reduced by increasing the efficiency of irrigation pumping and distribution more rapidly than is assumed in the BASELINE. Voluntary improvements would be initiated by producers as irrigation equipment is repaired or replaced. Thus, spending would not exceed BASELINE maintenance costs. However, pumping efficiency would not show significant improvement until 1990.

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*All of the scenarios discussed here are shown in detail in the report (24).

Scenario 2. RESTRICTION

The restriction scenario is created by projecting the results of public action to regulate the use of water, in addition to the improvements assumed in the EFFICIENCY scenario. Water use is cut by 10 percent in 1985, 20 percent in 1990, and 30 percent by the year 2000 and thereafter. Crop prices are adjusted for changes in cropping patterns in the six-state study region.

Scenario 3. ENHANCEMENT

This scenario would have been created by projecting the results of measures taken to increase aquifer recharge through infiltration and to increase precipitation through weather modification. No projections could be made because no information on the results of these measures could be obtained.

Scenario 4. INTRASTATE WATER TRANSFER

This scenario would have been created by projecting the results of transferring water to the Colorado high plains from other region of Colorado. Such transfers might be physically possible, but their costs and potential have not been ascertained so no projections can be made.

Scenario 5. INTERSTATE WATER TRANSFER

Costs of water transfer from the Missouri River have been prepared by the U.S. Army Corps of Engineers. Preliminary estimates indicate that the cost of water made available through such transfers would exceed, by five times, the additional net value that could be produced in Colorado crop production. Thus, it must be assumed that water transfer costs are not charged to farm producers. To examine the results of making additional water available, a projection was made by assuming that by 2000 enough water could be transferred to restore irrigation on all lands where it had been discon-

tinued for lack of economically available ground water. This scenario has two subsets. The efficiency improvements of Scenario 1 are incorporated to create scenario 5A. Scenario 5B is generated by adding the regulation on water use assumed in Scenario 2.

Scenario 6. PESSIMISTIC BASELINE

The PESSIMISTIC BASELINE scenario examines the sensitivity of the results to the relatively optimistic assumptions of the other projections. Some of the assumptions on which the preceding projections are based may be unrealistically optimistic. Specifically, the projections are predicated on assumptions that agricultural productivity--crop yields per acre--will continue to increase strongly throughout the next 40 years, although not as much as in the last several decades. Also it is assumed that commodity prices--especially the price of corn which is the main irrigated crop--will increase steadily to nearly one-third higher than its present level by 2020.

There are fairly convincing reasons to question the validity of these assumptions. Yield increases in the past have been based largely on increasing fertilizer applications. The easy problems have been solved. Fertilizer is generally energy intensive and based on petroleum products, thus may be increasingly expensive. Feed grain prices have not only remained fairly static for several years, but several interpretations of demand trends, energy costs, and livestock production alternatives suggest that they may remain at present levels indefinitely. Finally, the costs of fuel and electricity for irrigation and tillage, as well as the cost of fertilizer, may increase more rapidly than assumed in the other projections. Less-favorable assumptions were used by the Colorado study team to develop a PESSIMISTIC BASELINE projection.

The PESSIMISTIC BASELINE scenario is specifically shaped to show the effects of the joint occurrence of several less favorable conditions. While each of these conditions is quite possible by itself, their joint occurrence would be less likely. This scenario provides a check on the other projections where the joint occurrence of highly favorable conditions is assumed. Thus our PESSIMISTIC BASELINE scenario provides a more realistic range of outcomes to the study. Funding did not permit testing scenarios 1 - 5 under the PESSIMISTIC conditions.

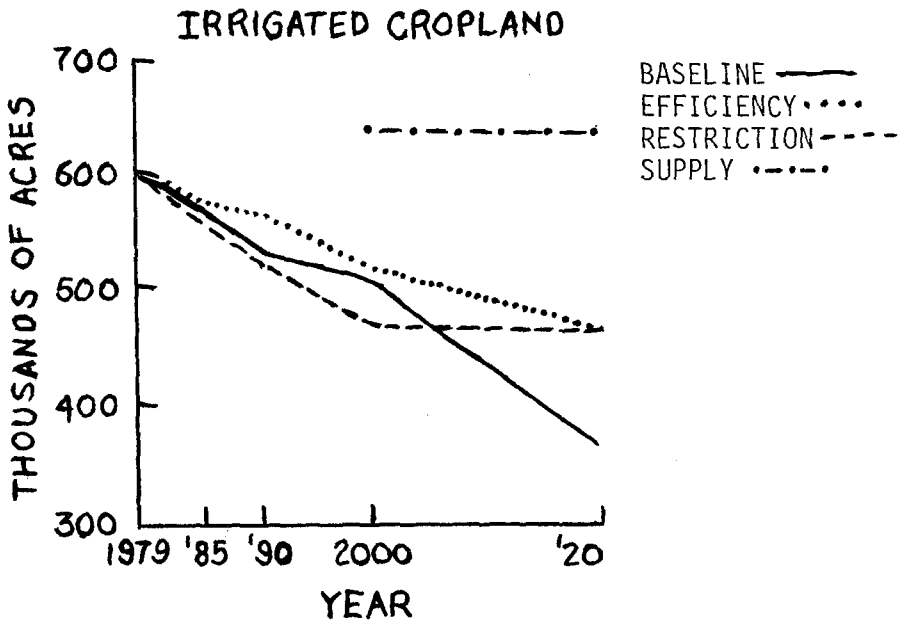
The assumptions for scenario 6 are as follows: crop prices are held constant in real dollars at their 1979 level, prices of energy and fertilizer are projected to increase twice as fast as in the previous scenarios, grain and sunflower yields are projected to increase one-half as fast as in the previous scenarios and fertilizer use is scaled back proportionately.

6. PROJECTED CHANGES IN FARM OUTPUTS

The direct effects on farms of the alternative scenarios are projected in the report (24). The farm level analysis simulates the reactions of profit oriented farmers to changes in water availability and costs, energy costs, fertilizer costs, crop prices, technological change and government policies. The solution technique combines a model which predicts depth to water and water remaining for each township, a national model which predicts crop prices, and farm management models which use linear programming to select optimal water and energy purchases and optimal crop mix under varying conditions specified in the scenarios. The study forecasts farm water and energy consumption, crop production and farm incomes for the years 1979, 1985, 1990, 2000, and 2020. It is these projected changes in crop production which are the point of departure in this analysis of direct and in-

direct employment and population effects. Table 3 summarizes the total changes in the value produced by irrigated and non-irrigated crop agriculture for each of the scenarios.

(FIGURE 5)



The BASELINE scenario shows an agricultural economy in the Ogallala Aquifer area growing by 23 percent in the next decade, 40 percent by 2000, and 45 percent by 2020--all in real terms, or constant dollars. The EFFICIENCY scenario (Scenario 1) projects even stronger growth with a 62 percent rise in value produced by 2020. The RESTRICTION scenario (Scenario 2) shows the dampening effects of water use regulation beyond those imposed by pumping costs, with production levels dropping below those of the BASELINE until sometime between 2000 and 2020. But after 2020, production levels can remain stable longer (or increase slightly) under the RESTRICTION scenario than in the BASELINE and EFFICIENCY cases, because of the effect of regulation which extends groundwater resources. This is shown in figure 5 where irrigated acreage first falls below the baseline and later rises above it.

Table 3

Aggregate Value of Crop Production Under Different Scenarios

Million of Dollars
(1979 Dollars)

PROJECTIONS	1979	1985	1990	2000	2020
0. BASELINE (Total)	321	371	396	450	464
Irrigated Crops	189	223	230	255	208
Non-Irrigated	132	148	166	195	256
1. EFFICIENCY (Total)	as	as	409	466	519
Irrigated Crops	above	above	245	272	270
Non-Irrigated			164	194	249
2. RESTRICTION (Total)	as	359	371	402	473
Irrigated Crops	above	211	205	207	228
Non-Irrigated		148	166	195	247
5A. WATER TRANSFER (Total)	as	as	as	505	595
Irrigated Crops	above	above	above	316	357
Non-Irrigated				189	238
5B. WATER TRANSFER (Total)	as	as	as	459	533
Irrigated Crops	above	above	above	270	295
Non-Irrigated				189	238
6. PESSIMISTIC BASELINE (Total)	as	286	214	199	205
Irrigated Crops	above	140	52	19	0
Non-Irrigated		146	162	180	206

The additional water brought into use through the 5A and 5B INTERSTATE TRANSFER alternatives will increase agricultural production somewhat after 2000. From then until 2020 the value of crop production under these alternatives will be 9 - 15 percent above the corresponding levels projected for the EFFICIENCY and RESTRICTION scenarios, respectively.*

The PESSIMISTIC BASELINE projects a rapid decline in irrigated production, with irrigation being discontinued almost entirely by 1990 and corn production from Ogallala Aquifer water dropping to zero by then. This is because under the PESSIMISTIC BASELINE assumptions about commodity prices and energy costs, irrigation equipment cannot be economically replaced and major maintenance would be deferred indefinitely. By 1990, under this scenario, crop production will be about 33 percent below that in 1978. Crop value produced is below the BASELINE level by 23 percent in 1985, by 46 percent in 1990, and by 56 percent after 2000.

7. EMPLOYMENT AND POPULATION IMPACTS: PRODUCTION SCENARIOS

The projected employment and population levels for the year 1985, 1990, 2000, and 2020 are shown in Table 4. The EFFICIENCY, RESTRICTION, and WATER TRANSFER scenarios all are based on certain assumptions from the BASELINE scenario. Corresponding production scenarios have not been created for the PESSIMISTIC BASELINE assumptions due to funding limitations.

Tables 5 and 6 show the employment requirements for each sector for the years 1985 and 2000. Scenarios 5A and 5B are excluded since water transfer from other states has been shown to be economically infeasible for Colorado. Current employment by sector is shown for comparison in Table 7.

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*Note: To obtain the added value produced due to water transfer, one must only compare scenario 5A with the EFFICIENCY scenario and scenario 5B with the RESTRICTION scenario. Other comparisons are invalid.

TABLE 4

PROJECTED EMPLOYMENT/POPULATION 1/

	1978	1985	1990	2000	2020
0. BASELINE	30,090	33,495	33,884	34,857	34,982
	79,739	88,762	89,793	92,371	92,702
1. EFFICIENCY	30,090	33,495	34,149	35,168	36,107
	79,739	88,762	90,495	93,195	95,684
2. RESTRICTION	30,090	33,385	33,362	34,094	35,121
	79,739	88,470	88,409	90,349	93,071
5A. WATER TRANSFER 3/	30,090	33,495	34,149	36,136	37,767
	79,739	88,762	90,495	95,760	100,083
5B. WATER TRANSFER 3/	30,090	33,385	33,362	35,260	36,339
	79,739	88,470	88,409	93,439	96,298
6. PESSIMISTIC BASELINE	30,090	30,427	30,744 2/	30,565 2/	30,691
	79,739	80,632	81,472 2/	80,997 2/	81,331 2/

1/ Population is estimated at 2.65 times employment using the ratio for 1978.

2/ If feedlot operators and/or meat processors are unwilling or unable to continue operations in the region when local feed supplies are eliminated, these values could fall by as much as 27 percent to about 22,500 employment and 59,000 population.

3/ 5A considers water importation added to the EFFICIENCY scenario and 5B considers water importation added to the RESTRICTION scenario. Water cannot be imported prior to the year 2000.

TABLE 5

EMPLOYMENT BY SECTOR FOR SELECTED SCENARIOS: 1985

Sector	BASELINE	EFFICIENCY	RESTRICTION	PESSIMISTIC BASELINE
irr-corn	1769	1769	1734	1051
irr-wheat	48	48	48	294
irr-sorg	93	93	92	12
dry-wheat	1500	1500	1495	1424
dry-sorg	54	54	54	46
other-irr	414	414	395	362
other-dry	262	262	265	237
feedlots	4712	4712	4712	3539
range-cttl	2847	2847	2847	2654
other-anim	318	318	318	318
food-proc	966	966	966	965
printing	180	180	179	173
mach-mfg	636	636	636	636
stone/clay	68	68	68	66
other-mfg	165	165	165	165
oil/gs-pr	377	377	376	362
constructn	945	945	944	922
whlsl-mach	536	536	536	534
whlsl-farm	809	809	804	703
oth-whlsl	724	724	724	703
rtl-fuel	489	489	489	475
whlsl-fuel	170	170	169	158
auto-dlr	564	564	563	561
eat/drink	2149	2149	2146	2088
other-rtl	2312	2312	2309	2254
ag-service	144	144	143	132
finance	838	838	832	752
ins/re	251	251	250	233
education	2854	2854	2847	2735
health	1733	1733	1728	1655
other-ser	1190	1190	1185	1063
postal-ser	132	132	132	128
communicat	342	342	341	325
transport	673	673	672	627
gas-pr/dist	202	202	199	161
electric	238	238	235	196
wat/se/san	54	54	54	52
loc-govt	1102	1102	1098	1031
TOTAL	33,495	33,495	33,385	30,691

TABLE 6

EMPLOYMENT BY SECTOR FOR SELECTED SCENARIOS: 2000

SECTOR	BASELINE	EFFICIENCY	RESTRICTION	PESSIMISTIC BASELINE
irr-corn	2195	2341	1804	1064
irr-wheat	48	48	48	145
irr-sorg	59	67	62	11
dry-wheat	1929	1932	1882	1720
dry-sorg	40	40	40	28
other-irr	383	392	410	370
other-dry	378	378	372	319
feedlots	4713	4713	4712	3539
range-cttl	2847	2847	2847	2654
other-anim	318	318	318	318
food-proc	966	966	966	965
printing	184	185	182	174
mach-mfg	635	635	635	635
stone/clay	68	68	67	65
other-mfg	165	165	165	165
oil/gs-pr	219	223	210	192
constructn	947	949	941	914
whlsl-mach	536	536	535	533
whlsl-farm	888	902	848	727
oth-whlsl	729	731	725	701
rtl-fuel	498	500	494	477
whlsl-fuel	184	185	180	165
auto-dlr	564	565	564	561
eat/drink	2189	2197	2169	2094
other-rtl	2349	2357	2331	2261
ag-service	166	167	161	144
finance	914	928	879	771
ins/re	264	267	258	236
education	2927	2946	2878	2724
health	1785	1796	1760	1665
other-ser	1282	1297	1245	1097
postal-ser	136	136	134	128
communicat	351	353	346	326
transport	677	678	675	628
gas-pr/dist	228	239	204	153
electric	257	267	236	185
wat/se/san	56	56	55	52
loc-govt	1145	1157	1116	1023
TOTAL	34,857	35,167	34,094	30,565

TABLE 7

1978 EMPLOYMENT AND VALUE OF PRODUCTION BY SECTOR FOR THE ELEVEN-COUNTY REGION

SECTOR	EMPLOYMENT Workers	VALUE OF PRODUCTION Millions of $
irr-corn	1172	$129
irr-wheat	109	12
irr-sorg	65	7.2
dry-wheat	1329	146
dry-sorg	68	7.4
other-irr	389	42.7
other-dry	146	16
feedlots	3539	327.7
range-cttl	2654	245.7
other-anim	318	27.9
food-proc	965	386.2
printing	167	4.5
mach-mfg	295	15.1
stone/clay	67	4.5
other-mfg	165	6.3
oil/gs-pr	550	67.9
constructn	931	44.3
whlsl-mach	535	15.9
whlsl-farm	698	249.4
oth-whlsl	705	20.8
rtl-fuel	474	13.2
whlsl-fuel	155	4.5
auto-dlr	560	9.5
eat/drink	2083	20.6
other-rtl	2247	68.9
ag-service	127	36.3
finance	739	60
ins/re	229	34.2
education	2751	49.8
health	1647	16.6
other-ser	1042	54.6
postal-ser	127	6.3
communicat	322	14.1
transport	625	37.9
gas-pr/dist	161	32.9
electric	201	61
wat/se/san	52	4.7
loc-govt	1042	58.9
households	0	424.4
stat-govt	272	40
fed-govt	367	76.4
TOTAL	30,090	$2901.3

8. STABILIZING EFFECT OF LIVESTOCK AND FOOD PROCESSING EXPORTS

Irrigated crop production is a major economic base of the Ogallala High Plains region, but livestock contributes substantially more to the eleven-county economy. In 1978, irrigated crop production in the 11 counties was $191 million while feedlot sales were $328 million and cattle ranch sales were $246 million. As shown by the inter-industry model of the 11 counties, over $70 million worth of irrigated feeds were used in the region to produce the total livestock production of $574 million. The remainder of the irrigated feed production was sold to other livestock, food processing, wholesalers, households or to export. Exports by all irrigated agriculture totaled some $36 million while livestock exports totaled about $317 million. Livestock exports and food processing exports (mainly meat products) account for over two-thirds of total locally produced exports. Thus the economic base of the Ogallala region is dominated by livestock.

Economic change forecasted due to falling water tables and/or the alternative mitigation policies would be drastically affected if cattle feeding and meat processing were impacted by water scarcity. If feed shortages led to a decline in cattle feeding and meat processing, the effect on the region's economy would be severe. None of the scenarios modeled consider livestock decline due to feed shortages. The PESSIMISTIC BASELINE scenario eliminates growth of livestock based upon trends in consumer demand not due to feed supply shortages. All projection scenarios except for the PESSIMISTIC scenario assume that feedlot exports continue to grow until 1985. Considering recent livestock prices--often below costs of production--this assumption may be optimistic. The PESSIMISTIC BASELINE scenario assumes that feedlot exports remain at the 1978 level throughout the 40 year projection period.

A further stabilizing influence in the scenarios is caused by the food processing export figure. This is held constant over the projection period. If feed shortages should lead to reductions in cattle feeding, then it is likely that meat processors would move out of the area, thus reducing processing exports.

9. FORWARD LINKAGES COULD FURTHER WEAKEN LOCAL ECONOMY

The economic analysis of direct and indirect effects of changes in water supply and of the various mitigation scenarios calculates only backward linkage effects. The analysis shows the total impacts of changes in exports from the region due to water scarcity or due to mitigation efforts. The analysis does not show the forward linkage effects. Generally the forward linkages would not matter. However, in the case of the PESSIMISTIC BASELINE scenario they are crucial. A forward linkage effect occurs if, for example, cattle feeders leave the region when feed shortages occur. Furthermore, it might be assumed that meat processors would leave the region when feedlots move out. Under the PESSIMISTIC BASELINE scenario, supplies of feed in the region (irrigated corn and other irrigated crops) are projected to fall drastically. If local supplies of feed are necessary to maintain feedlots (if supplies are not available from nearby regions) then all feedlot activity will cease in the region by 1985. If feedlot output is vital to meat processors (if meat processors won't import cattle from nearby regions) then most of the food processing sector would also leave the region. The extent to which these developments would occur depend on sensitivity to shipping costs and the possible expansion of feed and cattle inputs from nearby regions where irrigation is still available. The prime contractor for this study argues that much ground water remains to be de-

veloped in eastern Kansas and feedlots could be supplied from this source. If feedlots chose to move closer to new feed supplies, however, the forward linkage effect could result in additional impacts in the Colorado High Plains. Assuming ranch exports remain high but feedlot exports are eliminated, the employment impact would be a loss of 2700 jobs in the region. If food processing also moves from the region, the loss of jobs, directly and indirectly would rise above 8200. Thus the consideration of forward impacts could further reduce employment in the PESSIMISTIC BASELINE scenario by an additional 27 percent.*

10. IMPACTS ON THE NON-OGALLALA PORTION OF COLORADO

At the outset, it should be noted that the eleven-county Ogallala region of Colorado accounts for a very small and declining share of state employment and population. Thus any changes in employment and population in the Ogallala region will have an imperceptible effect on the Colorado economy. Table 2 shows that less than 3 percent of Colorado's population resides in the Ogallala study region. The changes projected to occur under the various scenarios shown in sections 7, 8 and 9 of this report are miniscule compared to the total employment, income, and spending in the city of Denver alone. Since the Ogallala economy is so small compared to the state economy, it is to be expected that the rest of Colorado would feel little effect of any changes which might occur in the Ogallala region.

An alternative way of describing the impact is to say that virtually all of the effect on the state of Colorado is captured by our input-output model of the eleven-county Ogallala region. In fact, it is unlikely that any model, even a current Colorado state input-output model built using

*The timing of this impact would depend on the reactions of feedlot and meat processing operators to shift their location as shipping costs trend upward.

survey data and requiring considerable resources to construct, would be able to detect the economic changes in the state economy over and above those expected in the Ogallala region. Examination of Table 6 shows that the employment differences for the year 2000 among the four scenarios are only about one percent or less except for the PESSIMISTIC case which shows a decrease of about 12 percent. If the 2.7 percent Ogallala share of Colorado employment is reduced by 12 percent, it falls to 2.4 percent. Thus, the worst case shown on Table 6 results in a change of Colorado employment of only three-tenths of one percent. Such a small change is not within the accuracy of measurement of state data and certainly is not measurable by a state economic projections model.

Technically, the above discussion implies that the economic multipliers for the economic sectors which are affected by changes in production in the Ogallala region are not much larger for Colorado than they are for the Ogallala region. This comparison can be made using our Ogallala model and a relatively old model of the state of Colorado (4). Although the state model is for 1970, it is unlikely that multipliers for the agricultural sectors will have changed markedly since Colorado's expansion and structural change during the last ten years has been mainly in the high technology industries while agriculture has remained relatively constant.

Our analysis using the Ogallala model applied economic multipliers designed to show the impacts of changes in exports from the eleven-county Ogallala region. Typical multipliers for the relevant sectors of the Ogallala Aquifer region are shown in Table 8. For comparison purposes we have shown similar multipliers from the Colorado State model (the state model has less detail in the agricultural sectors). The state multipliers have

been adjusted downward to account for the change in accounting stance going from the Ogallala region to the state economy. An export from the Ogallala region (mainly to the rest of Colorado) is simply a change in output from the accounting stance of the state. Thus the comparable state multipliers are for changes in output rather than exports. Comparison of multipliers for similar sectors, as expected, shows relatively little difference between the region and the state.

TABLE 8

TYPICAL MULTIPLIERS FOR THE RELEVANT SECTORS
OF THE OGALLALA AQUIFER REGION

OGALLALA REGION		STATE OF COLORADO [1/]	
Sector	Multiplier	Sector	Multiplier
Feedlots	2.15	Livestock	2.25
Range-Cttl	2.62		
Irr-Corn	2.44		
Irr-Wheat	2.05	Irr-Ag	2.72
Irr-Sorg	2.19		
Oth-Irr	2.14		
Dry-Wheat	2.27		
Dry-Sorg	2.24	Dry-Ag	2.45
Oth-Dry	2.14		
Food Proc	2.23	Food Proc	2.39

SOURCES: Ogallala region: see second column of appendix Table II; State of Colorado: see (5): An Economic Analysis of Water Use in Colorado's Economy, S. Lee Gray and John R. McKean, Dec. 1975 Colorado Water Resources Research Institute Completion Report Series #70.

1/Business multipliers for Colorado shown in Table IV-4 were divided by the corresponding diagonal elements of the inverse matrix shown in Table IV-3 in order to reduce the Colorado multipliers from export to output effects (5).

APPENDICES

Appendix

I. The 1978 Economy: Transactions Among Sectors

II. Business Transactions Multipliers

III. Income Multipliers

IV. Employment Multipliers

V. Withdrawal and Consumptive Use Requirements by Sector

VI. Direct Plus Indirect Water Requirements

APPENDIX I

THE 1978 ECONOMY: TRANSACTIONS AMONG SECTORS [1/]

		1	2	3	4	5	6	7	8	9	10
		irr-corn	irr-wheat	irr-sorg	dry-wheat	dry-sorg	other-irr	other-dry	feedlots	range-cttl	other-anim
1	irr-corn	0.	0.	0.	0.	0.	0.	0.	59402188.	4658500.	3905580.
2	irr-wheat	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	irr-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	dry-wheat	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	dry-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	other-irr	0.	0.	0.	0.	0.	0.	0.	1639736.	4658500.	2984980.
7	other-dry	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	feedlots	0.	0.	0.	0.	0.	0.	0.	0.	24901800.	0.
9	range-cttl	0.	0.	0.	0.	0.	0.	0.	54052452.	0.	0.
10	other-anim	0.	0.	0.	0.	0.	0.	0.	0.	0.	2622318.
11	food-proc	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	printing	0.	0.	0.	0.	0.	0.	0.	8996.	0.	0.
13	mach-mfg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	stone/clay	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	other-mfg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	oil/gs-er	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	constructn	0.	0.	0.	0.	0.	0.	0.	712975.	0.	0.
18	whlsl-mach	0.	0.	0.	0.	0.	0.	0.	115484.	0.	31559.
19	whlsl-farm	37219819.	1478530.	1199558.	36937932.	1802284.	4299970.	3631450.	18211262.	73988000.	446350.
20	oth-whlsl	0.	0.	0.	0.	0.	0.	0.	890189.	0.	557079.
21	rtl-fuel	0.	0.	0.	0.	0.	0.	0.	89593.	0.	0.
22	whlsl-fuel	235321.	21957.	14552.	796844.	23495.	116375.	82329.	56573.	852628.	82459.
23	auto-dlr	0.	0.	0.	0.	0.	0.	0.	44189.	0.	39162.
24	eat/drink	0.	0.	0.	0.	0.	0.	0.	7563.	0.	0.
25	other-rtl	0.	0.	0.	0.	0.	0.	0.	265083.	0.	0.
26	as-service	2424202.	505415.	211665.	17448409.	717777.	990136.	209490.	1538966.	12051600.	195280.
27	finance	6710000.	627000.	374000.	7613880.	317400.	2640000.	811910.	1937949.	9362547.	2287554.
28	ins/re	1054710.	169199.	82386.	2470960.	53905.	304447.	172200.	1638784.	2173670.	146439.
29	education	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	health	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	other-ser	4337360.	97770.	241755.	1445787.	1153623.	2417010.	3681240.	2772244.	7719600.	2175966.
32	postal-ser	0.	0.	0.	0.	0.	0.	0.	18722.	0.	0.
33	communicat	0.	0.	0.	0.	0.	0.	0.	264474.	0.	0.
34	transport	0.	0.	0.	0.	0.	0.	0.	3914584.	13310000.	111560.
35	gas-pr/dis	15413000.	1420000.	864000.	0.	0.	3782300.	0.	302153.	0.	0.
36	electric	13103800.	1194500.	765300.	0.	0.	5395630.	0.	1541952.	0.	540000.
37	wat/se/san	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
38	loc-govt	2712490.	435152.	211522.	6050180.	144276.	920775.	0.	1259965.	9922000.	306667.
39	subtotals	83310502.	5949525.	3964738.	72763992.	4217760.	20798693.	7903499.	150707366.	163491048.	16427153.
40	households	6124258.	725247.	494018.	19382720.	634232.	6116850.	1756880.	683694.	23764400.	1037190.
41	state-govt	0.	0.	0.	0.	0.	0.	0.	662418.	266200.	167362.
42	fed-govt	0.	0.	0.	0.	0.	0.	0.	6233965.	4186600.	89490.
43	transfers	753611.	120896.	58866.	1765548.	42088.	254488.	123640.	1170943.	1553130.	104634.
44	prof-demr	30230470.	4347818.	2186896.	21196392.	1514312.	12657650.	4511717.	19646573.	36000000.	5523606.
45	imports	6408303.	877164.	456058.	30939402.	1035565.	2660431.	1602221.	142432826.	14436256.	4540371.
46	totals	126827244.	12020648.	7162556.	146048054.	7443957.	42683312.	15992610.	327687768.	245697634.	27079026.

1/ Sales in dollars from sectors shown at the left of the table to sectors listed at the column heads.

		11	12	13	14	15	16	17	18	19	20
		food-proc	printing	mach-mfg	stone/clay	other-mfg	oil/gs-pr	constructn	whlsl-mach	whlsl-farm	oth-whlsl
1	irr-corn	5961559.	0.	0.	0.	0.	0.	0.	0.	41032928.	208100.
2	irr-wheat	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	irr-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	dry-wheat	2942564.	0.	0.	0.	0.	0.	0.	0.	84798136.	178371.
5	dry-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	other-irr	8150320.	0.	0.	0.	0.	0.	0.	0.	16942397.	89190.
7	other-dry	760500.	0.	0.	0.	0.	0.	0.	0.	8356712.	89190.
8	feedlots	177000000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	range-cttl	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	other-anim	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	food-proc	7027432.	0.	0.	0.	0.	0.	0.	0.	0.	4190960.
12	printing	9197.	18210.	60964.	0.	13860.	0.	51213.	20926.	120292.	193918.
13	mach-mfg	118364.	0.	566000.	0.	46762.	139676.	0.	0.	0.	209540.
14	stone/clay	0.	0.	0.	0.	0.	209480.	2219349.	0.	0.	0.
15	other-mfg	48763.	0.	0.	0.	46768.	0.	0.	0.	0.	0.
16	oil/gs-pr	0.	0.	0.	0.	0.	8359906.	0.	0.	0.	0.
17	constructn	0.	391.	20618.	232582.	2470.	1132064.	6407772.	156687.	70551.	1353572.
18	whlsl-mach	1734.	0.	11313.	4638.	0.	94094.	52662.	0.	41691.	0.
19	whlsl-farm	0.	0.	0.	0.	0.	0.	0.	0.	10402824.	1010769.
20	oth-whlsl	75900.	87.	1797.	10808.	20892.	75150.	474467.	7045.	14499.	46322.
21	rtl-fuel	0.	12082.	13496.	0.	3585.	5416.	0.	159410.	52961.	35661.
22	whlsl-fuel	66313.	1763.	15529.	18709.	3478.	70144.	11777.	29264.	12107.	19941.
23	auto-dlr	12381.	26.	6181.	2658.	764.	6763.	4[illegible].	1[illegible].	1437.	6764.
24	eat/drink	0.	568.	0.	0.	6574.	58203.	3921.	38793.	11150.	13699.
25	other-rtl	17750.	8732.	2047.	0.	14005.	1[illegible].	5[illegible].	62541.	31892.	9[illegible].
26	am-service	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	finance	0.	54560.	161666.	93927.	0.	3[illegible].	16[illegible].	652745.	9[illegible].	4[illegible].
28	ins/re	41993.	17416.	120623.	43435.	15368.	150961.	4[illegible].	315392.	496592.	200700.
29	education	0.	0.	0.	0.	0.	1064.	0.	0.	0.	0.
30	health	0.	0.	0.	0.	0.	1765.	0.	0.	0.	0.
31	other-ser	92721.	51872.	48564.	27060.	40482.	2[illegible].	25[illegible].	363783.	605090.	140346.
32	postal-ser	18099.	203276.	10137.	2236.	3113.	9473.	29606.	57880.	21006.	37853.
33	communicat	115313.	54951.	61424.	26836.	25713.	77542.	157234.	827761.	222694.	115748.
34	transport	7922955.	11691.	93142.	5814.	56536.	76952.	14[illegible].	400546.	13129.	54771.
35	gas-pr/dis	11963.	21455.	57757.	4472.	20487.	3086[illegible].	5[illegible].	160205.	424216.	105119.
36	electric	513175.	42629.	87329.	17892.	57397.	2[illegible].	1[illegible].	191706.	560300.	92157.
37	wat/se san	181462.	0.	1552.	2236.	1520.	10242.	2[illegible].	14721.	2486.	27974.
38	loc-govt	503115.	61579.	42778.	4600.	50970.	3723772.	51213.	464092.	825916.	113146.
39	subtotals	211594970.	566480.	1325917.	497903.	420552.	17576[illegible].	14737712.	2940759.	165372034.	9012755.
40	households	11821755.	1238549.	2236917.	704457.	1352684.	6[illegible].	11[illegible].	6237716.	6727097.	6805365.
41	state-govt	203292.	46298.	70443.	14420.	31178.	1750111.	2[illegible].	255602.	127157.	456580.
42	fed-govt	2998601.	133311.	562964.	199091.	256346.	9630[illegible].	10[illegible].	1176023.	418701.	963948.
43	transfers	36004.	12444.	86188.	31035.	10900.	107[illegible].	35[illegible].	225364.	254824.	145404.
44	prot derr	5345352.	616773.	1355718.	413728.	421718.	1[illegible].	1[illegible].	3279656.	14344223.	2645948.
45	imports	154167308.	1914458.	9426505.	2621109.	3770251.	1[illegible].	14[illegible].	650150.	6202185.	816549.
46	totals	386179284.	4503333.	15062652.	4472743.	6273309.	6[illegible].	4[illegible].	15[illegible].	249371259.	20644[illegible].

		21	22	23	24	25	26	27	28	29	30
		rtl-fuel	whlsl-fuel	auto-dlr	eat/drink	other-rtl	ag-service	finance	ins/re	education	health
1	irr-corn	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	irr-wheat	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	irr-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	dry-wheat	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	dry-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	other-irr	0.	0.	0.	0.	0.	4353888.	0.	0.	0.	0.
7	other-dry	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	feedlots	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	range-ctl	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	other-anim	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	food-proc	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	printing	105200.	26302.	533000.	54210.	2100000.	4136.	56890.	145013.	0.	7600.
13	mach-mfg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	stone/clay	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	other-mfg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	oil/gs-pr	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	constructn	0.	32352.	12620.	448932.	4796000.	53342.	583631.	35544.	311694.	81010.
18	whlsl-mach	0.	0.	0.	0.	0.	0.	0.	0.	96045.	0.
19	whlsl-farm	0.	0.	0.	0.	0.	0.	0.	0.	264080.	33950.
20	oth-whlsl	221797.	159.	1324.	0.	100220.	14562.	5415.	3205.	598955.	1465.
21	rtl-fuel	0.	0.	60397.	25340.	345489.	4934.	1736.	26610.	0.	20987.
22	whlsl-fuel	0.	0.	11733.	3693.	52625.	33629.	253.	4308.	15661.	3216.
23	auto-dlr	0.	20681.	0.	1556.	39044.	12371.	676.	6406.	44137.	4345.
24	eat/drink	0.	911.	5091.	0.	79385.	219.	4729.	15061.	190217.	9606.
25	other-rtl	97494.	0.	6339.	139293.	327542.	17277.	15521.	25172.	226537.	305035.
26	ag-service	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	finance	479124.	338450.	142635.	1537342.	1015032.	1772107.	0.	131653.	1335400.	278960.
28	ins/re	167543.	138157.	397481.	33982.	1350493.	97731.	290243.	48131.	1906896.	306955.
29	education	0.	0.	0.	0.	28349.	0.	3400.	1490.	1305490.	0.
30	health	0.	0.	0.	0.	0.	0.	0.	0.	79550.	394480.
31	other-ser	1585532.	84043.	253438.	292152.	5364210.	29691.	749769.	309010.	1585560.	433200.
32	postal-ser	38155.	12290.	21454.	22348.	183358.	6096.	230000.	48508.	5980.	234630.
33	communicat	119372.	70994.	356998.	518822.	1233702.	31352.	40153.	263094.	11940.	152630.
34	transport	19077.	30197.	0.	45782.	3879556.	3483.	15000.	0.	222060.	10230.
35	gas-pr/dis	287902.	36892.	94651.	326155.	1698485.	1126252.	84320.	35207.	25040.	149200.
36	electric	431157.	42777.	31550.	1306106.	3530861.	62134.	109668.	39305.	209810.	109950.
37	wat/se/san	191868.	7735.	4543.	121324.	147993.	2334.	11434.	7605.	12376.	47000.
38	loc-govt	92118.	61154.	93490.	574726.	1190130.	52254.	176375.	102139.	6560.	0.
39	subtotals	4109239.	900156.	2046844.	5451768.	27454494.	7673735.	2372983.	1241779.	8454190.	2564839.
40	households	2867355.	1543146.	5677079.	7120145.	15628370.	1110388.	7513270.	1851823.	27492810.	7658740.
41	state-govt	47967.	118275.	52903.	253135.	1010022.	1127.	227819.	36780.	2026360.	51600.
42	fed-govt	93753.	375040.	370402.	1449461.	5704722.	61250.	4259674.	219793.	0.	467610.
43	transfers	119713.	93717.	264008.	24280.	964954.	69967.	32143706.	26674.	1362514.	219325.
44	prof-depr	5074636.	1350493.	871549.	5780412.	15609375.	1063621.	9200099.	2439400.	5045530.	3334490.
45	imports	840281.	149452.	225037.	544900.	2569811.	26334480.	36241805.	2841741e.	5471229.	1758766.
46	totals	13152944.	4535279.	9530422.	20624101.	68932748.	36314474.	68962563.	34235665.	47642623.	16615420.

		31	32	33	34	35	36	37	38	39	40
		other-ser	postal-ser	communicat	transport	gas-pr/dis	electric	wat/se/san	loc-govt	subtotals	households
1	irr-corn	0.	0.	0.	0.	0.	0.	0.	0.	115168655.	0.
2	irr-wheat	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	irr-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	dry-wheat	0.	0.	0.	0.	0.	0.	0.	0.	87919071.	0.
5	dry-sorg	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	other-irr	0.	0.	0.	0.	0.	0.	0.	0.	37919011.	1509945.
7	other-dry	0.	0.	0.	0.	0.	0.	0.	0.	9206402.	0.
8	feedlots	0.	0.	0.	0.	0.	0.	0.	0.	201901800.	0.
9	range-cttl	0.	0.	0.	0.	0.	0.	0.	0.	54052452.	0.
10	other-anim	0.	0.	0.	0.	0.	0.	0.	0.	2622318.	0.
11	food-proc	0.	0.	0.	0.	0.	0.	0.	0.	11218462.	950090.
12	printing	300555.	0.	5440.	69169.	17557.	9678.	0.	0.	3755463.	592685.
13	mach-mfg	0.	0.	0.	0.	0.	0.	0.	0.	1012102.	0.
14	stone/clay	0.	0.	0.	0.	0.	0.	0.	0.	2428729.	1680580.
15	other-mfg	0.	0.	0.	0.	0.	0.	0.	0.	95551.	0.
16	oil/gas-pr	0.	0.	0.	0.	6323732.	0.	0.	0.	14674633.	0.
17	constructn	229346.	11546.	7610.	0.	48224.	26460.	976205.	27066609.	20430492.	1821660.
18	whlsl-mach	0.	0.	0.	716.	19911.	0.	9375.	1563806.	636200.	0.
19	whlsl-rama	0.	0.	0.	0.	0.	0.	1778.	0.	191170258.	0.
20	oth-whlsl	50097.	0.	836.	221275.	46364.	111145.	58137.	695473.	8252814.	1862737.
21	rtl-fuel	130061.	0.	24040.	33241.	10845.	29382.	0.	0.	1137394.	859962.
22	whlsl-fuel	18980.	0.	3508.	27552.	1583.	4273.	2241.	82603.	2771132.	903972.
23	auto-dlr	20969.	15441.	3876.	31003.	1119.	4075.	3705.	149174.	542549.	0.
24	eat/drink	56902.	0.	5480.	38474.	1186.	7887.	0.	3896.	557615.	12347979.
25	other-rtl	465675.	659.	3226.	39256.	34818.	21586.	636.	12051.	2253517.	33512472.
26	ag-service	0.	0.	0.	0.	0.	0.	2760.	60097.	36255144.	59330.
27	finance	983534.	0.	163028.	82374.	223964.	124021.	384029.	3080056.	44884468.	15238100.
28	ins/re	196953.	0.	31692.	431384.	342129.	107004.	31407.	485199.	16535707.	17669144.
29	education	0.	0.	0.	0.	0.	0.	0.	26071060.	50210995.	2606840.
30	health	0.	0.	0.	0.	0.	0.	2222.	462651.	961218.	15654202.
31	other-ser	357804.	98142.	22364.	82666.	85185.	95810.	151136.	1051826.	40207696.	14011560.
32	postal-ser	210840.	0.	113474.	39323.	117747.	119362.	73.	17927.	1345478.	1547505.
33	communicat	789914.	22755.	0.	252266.	21181.	50908.	4575.	181061.	6126345.	7914250.
34	transport	232859.	3201880.	11951.	339849.	44246.	0.	213740.	31509.	34293340.	3352510.
35	gas-pr/dis	470386.	0.	20649.	256105.	15209.	12355.	0.	0.	27581246.	5253365.
36	electric	574916.	38529.	24995.	256928.	70603.	22253963.	3403854.	364354.	56560948.	4298210.
37	wat/se/san	193214.	2204.	4500.	28334.	1412.	37914.	0.	412457.	1509044.	2493650.
38	loc-govt	409805.	0.	854218.	1143434.	677266.	2113440.	352871.	737711.	36444081.	5827590.
39	subtotals	5693310.	3390958.	1300887.	3373849.	8104281.	25131249.	2540778.	36704116.	1103192272.	157411780.
40	households	7210752.	1903243.	3220412.	10903632.	2346751.	3513020.	757872.	12695309.	244572310.	1388470.
41	state-govt	795653.	0.	119548.	625886.	266907.	42119.	79519.	585950.	10669518.	2821040.
42	fed-govt	2779549.	171660.	288643.	2637269.	1412965.	231874.	47968.	478418.	49741915.	4950520.
43	transfers	140727.	0.	22645.	308233.	244458.	77286.	22441.	346684.	4278018.	12624946.
44	prof-dem	14618769.	279994.	5056917.	4724351.	2988420.	12800000.	990977.	3705644.	265066500.	15409090.
45	imports	23312327.	545889.	4027445.	15299590.	17501481.	19187002.	2940758.	4367795.	624059058.	18417298.
46	totals	54551285.	6291739.	14116497.	37872810.	32365273.	60783150.	4672110.	58859918.	2360274784.	424443512.

		41	42	43	44	45	46
		state-govt	fed-govt	transfers	investment	exports	totals
1	irr-corn	0.	0.	0.	0.	13651289.	123827244.
2	irr-wheat	0.	0.	0.	0.	12020648.	12020648.
3	irr-sorg	0.	0.	0.	0.	7162556.	7162556.
4	dry-wheat	0.	0.	0.	0.	58129952.	146048054.
5	dry-sorg	0.	0.	0.	0.	7443957.	7443957.
6	other-irr	0.	0.	0.	0.	3269376.	42688312.
7	other-dry	0.	0.	0.	0.	6784790.	15992610.
8	feedlots	0.	0.	0.	0.	12709594.	327637788.
9	range-cttl	0.	0.	0.	0.	191645189.	245697434.
10	other-anim	0.	0.	0.	0.	25250600.	27079026.
11	food-proc	0.	122000.	0.	0.	373668722.	384179234.
12	printing	4175.	905.	0.	0.	0.	4533333.
13	mach-mfg	0.	0.	0.	0.	14660556.	15462652.
14	stone/clay	90468.	0.	0.	272966.	0.	4472743.
15	other-mfg	0.	0.	0.	0.	6178958.	6273909.
16	oil/gs-er	0.	0.	0.	0.	53177640.	67852278.
17	constructn	7279782.	6687.	0.	14993811.	0.	44332432.
18	whlsl-mach	0.	0.	0.	15222960.	0.	15859160.
19	whlsl-farm	12374.	0.	0.	0.	58238826.	249371258.
20	oth-whlsl	6441.	543914.	0.	0.	10159161.	20844867.
21	rtl-fuel	15638.	28939.	0.	0.	5570491.	13152944.
22	whlsl-fuel	12958.	4223.	0.	0.	812994.	4535279.
23	auto-dlr	9343.	0.	0.	9979530.	0.	9530422.
24	eat/drink	2478.	0.	0.	0.	7716029.	20624101.
25	other-rtl	10272.	10264.	0.	0.	5014622.	68932745.
26	ag-service	0.	0.	0.	0.	0.	36314474.
27	finance	0.	0.	0.	0.	0.	60042568.
28	ins/re	0.	30814.	0.	0.	0.	34235665.
29	education	15622600.	1400000.	0.	0.	0.	49842632.
30	health	0.	0.	0.	0.	0.	16615420.
31	other-ser	68490.	263540.	0.	0.	0.	54551286.
32	postal-ser	6745.	2892011.	0.	0.	0.	6291739.
33	communicat	32692.	43210.	0.	0.	0.	14116497.
34	transport	13140.	213820.	0.	0.	0.	37872810.
35	gas-pr/dis	30660.	0.	0.	0.	0.	32665273.
36	electric	118372.	5620.	0.	0.	0.	60983150.
37	wat/se/san	4186.	671000.	0.	0.	0.	4678110.
38	loc-govt	4283870.	2851000.	0.	0.	9393387.	58859918.
39	subtotals	27624884.	9087947.	0.	39468267.	1023[illegible]64.	2360274848.
40	households	4632896.	3348000.	170501834.	0.	0.	424443512.
41	state-govt	420196.	4942000.	0.	0.	0.	39953752.
42	fed-govt	102.	301320.	0.	0.	0.	98748537.
43	transfers	0.	56415017.	0.	0.	0.	112820151.
44	prof-depr	62076.	497780.	-114108834.	0.	0.	186928614.
45	imports	7213596.	1777418.	0.	132068532.	154251352.	1083542992.
46	totals	39953752.	76369482.	56393000.	171539800.	1177741024.	4306712384.

APPENDIX II

BUSINESS TRANSACTIONS MULTIPLIERS

(In dollars of business activity generated in the High Plains region of Eastern Colorado per dollar delivered to final demand.)

	Sector	Business Multiplier I	Business Multiplier II
1	irr-corn	2.1673	2.4391
2	irr-wheat	1.8124	2.0453
3	irr-sorg	1.9293	2.1895
4	dry-wheat	1.9048	2.2653
5	dry-sorg	1.9533	2.2424
6	other-irr	1.7732	2.1375
7	other-dry	1.8312	2.1434
8	feedlots	1.9702	2.1513
9	range-cttl	2.2543	2.6177
10	other-anim	2.0090	2.2493
11	food-proc	2.0602	2.2259
12	printing	1.1797	1.7057
13	mach-mfg	1.1049	1.3823
14	stone/clay	1.1489	1.4624
15	other-mfg	1.0925	1.4833
16	oil/gs-pr	1.3899	1.6585
17	construction	1.5010	2.0984
18	whlsl-mach	1.3163	2.0901
19	hlsl-farm	2.3020	2.5666
20	oth-whlsl	1.7900	2.4627
21	rtl-fuel	1.4039	1.8675
22	whlsl-fuel	1.2386	1.8743
23	auto-dlr	1.2571	2.3343
24	eat/drink	1.3669	2.0423
25	other-rtl	1.5290	2.0727
26	ag-service	1.3219	1.4392
27	finance	1.0536	1.2803
28	ins/re	1.0458	1.1519
29	education	1.2115	2.2036
30	health	1.2017	2.0401
31	other-ser	1.1404	1.4053
32	postal-ser	1.6144	2.4012
33	communicat	1.1492	1.6039
34	transport	1.1308	1.6618
35	gas-pr/dis	1.3460	1.5471
36	electric	1.6988	1.9093
37	wat/se/san	1.7841	2.3284
38	loc-govt	1.7858	2.7053
39	households	------	1.6712

APPENDIX III

INCOME MULTIPLIERS

(In dollars of income generated in the High Plains region of Eastern Colorado per dollar of direct income paid to households.)

Sector	Income Multipliers	
	Type I	Type II
irr-corn	2.5792	2.8901
irr-wheat	2.3098	2.5882
irr-sorg	2.2577	2.5298
dry-wheat	1.6255	1.8214
dry-sorg	2.0307	2.2754
other-irr	1.5216	1.7050
other-dry	1.7008	1.9058
feedlots	5.1945	5.8207
range-cttl	2.2479	2.5189
other-anim	3.8830	4.3511
food-proc	3.2395	3.6301
printing	1.1521	1.2910
mach-mfg	1.1176	1.2523
stone/clay	1.1909	1.3345
other-mfg	1.0845	1.2153
oil/gs-pr	1.6959	1.9003
constructn	1.4399	1.6135
whlsl-mach	1.1585	1.2981
whlsl-farm	5.8680	6.5754
oth-whlsl	1.2330	1.3816
rtl-fuel	1.2725	1.4259
whlsl-fuel	1.1180	1.2527
auto-dlr	1.0817	1.2121
eat/drink	1.1706	1.3118
other-rtl	1.4349	1.6079
ag-service	2.2963	2.5731
finance	1.0841	1.2148
ins/re	1.1735	1.3150
education	1.0766	1.2064
health	1.0884	1.2196
other-ser	1.1992	1.3438
postal-ser	1.5563	1.7439
communicat	1.1780	1.3201
transport	1.1034	1.2364
gas-pr/dis	1.6851	1.8883
electric	2.1866	2.4502
wat/se/san	2.0103	2.2526
loc-govt	2.5508	2.8583

APPENDIX IV

EMPLOYMENT MULTIPLIERS

	Sector	Direct + Indirect Labor Requirement Per Thousand $ of Final Demand		Direct + Indirect Labor Requirement Per Added Worker Hired*
		TYPE I	TYPE II	
1	irr-corn	.01794	.02072	2.28
2	irr-wheat	.01598	.01836	2.02
3	irr-sorg	.01682	.01942	2.13
4	dry-wheat	.01685	.02054	2.26
5	dry-sorg	.01828	.02123	2.33
6	other-irr	.01590	.01962	2.16
7	other-dry	.01754	.02073	2.28
8	feedlots	.01973	.02158	2.00
9	range-cttl	.02254	.02625	2.43
10	other-anim	.02274	.02519	2.33
11	food-proc	.01309	.01478	5.91
12	printing	.04074	.04611	1.24
13	mach-mfg	.02144	.02427	1.24
14	stone/clay	.01777	.02097	1.40
15	other-mfg	.02816	.03215	1.22
16	oil/gs-pr	.01410	.01684	2.08
17	constructn	.03143	.03753	1.79
18	whlsl-mach	.03991	.04781	1.42
19	whlsl-farm	.01411	.01681	6.00
20	oth-whlsl	.04181	.04868	1.44
21	rtl-fuel	.04256	.04730	1.31
22	whlsl-fuel	.03813	.04463	1.30
23	auto-dlr	.06442	.07542	1.28
24	eat/drink	.10650	.1134	1.12
25	other-rtl	.04202	.04757	1.46
26	ag-service	.00665	.00785	2.24
27	finance	.01332	.01563	1.27
28	ins/re	.00773	.00882	1.32
29	education	.05990	.07008	1.27
30	health	.10450	.1131	1.14
31	other-ser	.02175	.02446	1.28
32	postal-ser	.03076	.03879	1.92
33	communicat	.02662	.03126	1.37
34	transport	.01934	.02476	1.50
35	gas-pr/dis	.00930	.01135	2.32
36	electric	.00853	.01068	3.24
37	wat/se/san	.02567	.03123	2.81
38	loc-govt	.05167	.06107	3.45
39	households	------	.01707	----

* Based upon Type II employment multipliers.

APPENDIX V

WITHDRAWAL AND CONSUMPTIVE USE REQUIREMENTS BY SECTOR

(In Gallons Per Dollar of Output)

	Sector	Withdrawal	Consumptive
1	irr-corn	1,872.0	749.0
2	irr-wheat	1,893.0	757.0
3	irr-sorg	2,666.0	1,066.0
4	dry-wheat	0	0
5	dry-sorg	0	0
6	other-irr	2,093.0	837.0
7	other-dry	0	0
8	feedlots	30.0	30.0
9	range-cttl	0	0
10	other-anim	16.0	16.0
11	food-proc	6.0	.4
12	printing	2.0	.2
13	mach-mfg	7.0	1.7
14	stone/clay	137.0	4.8
15	other-mfg	27.6	8.9
16	oil/gs-pr	1,031.0	529.2
17	constructn	4.0	.4
18	whlsl-mach	2.3	.6
19	whlsl-farm	2.3	.6
20	oth-whlsl	2.3	.6
21	rtl-fuel	2.3	.6
22	whlsl-fuel	2.3	.6
23	auto-dlr	3.9	1.0
24	eat/drink	7.0	2.1
25	other-rtl	3.9	1.0
26	ag-service	8.0	.8
27	finance	2.3	.2
28	ins/re	8.0	.8
29	education	1.5	.4
30	health	5.1	1.3
31	other-ser	3.5	.7
32	postal-ser	1.0	.1
33	communicat	2.1	.1
34	transport	2.1	.1
35	gas-pr/dis	267.0	13.4
36	electric	267.0	13.4
37	wat/se/san	0	.1
38	loc-govt	1.0	.32
39	households	3.2	.1
40	state-govt	1.0	.1
41	fed-govt	1.0	.1

APPENDIX VI

DIRECT PLUS INDIRECT WATER REQUIREMENTS

(In Gallons Per Dollar of Output Delivered to Final Demand)

	Sector	Withdrawal	Consumptive Use
1	irr-corn	2160	837
2	irr-wheat	2085	809
3	irr-sorg	2886	1127
4	dry-wheat	195	13
5	dry-sorg	181	68
6	other-irr	2265	879
7	other-dry	149	56
8	feedlots	528	222
9	range-cttl	340	132
10	other-anim	649	259
11	food-proc	339	137
12	printing	19	4
13	mach-mfg	18	4
14	stone/clay	148	7
15	other-mfg	42	12
16	oil/gs-pr	1204	607
17	constructn	43	10
18	whlsl-mach	30	6
19	whlsl-farm	603	232
20	oth-whlsl	153	57
21	rtl-fuel	42	8
22	whlsl-fuel	24	5
23	auto-dlr	33	7
24	eat/drink	57	9
25	other-rtl	54	9
26	ag-service	298	111
27	finance	9	16
28	ins/re	11	1
29	education	30	7
30	health	32	7
31	other-ser	19	3
32	postal-ser	24	5
33	communicat	13	3
34	transport	20	4
35	gas-pr/dis	503	131
36	electric	426	22
37	wat/se/san	52	7
38	loc-govt	30	7
39	households	31	7

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