WATER RESOURCE ECONOMICS

The Economic Effects of Weather Modification Activities

Part II
Range Production And Interindustry Analysis

TEXAS DEPARTMENT OF WATER RESOURCES

LP-21

MARCH 1979

THE ECONOMIC EFFECTS OF WEATHER MODIFICATION ACTIVITIES

PART II

RANGE PRODUCTION AND INTERINDUSTRY ANALYSIS

by

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INTRODUCTION

Background

General

The Division of Atmospheric Water Resources Management, Bureau of Reclamation, United States Department of the Interior, has the task of "establishing a verified, working technology and operational management framework by 1980 capable of producing additional rain from cumulus clouds in the semi-arid Plains States." The experiments required to attain the objectives of the program are termed the "High Plains Cooperative Experiment," or HIPLEX.

To carry out this cumulus cloud rainfall augmentation study, three field research sites have been selected along the High Plains Region east of the Continental Divide. These sites are near Miles City, Montana; Goodland, Kansas; and Big Spring, Texas.

The Bureau of Reclamation, working through the Texas Water Development Board (TWDB) under a cooperative contract agreement, made available to the Board certain funds for carrying out specific tasks in the Southern sector (Big Spring-Snyder area) of HIPLEX for the Federal Fiscal Year 1976.

A portion of these funds were awarded by the Board (under contract) to the Colorado River Municipal Water District, Big Spring, Texas, to collect and document rainfall data from a network of about 50 recording rain gauges and

approximately 94 wedge-type fencepost rain gauges. The District also operates an RD-65 rawinsonde unit to measure atmospheric temperature, wind, and humidity profiles during operational days.

Since 1971, the District has sponsored a rainfall stimulation project. The District at first awarded a contract to a private firm to conduct an operational cloud seeding program for the purpose of enhancing rainfall (TWDB, 1974). The primary goal of the project was to increase runoff into the storage lakes in the area, primarily Lake J. B. Thomas and E. V. Spence Reservoir. The District is now seeding clouds with its own aircraft, pilot, and equipment. As a part of the District's data collection program, the seeding aircraft is recording cloud base height, temperature, and various updraft characteristics on those clouds seeded.

Another part of the funds made available to the Board by the Bureau was assigned by the Board (under contract) to the research firm, Meteorology Research, Incorporated, of Altadena, California to upgrade and maintain the Snyder-based Bureau-owned M-33 radar system used to measure certain cloud parameters for post analyses of cloud characteristics and seedability.

Texas Tech University was awarded a portion of the funds by contract for cloud studies by remote sensing techniques. Texas Tech will do qualitative analyses of satellite imagery

to observe cloud response to cloud seeding and to determine certain physical cloud properties.

For FY 76, Texas A&M University will use a part of the funds to conduct, under contract, a measurement project capable of resolving mesoscale features associated with convective cloud systems.

Finally, a portion of the FY 76 funds made available by the Bureau was earmarked for in-house use by the Texas Water Development Board to continue a study of the economic effects of weather modification. The first phase of this study was conducted during FY 75 and consisted of an analysis of rainfall effects on crop production. The second phase of this study is described in this report.

Approach

The immediate goal of the HIPLEX program is to reduce scientific and management uncertainties in cloud seeding technology in the High Plains region of the United States. One of the uncertainties identified by the Bureau is a means of determining the circumstances under which precipitation increases would be desirable from economic and social viewpoints. Specifically, how much economic value can be expected from a controlled increase in rainfall, and who will realize the benefits. It has already been shown in the first phase report on crop production[1] how rainfall during various times of the

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[1] Texas Water Development Board, The Economic Effects of Weather Modification Activities, Part I - Crop Production, Nov., 1975.

year affects crop yields, but other effects are also realized from increases in rainfall.

The Bureau allotted certain funds to the Board and the Board matched the allotted amount to continue to a study of agricultural production in the Big Spring-Snyder area during Federal Fiscal Year 1976. A detailed work plan was prepared by the Board covering a full 3-1/2 year research effort. The initial emphasis of the study (FY 75) was to estimate the value of additional crop yields resulting from hypothetically-induced rainfall. These direct effects were realized as increases in income to the agricultural producers of food and fiber. The results of this preliminary demonstration study were described in the report previously cited. The present report describes the effects of additional rainfall on rangeland forage production, the effects of that forage production on the livestock industry, and, finally, the impact of that livestock production on the economy of the area. An input-output model of the study region was developed so that the interindustry effects of additional rainfall could be estimated and is shown in Chapter 2 of this report.

Effects other than agricultural will be examined in future portions of the study. These include the effect of increased rainfall on the level of municipal and industrial water supplies and water-use patterns, and on the recreational use of study area reservoirs.

Objectives

The specific objectives of the present phase of the

study are:

1. Determine response of range yield to changes in the average amount of precipitation received during various times of the year;
2. Determine direct income effects resulting from changes in range forage response; and,
3. Determine the total economic effects which occur in the Big Spring-Snyder area when additional rainfall causes an increase in crop and rangeland production.

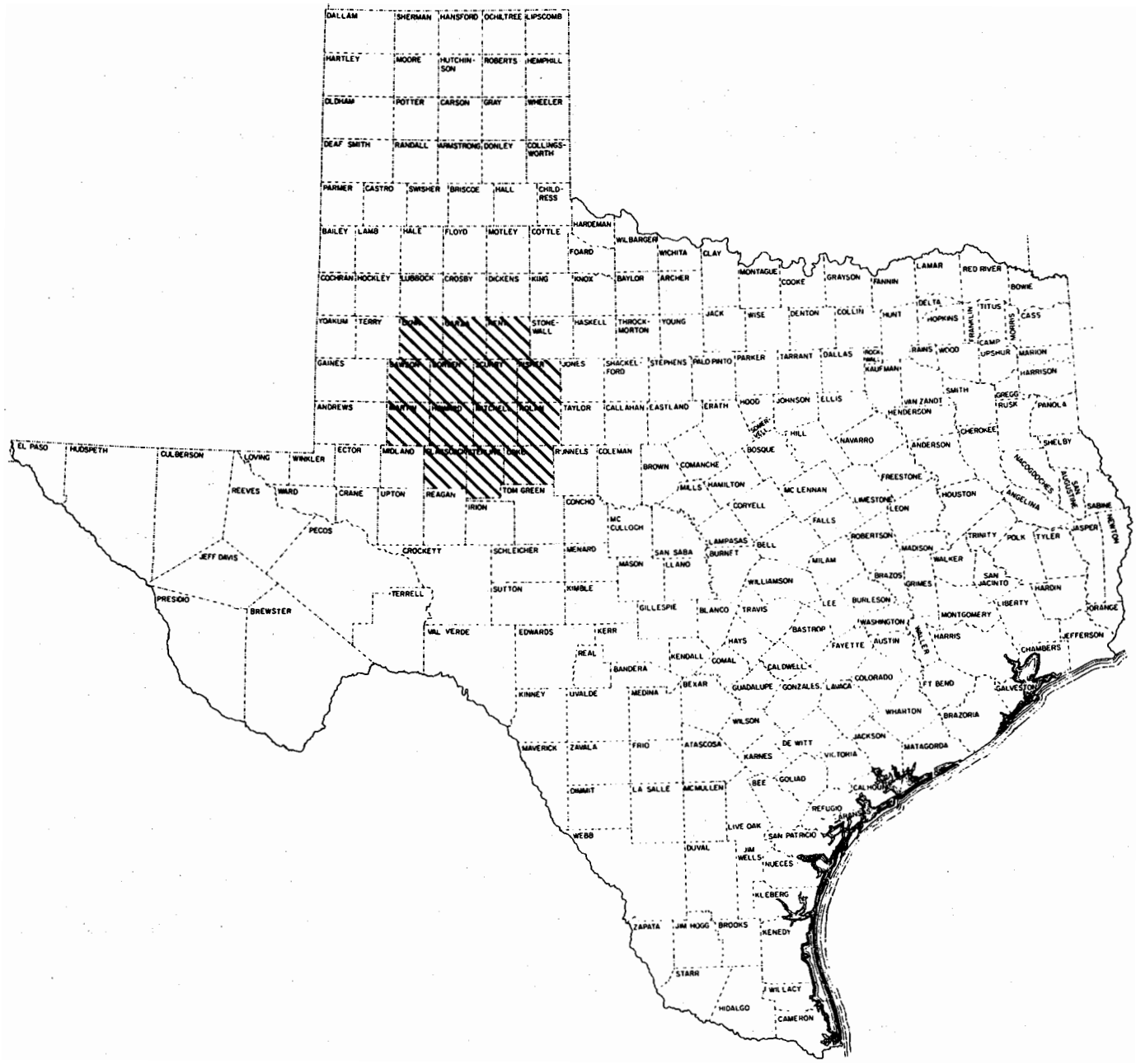
The Study Area

The area selected for this study consists of a 14-county region of the Texas Permian Basin lying generally between the Cities of Abilene, Lubbock, Midland, and San Angelo (see Figure 1). The counties included in the study are Borden, Coke, Dawson, Fisher, Garza, Glasscock, Howard, Kent, Lynn, Martin, Mitchell, Nolan, Scurry, and Sterling.

The terrain is characterized by plains in the West sloping downward to rolling hills in the East. The Caprock Escarpment divides the two types of terrain. Soils in the area are generally red or brown sandy loams several feet thick. This type of soil easily supports extensive crop production.

Precipitation in the study area varies from an annual normal of about 14 inches (35.7 cm.) in the Southwest to about 22 inches (55.9 cm.) in the East. Mean monthly temperatures range

Figure 1.--Location of the Big Spring-Snyder, Texas Weather Modification Study Area



from 40°F (4°C) in January to 82°F (28°C) in July.

The study area encompasses 12,678 square miles (32,836 sq. km.), or 8,113,920 acres. Of this total area, approximately 97% is used in agricultural production. About 64% of the total acreage, 5,194,186 acres, is used as rangeland on which cattle, sheep, and goats are produced.

Five surface water storage facilities constructed on the Colorado River or on its tributaries are located in or near the study area. These facilities are Lake J. B. Thomas, Lake Colorado City, and E. V. Spence Reservoir on the Colorado River, and Champion Creek Reservoir and Oak Creek Reservoir on the tributaries. These facilities provide water to the major cities and industries encompassed by the District.

Economic Characteristics

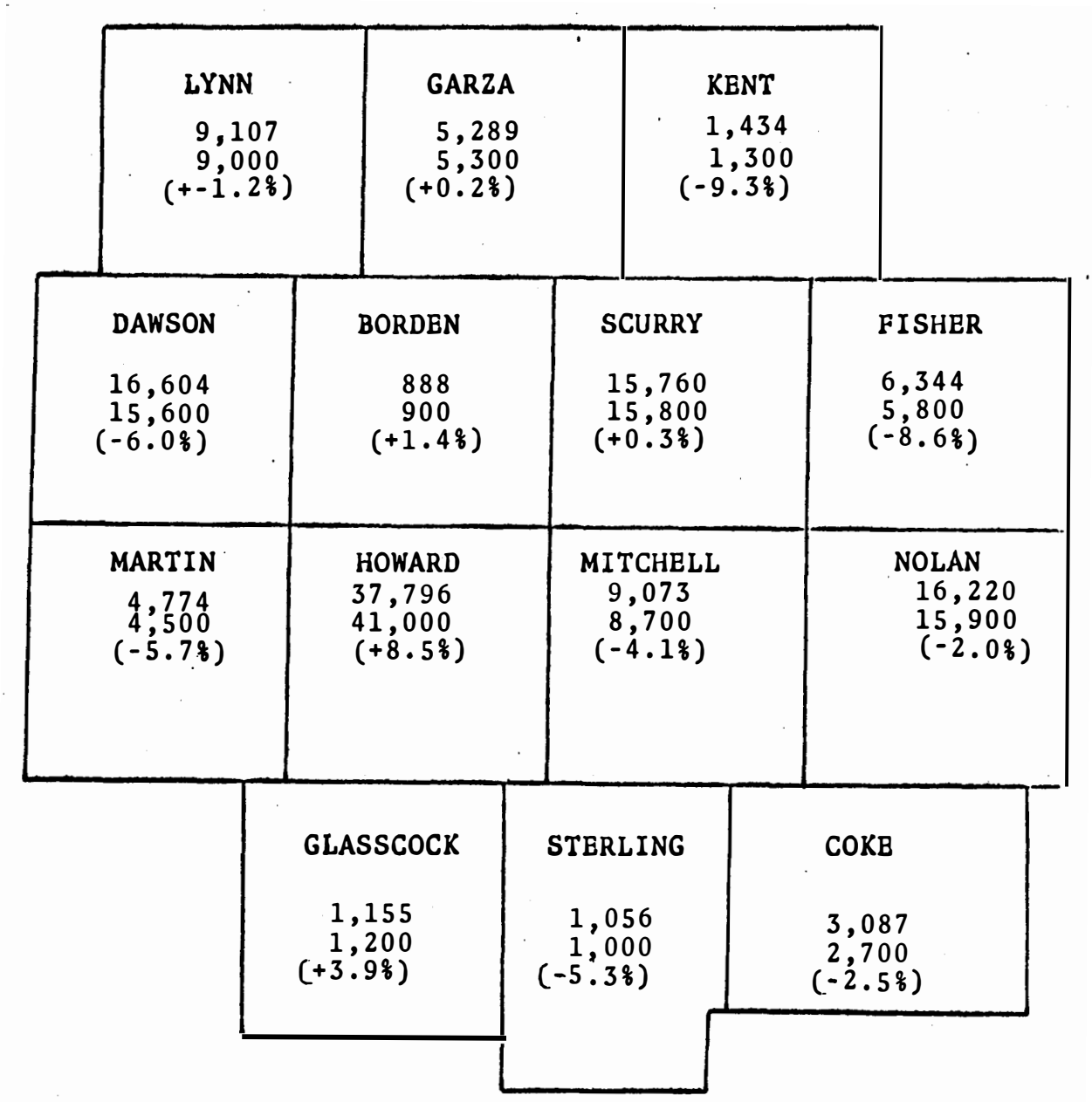
Population in the study area generally declined from 1960 to 1970. It dropped from 149,056 in 1960 to 128,587 in 1970. Of this 1970 population, 49.4 percent lived in the cities of Big Spring, Snyder, Lamesa, and Sweetwater (Census of Population, 1970). Nine of the counties in the study area are expected to experience continuing declines in population (see Figure 2). It has been projected by the Economics Division of the TWDB that by 1980, population in the study area will be 128,700, eventually reaching a level of 101,600 by the year 2020.

The work force participation rate of the population rose slightly from 35.1 percent in 1960 to 38.7 in 1970. Of the 52,310 members of the work force in 1960, 2,140, or 4.1 percent, were unemployed. This unemployment figure was reduced in 1970 when 1,290 (2.6 percent) of the 49,740 member work force were unemployed.

While the work force as a whole declined, agricultural employment increased from 1960 to 1970, from 10,330 (20.6 percent of the work force) to 12,085 (24.9 percent of the work force).

The economy of the area is centered basically around agriculture and oil. Farming, primarily of cotton, grain sorghum, and wheat, accounted for 27.9 percent of all earnings in the region in 1970. Although the mining industry contributed only 6.1 percent of the total earnings of the region, related industries such as production of oil field

Figure 2.--Population by County, 1970 and 1980, and Percentage Change, Big Spring-Snyder Area*



Total: 1970 - 128,587
1980 - 128,700
% +0.1

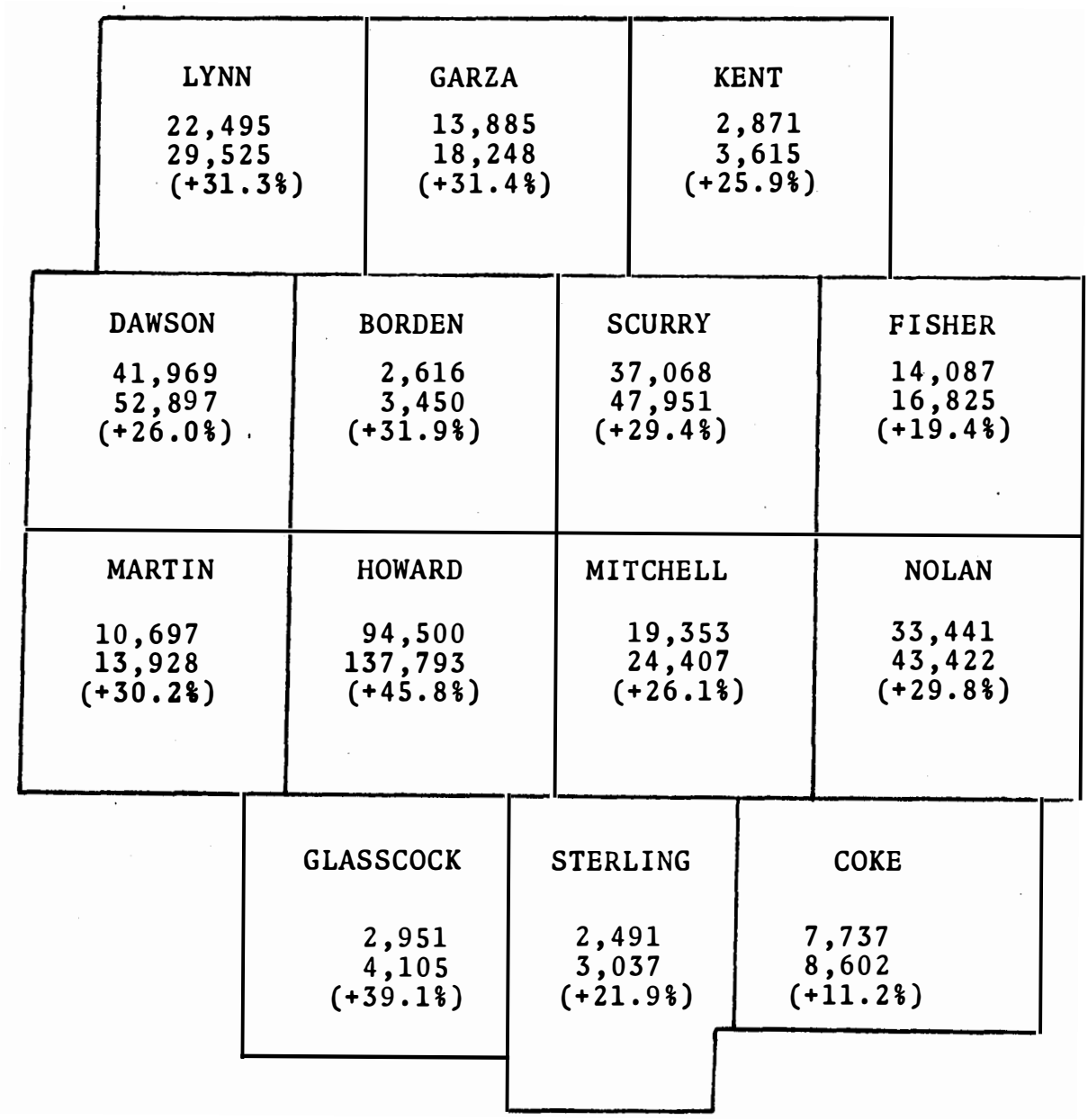
*Based on TWDB Projections

machinery, petrochemicals, textiles, and fertilizers gave the oil industry quite an impact on the economy (Bureau of Economic Analysis, 1972).

Another factor which reflects the importance of agriculture in the study area is proprietor's income. Proprietor's income is the value of income earned by unincorporated businesses, less expenses. Farmers, doctors, lawyers, entrepreneurs in nonfarm businesses and others in self-employment status are included as proprietors. In 1970, total proprietor's income for the region was $125.4 million of which farm proprietors earned $87.0 million or 69.4 percent.

Figures 2 through 5 present projections of economic activity in the study area for the year 1980. Besides population, which is expected to remain relatively constant between 1970 and 1980, the economic indicators are expected to rise substantially. Earnings in the area is expected to increase 33.2% while employment is expected to rise 9.3%. Per capita income, too, is projected to increase by as little as 28.5% in Sterling County to as much as 42.2% in Martin County.

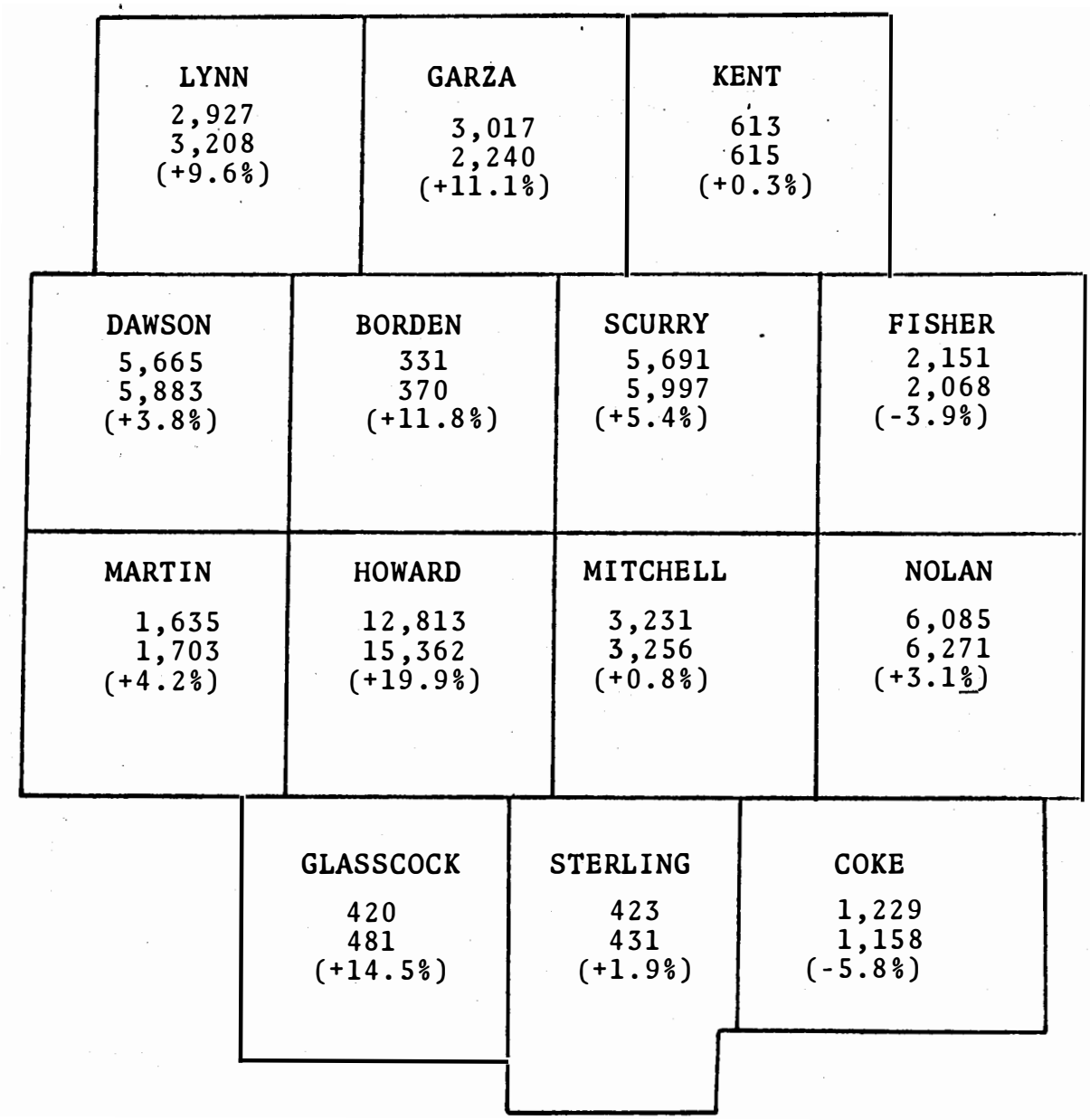
Figure 3.--Earnings by County for 1970 and 1980 and Percentage Change, Big Spring-Snyder Area ($1,000's)*



Total: 1970 - 306,161
1980 - 407,805
% - +33.2

*Based on TWDB Projections

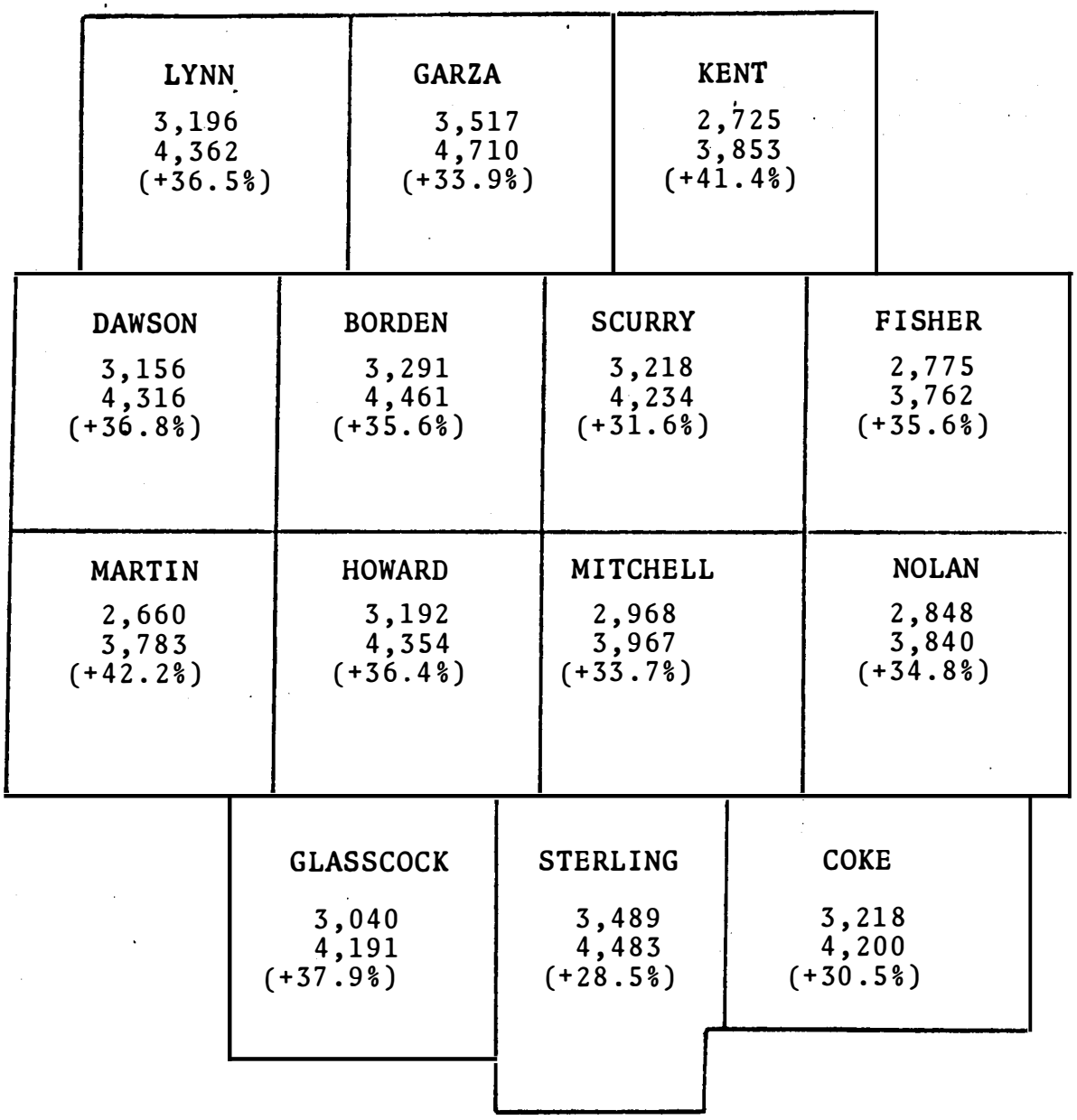
Figure 4.--Employment by County for 1970 and 1980 and Percentage Change, Big Spring-Snyder Area*



Total: 1970 - 44,853
1980 - 49,043
% - +9.3

* Based on TWDB Projections

Figure 5. Per Capita Income by County, 1970 and 1980, and Percentage Change, Big Spring-Snyder Area*



*Based on TWDB Projections

CHAPTER 1

RANGE FORAGE YIELD RESPONSE

The purpose of the range yield response portion of this economic study is to estimate the effects of hypothetically-induced rainfall on the forage yield of the native rangeland in the study area. The distribution of this rangeland is shown in Table 1. This forage yield has a direct bearing on the output and cost of production of the livestock industry in the area. The economic effects described in this study are estimates of the impact on regional economic activity of changes in the range livestock industry.

In this study, a change in range forage production is defined as a function of rainfall and previous range conditions. That is:

Yield = f (rainfall, previous range condition)

This functional relationship can be estimated through the use of multiple linear regression. This statistical technique utilizes a series of observations related to a particular event (in this case forage growth) and quantifies those relationships existing among the observations in the following form:

$$Y = a + b_1 X_1 + b_2 X_2 + \ldots + b_n X_n$$

where Y = predicted value of dependent variable

a = constant

b_1 = coefficient defining functional relationship between Y and X_1

X_1 = independent variable (rainfall, previous range condition)

Table 1.--Distribution of Rangeland Acreage in the Big Spring-Snyder Area.

County	Acres-Rangeland
Borden	471,800
Coke	517,595
Dawson	101,018
Fisher	294,144
Garza	467,674
Glasscock	483,769
Howard	354,439
Kent	481,244
Lynn	84,400
Martin	280,239
Mitchell	344,000
Nolan	456,891
Scurry	279,291
Sterling	577,682
TOTAL	5,194,186

With this model, a change in range condition given a change in one of the independent variables can be determined when the other independent variables are held constant at their means. Although it is possible that a relationship between two variables may only be coincidental, it can sometimes be justified that the relationship is a causal one. For instance, it is normally understood that an increase in rainfall would cause the amount of forage on rangeland to increase, so any defined relationship between these two variables can be considered causal.

The relationships described were determined from monthly observations of rainfall and range conditions using observations taken from 1941 through 1971.

Methodology

A search of the literature on determining rangeland response to rainfall did not reveal any concensus on a particular method for estimating the impact of increased forage production on livestock production which would be applicable to the Big Spring-Snyder study area. Almost all work in this area has been limited to a regression of rainfall measurements on clipping measurements in which the amount of forage growth on a small plot of land (usually no more than a few square yards in area) was determined. This type of measurement of forage growth has taken place only occasionally in the study area, and has never been repeated

on any plot of land. Consequently, the estimation of equations for rangeland response in the Big Spring area required the development of a technique combining some of the previously established procedures on evaluating the forage in economic terms.

Basically, three methods were considered in approaching this problem. All three had one common element -- that of determining the physical relationship between rainfall and forage growth. The differences existed in the method of evaluating that forage growth. Two sets of data were used to estimate the physical response of forage growth to rainfall. The first was the range condition reports of the Statistical Reporting Service of the U.S.D.A. These reports are subjective evaluations of the condition of the range which are made on the first day of each month by observers in the field. The evaluations are based on what the observers feel is the condition of the range as a percent of "normal", or what could "normally" be expected of the range for that time of year. The second source of data was the Soil Conservation Service in its county Soil Surveys. These surveys provided estimates of forage growth by range site for wet years and dry.

The procedure followed was to develop a multiple regression model relating average range conditions to rainfall during various times of the year. The results of the model provided an indication of the change in range conditions which might be expected to result from a change in one of the predictor rainfall variables.

Conversion of the predicted change in range conditions to a change in forage yield required three assumptions: (1) maximum forage yield is realized when the range condition is rated at 100%; (2) mean forage yield, i.e., the mid-point of the range of yields as reported by the SCS, is realized when the range condition is at its mean value; and (3) a linear relationship exists between range conditions and forage production between the two points described above such that:

$$\frac{\text{(Max. yield - mean yield)}}{\text{(100\% - mean range condition)}} = \text{increased forage yield per 1\% increase in range condition}$$

Having estimated the forage yield per unit change in range condition, several methods were examined to evaluate that yield. Two methods which were examined are based on the assumption of increased stocking rates, and a third method on the assumption of supplement substitution. The first method required an estimate of the increased number of animal units* which could graze in the study area, and still maintain the present amount of forage consumption per animal unit. The market value of the additional animal units would then be determined.

The second method was based on the assumption that present

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* An animal unit is basically equivalent to a 1,000 lb. cow. Sheep and hogs are considered to be about 1/5 animal unit, while a large bull might be 1.3 animal units (Allred).

stocking rates and kilocalories of energy-intake per animal unit would remain the same. The effect of increased forage growth would be the substitution of forage for some of the supplements currently being fed to range livestock. The economic value of the forage growth is reflected by the savings to the livestock producers from not having to purchase as much supplemental feed.

The third method, and the one finally adopted, was based on an estimate of the additional number of animal units months of grazing which could result from better range conditions. This value was multiplied by the cost to a rancher of purchasing one animal unit month of grazing to estimate the total value of increased grazing. This procedure was used by Earl A. Hausle in "Potential Economic Values of Weather Modification on Great Plains Grasslands." This method was preferred largely due to problems in the other two methods. For example, the first method requires a determination of the market value of an animal unit. The major drawback in this method is that it is extremely difficult to estimate the market value of a representative animal unit consisting of a mixture of goats, sheep, and cattle. The greatest disadvantage with the second method is that the number of kilocalories of energy intake per unit depends on the type of feeding system the livestock producers are utilizing, thereby requiring the estimation of a representative feeding system for the study area. In addition, the exact substitution rate of forage for supplement is quite difficult to determine.

The problem with the Hausle method is determination of the cost of an animal unit month of grazing. In this study, this is the cost to a livestock producer for leasing grazing rights on someone else's property as determined by the Texas Agricultural Extension Service.[1] The producer would not incur this cost on his own land, but it is felt that if he is willing to pay someone else that amount, then he must expect that he can receive an equivalent return on his livestock. That return would flow to the producer whether he grazes his livestock on his own land or on someone else's. The Hausle method was used to value the changes in forage production for this economic evaluation of the effects of weather modification on rangeland production of livestock.

Data Acquisition

Range Conditions

Monthly reports of range condition estimates were obtained from the Statistical Reporting Service. These data were collected for crop reporting districts 1, 2, and 7 for the years 1940 through 1971. These crop reporting districts, however, also encompass counties outside the study area, so the range condition reports are only partially representative of the range conditions in the study area. In order to develop a set of range condition estimates peculiar to the study area, it was assumed that the reports for crop reporting districts were

[1] Texas Agricultural Extension Service, "Budgets for Texas Crops", Texas A&M University, (MP-1027), College Station, Texas.

indicative of the range condition at the geographic center of each respective district. An interpolation routine drawn from computer graphics was used to weight the district reports to produce an estimated range condition for the rangeland activity center of the study area.[2] This activity center is the point through which a north-south line divides all rangeland acreage equally east and west, and an east-west line divides the acreage equally north and south. For the Big-Spring Snyder area, the rangeland activity center lies approximately 11 miles northwest of Colorado City in Mitchell County (see Figure 6). It was assumed that the range condition at this geographical location is representative of the entire study area.

Rainfall and Temperature

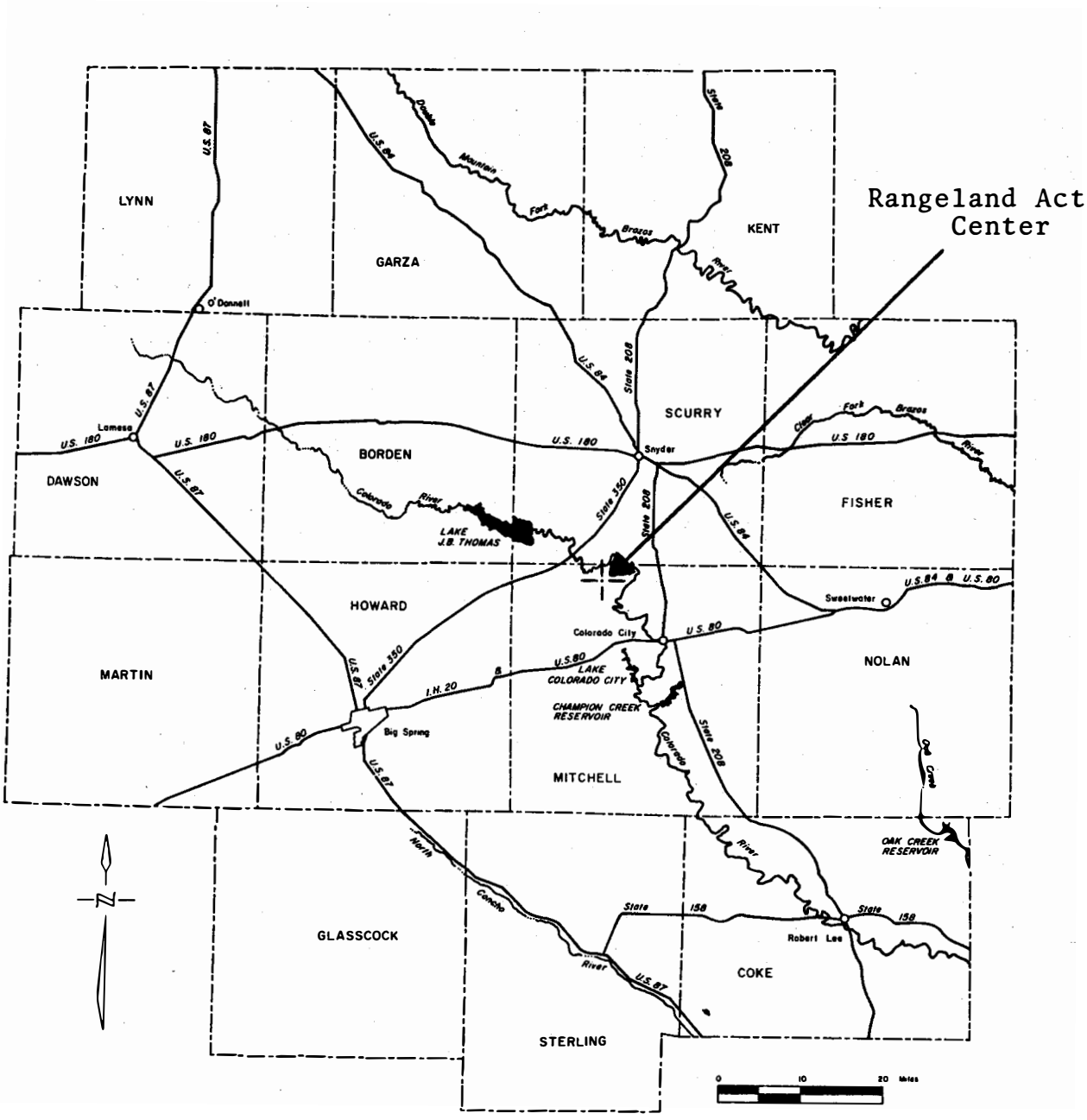
Observations of rainfall data were developed for the rangeland activity center just as they were for the crop activity centers. This procedure is described in detail in the previous report.

Forage Yield

Estimates of forage yield by range site were obtained from county Soil Surveys published by the Soil Conservation Service. These estimates showed the pounds of forage which would be expected in wet years and dry years on a given range site when the range is in excellent condition. The forage that is included in the estimates includes a wide variety of grasses peculiar to a particular climate and a particular soil.

[2] Refer to previous report for details.

Figure 6.--The Big Spring-Snyder Study Area and the Location of the Rangeland Activity Center



These estimates were updated by the Area Range Conservationist in the Big Spring area who provided an estimated of the current average forage yields being realized in the region according to range site. The range of forage yields from the soil surveys were adjusted to reflect this updated information. The adjustment procedure was done as follows:

$$\text{Max. yield (adj.)} = \text{Updated Average} \times \frac{\text{Max. Yield}}{\text{Reported Average}}$$

$$\text{Min. yield (adj.)} = \text{Updated Average} \times \frac{\text{Min. Yield}}{\text{Reported Average}}$$

The forage yields for each range site were then weighted by the number of acres of each range site resulting in an average maximum and minimum forage yield per acre for the study area. It was then assumed that this average represented the forage production possibilities occurring at the crop activity center of the study area.

Regression Model

The rangeland response model developed for the study area was determined using the step-wise regression routine of the UCLA BIOMED statistical package on the TWDB's Univac 1106.

The model contains three rainfall variables and a variable for the previous year's range condition. The model is significant at the 99.5% level and all of the coefficients are significant at the 95% level. The coefficient of determination, R^2, is

0.87. Specifically, the model is:

$$Y = -4.457 + 2.477\ X_1 + 1.073\ X_2 + 1.115\ X_3$$
$$(59.7359) \quad (7.6983) \quad (4.7659)$$
$$+ 85.943\ X_4$$
$$(133.6384)$$

Where: $\bar{Y}$ = 75.18%

$\bar{X}_1$= Sum of Jan. thru Apr. mean rainfall (3.79 inches) (9.6 cm.)

$\bar{X}_2$= May mean rainfall (2.95 inches) (7.5 cm)

$\bar{X}_3$= October mean rainfall (1.98 inches) (5.0 cm.)

$\bar{X}_4$= Previous year's range conditions (75.48%)

S.E. = 3.32

$F_{4,26}$ = 45.203

R^2 = .8743

The values in parentheses ( ) below the coefficients are the F-values used in determining the significance of each variable. As is readily seen, the most significant variable in the model is the previous year's range condition. This is largely due to the fact that if the range condition is good during any given year, the plants are healthy enough and have the stamina to survive the winter and start a good growth the following year. On the other hand, if the range condition is poor, the plants lack that stamina, and it is more difficult for them to develop a good stand the following year, regardless

of the amount of rainfall.

This model can be used to estimate the effects weather modification activities might have on the condition of the range by assuming that a 10% increase in average rainfall would occur during each of the months appearing in the model. The following table outlines these effects.

Table 2.--Effects of 10% Increase in Rainfall on Yearly Average Range Condition

	Increase in R.C.(%)
Jan.	0.166
Feb.	0.173
Mar.	0.198
Apr.	0.401
May	0.316
Oct.	0.221

The greatest effects of rainfall on range condition appear to be April, May, and October. The large effects are observed in those months principally because the average rainfall is substantially higher. A 10% increase in rainfall in May, for example, would be 0.295 inches (0.75 cm), while a similar increase in February would be only 0.070 inches (0.18 cm.)

Although rainfall in the summer months did not appear in the model, it seems logical that rainfall during the summer is also important in sustaining the rangeland and in establishing a healthy growth of cool weather grasses. Probably because of the high temperatures and the concurrent

high evapotranspiration rates, rainfall in June, July, and August has a relatively short term effect. That is, the primary effect of rainfall in any of these months is observed in the range conditions of the following months. The following table shows the correlation factors between rainfall in May through September and range conditions of the first three succeeding months.

Table 3.--Correlation of Rainfall with Range Conditions in the Three Succeeding Months

	Rainfall Month					
	May	June	July	August	September	Average
1st Mo. Following	.513	.470	.456	.504	.504	.489
2nd Mo. Following	.501	.455	.363	.481	.450	.450
3rd Mo. Following	.203	.409	.166	.487	.389	.331

There is an average of 0.489 correlation of the summer month rainfall with the range condition of the first succeeding month dropping to about a 0.450 for the second month, and a 0.331 average for the third month.

The growth cycle of range plants is another reason why rainfall in the summer months does not have a significant effect on the conditions of the range. Normally, range plants, like other crops, grow most during the spring and early summer. If the plants have established a good stand during that time,

then average rainfall during the summer is sufficient to sustain them through the year. However, if the plants have a poor stand at the end of their prime growing season, then there is very little that summer rainfall can do to improve that condition.

Economic Effects

The range condition response model described in the previous section, together with information about forage yields, rangeland acreages, and daily consumption by range livestock, provides the information necessary to estimate the economic effects of rainfall during various months of the year.

Using the procedure previously described in the methodology section, the weighted maximum production of forage at the range activity center was found to be 1,841 lbs (835 kg.) per acre, and the weighted average production was 1,397 lbs. (634 kg.). The difference between these two figures, 444 lbs. (201 kg.), is the total increase in forage production which would be realized if the range condition increased from its average of 75% to its maximum of 100%. Under the assumption that changes in range condition have a linear relationship with changes in forage production the average increase in forage production is computed to be 17.76 lbs. (8 kg.) per one percent increase in range condition.

With this base value relating range conditions to actual forage production, the physical impact of increased rainfall

on forage production can be determined by simply multiplying the estimated effects of rainfall on range condition, given in Table 2, by 17.76 (8.1 kg.). An estimate of the total effect of rainfall on forage growth in the region is found by multiplying these yields per acre by the number of rangeland acres in the study area. Table 4 shows these total effects.

Table 4.--Total Effects of a 10% Increase in Rainfall on Range Forage Production (millions of pounds)

	Forage-lbs. (kg.)
Jan.	15.3 (6.9)
Feb.	16.0 (7.3)
Mar.	18.3 (8.3)
Apr.	37.0 (16.8)
May	29.2 (13.2)
Oct.	20.4 (9.3)

The next step in determining the economic value of this total forage production is the computation of the number of animal unit months of grazing the forage will support. Two range management systems are considered in the analysis. System I, a system proposed by most range conservationists, is based on the assumption that only 50% of the available forage will be consumed by livestock. The other 50% is left

on the ground as a range improvement measure. System II, on the other hand, is suggested by some livestock specialists, and is based on the assumption that livestock could consume 60% of the available forage without damaging the rangeland. In this system, the condition of the range would maintain its current status. Hausle, in his study, estimated that one animal unit requires about 20 lbs. (9.1 kg.) of forage per day. By this criterion, 40 lbs. (18.1 kg.) of forage is required for each animal unit day of grazing under System I, and 33 lbs. (15 kg.) under System II. The number of animal unit days of grazing available from the increased production under each system was then found by dividing each value in Table 4 by 40 and 33, respectively. Animal unit months of grazing were computed by dividing the animal unit days available under each system by 30.

The direct economic effects of the assumed 10% increase in rainfall in each month appearing in the regression model were then determined. From the budgets of the Texas Agricultural Extension Service, it was found that in 1974, the average cost of an animal unit month of grazing was $8. Multiplying this value by the number of animal unit months of grazing provided by each management system produced an estimate of the direct economic effect resulting from a 10% increase in rainfall. These effects are found in Table 5.

Table 5.--Direct Economic Effects by Month and Range Management System Due to a 10% Increase in Rainfall (Thousands of Dollars)

	System I	System II
Jan.	$102.1	$123.7
Feb.	106.1	129.3
Mar.	121.9	147.7
Apr.	246.8	299.1
May	194.6	235.9
Oct.	135.8	164.6

The values listed in Table 5 are only the "direct" effects resulting from the increased rainfall. Other "indirect" effects also occur as a result of the increased income by livestock producers. Since this increase in income is received by households of the producer, secondary and tertiary effects would be realized when the producer spends his extra income on consumer goods or on expanding his output, thereby causing other sectors of the economy to increase their outputs.

Many such effects would occur throughout the economy. Meat packers, for instance, would receive an additional income from processing the livestock, and car dealers would increase their income when the livestock producers purchased more automobiles with their increased profits. An estimate of the total effects on the economy arising from an increase in rainfall, therefore, would provide a more accurate measurement

of the benefits of that rainfall.

These total effects can be estimated through the use of input-output analysis, and are described in more detail in Chapter 2 of this report.

Summary

The purpose of this project was to estimate the effects of weather modification activities on the production of forage on the native rangelands of the Big Spring-Snyder area, and to estimate the economic effects of changes in forage production on the livestock industry. Estimates of these effects were developed primarily through the use of multiple linear regression.

Some of the major results of the study were:

1. Rainfall during the spring months is very important to determining the condition of the range during the rest of the year. A 10% increase in rainfall in May, for example, would increase forage yield by 29.2 million pounds (13.3 million kg.) over the region, resulting in a value of as much as $235,900 in income to the area livestock producers.
2. The range condition of the previous year has a significant impact on the current range condition. A carry-over of healthy range plants through the winter months is very important in establishing a good stand of plants in the following spring.

3. A 10% increase in rainfall in April would have the largest effect on total income to area livestock producers. This 0.16 inches (0.41 cm.) increase could result in an income increase of as much as $299,100.

CHAPTER 2

INTERINDUSTRY EFFECTS OF WEATHER MODIFICATION

Chapter 1 of this report, and the previous report, "The Economic Effects of Weather Modification Activites - Part I, Crop Production" have outlined the effects of assumed 10 percent increases in rainfall on the household income of the crop and livestock producers in the Big Spring-Snyder area. The economic effects of that increase in income, however, extend beyond the crop and livestock producer's pockets into all the other sectors of the economy. There are four economic effects which normally result from increased crop and livestock production.

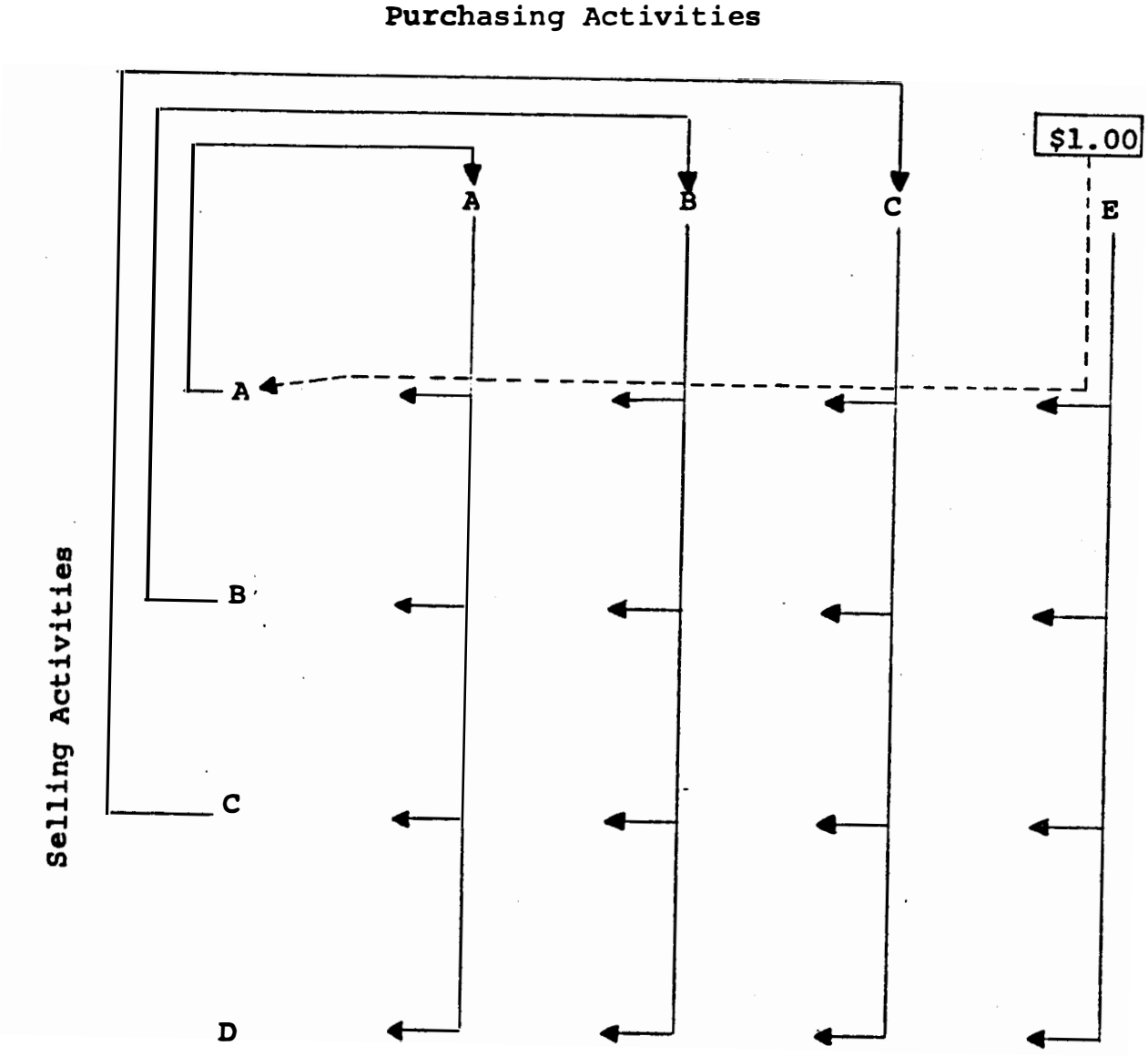
First is the direct effect which is that increase in production resulting "directly" from a certain outside stimulant such as an increase in sales to markets outside the region. In this case, the direct effect is the value of the additional production of crops and livestock.

Second is the indirect effect which occurs whenever a sector of the economy sells a good or service to a final consumer such as exports, government, or capital formation. These sectors of the economy are known as final demand sectors, and any purchases made by them are determined by factors lying outside the regional economic system. That is, the type and amount of good or service they purchase is not

controlled in any way by the regional economy. The indirect effect is realized when, for example, a $1.00 purchase is made by the federal government from the irrigated crop sector. In the Big Spring-Snyder area, the irrigated crop sector would then spend that $1.00 on purchasing goods and services required in its production process. It would spend 11.4¢ on chemicals, 4.6¢ on lumber and hardware, 7.2¢ on other agricultural services, and 26.3¢ on labor. The chemicals sector would, in turn, spend 2.4¢ of its 11.4¢ income on crude petroleum, 1.7¢ on other chemicals, and 1.7¢ on labor. The crude petroleum would then spend 0.2¢ on other mining products, as well as, smaller amounts on other products. The total increase in output of all the sectors of the economy, aside from the initial $1.00 increase by irrigated crops, is the indirect effect of that increase.

This chain of purchasing-selling activity can be further illustrated in Figure 7. This figure shows a hypothetical economy consisting of three producing, or processing, sectors (A,B, & C), a final payments sector, (D) and a final demand sector (E). A final payment sector is a sector which does not recirculate any of its income to other sectors of the regional economy. The imports sector, for example, is included in this category and is made up of producers of goods or services lying outside the region. Any money going to them in exchange for goods or services, remains outside the region and does not further affect the region's economic

Figure 7 The Flow of Money Through the Sectors of a Regional Economy



activity. Other sectors normally included in the final payments sector are government, depreciation, and, at times, households.

Figure 7, demonstrates the flows of money, and the reverse flow of goods and services, which occurs when the final demand for the product of sector A increases by $1.00. The cycle of money flow continues until the amount spent by any sector becomes negligible. Summing the total amount spent by all three producing sectors provides an estimate of the final demand multiplier; i.e., the total increase in output in the region resulting from the $1.00 initial increase in final demand for the product of sector A. Since that $1.00 initial increase is the direct effect, the indirect effect is the difference between the $1.00 and the total effect.

The third economic effect is the induced effect arising from increased consumer spending. In the example given above, if the producers of irrigated crops spent their additional 26.3¢ household income on consumer items such as groceries, clothing, gasoline, and recreation within the region, an additional amount of economic activity would be generated by the producers of those items. This economic activity exists in addition to the total direct and indirect effects mentioned above, and is computed as the difference between the total economic effects when payments to households are considered spent, thereby generating more economic activity, and when payments to households are considered a final payment.

The fourth economic effect, and one which has particular applicability in determining the total economic effects of additional rainfall, is the stemming-from effect. It is that indirect and induced effect which occurs when a processing sector purchases some additional amount of production of crops or livestock. It occurs because, in addition to purchasing the crop or livestock, the processor must purchase a proportional share of its other production requirements from other sectors of the economy. These other purchases generate a certain amount of indirect and induced effect on the other sectors of the economy. These effects, then, "stemmed-from" the initial increase in production of livestock or crops.

The effects described thus far are the normal effects arising as a result of an increase in final demand. In this project, however, a slight divergence is required to arrive at an accurate estimate of the economic value of additional rainfall. As was stated earlier, the indirect and induced effects occur when a sector makes additional purchases from other sectors of the economy to meet a change in final demand. In this case, however, the crop and livestock sectors received an additional household income without having to increase their purchases. The normal indirect and induced effects, therefore, do not occur. Instead, the effect which is most likely to occur, other

than the increase in production, is a result of households spending the additional income on consumer items. This expenditure would increase economic activity in the region. Therefore, economic effects resulting from increased rainfall would be the direct effect, the household consumption effect, and the stemming-from effect. These will be discussed in detail later.

One of the most comprehensive methods of measuring the effects described above is input-output analysis. This procedure was developed by Wassily W. Leontief and was first published by Leontief in his analysis of the structure of the American economy during the period 1919 to 1929 (Leontief, 1951). Since that time much research has been done to expand the usefulness of this procedure, and many studies, both for the United States as a whole and for smaller areas, have been conducted. Some of these studies include an analysis of the U.S. economy for 1947 (U.S. Department of Labor, 1953), a study of the economic structure of West Virginia (Barr, 1968), and the input-output study of the State of Texas (Grubb, 1973). The results of a study to determine the benefits of irrigation in Nebraska has also provided some very useful information pertaining to stemming-from effects (Roesler, 1968).

Purpose and Objectives

The purpose of this study is to determine those direct,

household consumption, and stemming-from economic effects which could be expected if attempts to increase rainfall through weather modification succeed. These effects will be computed for assumed increases in production of cotton, wheat, grain sorghum, and livestock already defined in earlier phases of this study.

The specific objectives for this study are as follows:

1. To develop an input-output model of the economy of the Big Spring-Snyder area.
2. To estimate those household consumption effects resulting from additional output by the cotton, wheat, grain sorghum, and livestock industries.
3. To estimate those "stemming-from" effects which occur when crop and livestock related sectors process an assumed increase in output of one of the four agricultural commodities mentioned in objective 2 above.

To measure the economic effects described above as they are related to weather modification in the Big Spring-Snyder area, an input-output model peculiar to the study area was developed. A mathematical description of this model is in Appendix C with the results of the model in Appendix B of this report. Several assumptions were necessary for this model: (1) technical coefficients, i.e., the mix of input requirements for any one sector of the economy,

remain constant over time; (2) relative prices of inputs remain constant over time; (3) the amount of any one input required in a production process is linearly related to the total output of the sector; and (4) the types of businesses composing any sector are relatively homogeneous; i.e., the mix of input requirements shown for a sector is representative of that sector.

The primary usefulness of the input-output model is to develop an understanding of the complex structure of the economy and to present some idea as to the degree of effects which could be expected to occur. The sectors of the economy of the Big Spring-Snyder area were delineated as shown in Table 6. A further description of the make up of each sector is shown in Appendix A. The model is composed of 32 processing sectors, 5 final payments sectors, and 6 final demand sectors.

Economic Input

Table 7 shows the output of each sector of the economy for the Big Spring-Snyder area in 1967. The sectors have been grouped by major categories of activity. By far the largest industry in the area is mining. Mining, primarily of petroleum, made up $438 million, or 36% of the total processing sector output of the area. Petroleum mining, although existing in all the counties in the area, is centered in Scurry County which produced 34% of the crude petroleum and 30% of the natural gas.

Table 6.--Economic Sectors of the Big Spring-Snyder Study Area

Sector Number	Sector Name
1	Irrigated Crops
2	Dryland Crops
3	Livestock
4	All Other Agriculture
5	Crude Petroleum and Natural Gas
6	Natural Gas Liguids, Oil & Gas Field Services
7	Construction
8	Meats & Dairies
9	Milling & Feeds
10	Foods & Beverages
11	Textile Products
12	Wood Products, Printing & Publishing
13	Chemicals, Petroleum Products, Plastic, Leather, Glass Products
14	Clay, Stone, Cement Products
15	Other Manufacturing
16	Local & Long Distance Trucking, Storage and Arrangement
17	Other Transportation
18	Communications
19	Gas Services
20	Electrical Services
21	Water & Sanitary Services
22	Wholesale Farm Products
23	Wholesale Petroleum Products
24	Other Wholesale
25	Lumber Yards, Hardware, etc.
26	Auto dealers, Repair, Service Station
27	Other Retail
28	Finance, Insurance, Real Estate
29	Amusement & Recreation
30	Medical Services
31	Educational Services
32	All Other Services
Final Payments	Households
	Federal Government
	State Government
	Local Government
	Imports
Final Demand	Households
	Federal Government
	State Government
	Local Government
	Exports and Inventory Change
	Capital Formation

Table 7.--Output by Sector and Major Group, Big Spring-Snyder Area, 1967, ($1,000's).

Agriculture			129,311.415
1	Irrigated Crops	21,917.990	
2	Dryland Crops	63,882.388	
3	Livestock	24,292.183	
4	All Other Agriculture	19,218.854	
Mining			437,958.492
5	Crude Petroleum and Natural Gas	359,178.887	
6	Natural Gas Liquids, Oil & Gas Field Services	78,779.605	
Construction			29,303.000
7	Construction	29,303.000	
Manufacturing			232,670.776
8	Meats & Dairies	8,105.641	
9	Milling & Feeds	1,755.678	
10	Foods & Beverages	7,182.118	
11	Textile Products	9,790.899	
12	Wood Products, Printing & Publishing	4,785.290	
13	Chemicals, Petroleum Products, Plastic, Leather, Glass Products	173,487.674	
14	Clay, Stone, Cement Products	9,368.371	
15	Other Manufacturing	18,195.105	
Utilities			44,893.462
18	Communications	10,340.266	
19	Gas Services	15,919.735	
20	Electrical Services	16,097.460	
21	Water & Sanitary Services	2,536.001	
Trade & Transportation			254,792.841
16	Local & Long Distance Trucking, Storage, and Arrangement	8,990.787	
17	Other Transportation	15,844.279	

Table 7.--Output by Sector and Major Group,
Big Spring-Snyder Area, 1967,
($1,000's). (continued)

22	Wholesale Farm Products	5,018.050	
23	Wholesale Petroleum Products	4,096.062	
24	Other Wholesale	16,930.681	
25	Lumber Yards, Hardware, etc.	28,638,501	
26	Auto Dealers, Repair, & Service Stations	70,651.761	
27	Other Retail	104,622.720	
Services			72,340.902
28	Finance, Insurance, Real Estate	19,941.828	
29	Amusement & Recreation	652.345	
30	Medical Services	13,756.934	
31	Educational Services	21,182.887	
32	All Other Services	16,806.908	
	TOTAL		1,201,270.888

Agriculture produced $129 million, or 11%, of the total processing sector output in 1967. Cotton, wheat, and grain sorghum made up 97% of the total dryland and irrigated crop production of $85.8 million, while livestock accounted for $24.3 million.

Imports of goods and services required for the various production processes by the economic sectors of an area are a major drain on economic gains from changes in final demand. In 1967, the processing sectors of the Big Spring-Snyder area imported a total of $543 million worth of goods and services, or over 45% of the total purchases by those sectors (See Table 8). Being consistent with its level of output, the mining industry imported 36% of all the imports into the region. The chemicals and other retail sectors also imported a large share of their inputs with about 11% of total imports going to each sector. The development of industries which supply the mining, chemicals, and other retail sectors of the Big Spring-Snyder regional economy would greatly enhance that regional economy.

Results of Analysis

This section presents the input-output model developed for the Big Spring-Snyder area, a brief description of how to read the various tables of the model, and an analysis of the total economic effects resulting from an assumed 10% measure in rainfall in the region.

Table 8.--Imports and Percent of Total Imports by Sector, Big Spring-Snyder Area, 1967

Sector		($1000) Imports	%
1	Irrigated Crops	7,985.778	1.47
2	Dryland Crops	22,672.147	4.17
3	Livestock	9,843.533	1.81
4	Other Agriculture	7,847.232	1.44
5	Crude Petroleum	155,022.672	28.55
6	Other Mining	39,219.371	7.22
7	Construction	16,816.812	3.10
8	Meats & Dairies	1,982.385	0.36
9	Milling & Feeds	610.844	0.11
10	Food & Beverages	4,387.595	0.81
11	Textiles	6,600.702	1.22
12	Wood Products	2,959.290	0.54
13	Chemicals	61,809.239	11.38
14	Cement Products	4,635.378	0.85
15	Other Manufacturing	12,561.885	2.31
16	Local and Long Distance Trucking, Storage, and Arrangement	4,374.279	0.81
17	Other Transportation	7,844.741	1.44
18	Communications	4,852.986	0.89
19	Gas Service	2,974.277	0.55
20	Electrical Services	6,385.656	1.18
21	Water & Sanitary Services	1,198.760	0.22
22	Wholesale Farm Products	2,443.311	0.45
23	Wholesale Petroleum Products	1,876.677	0.35
24	Other Wholesale	8,376.788	1.54
25	Lumber Yards, Hardware, etc.	14,769,584	2.72
26	Auto Dealers, Repair, & Service Stations	35,622.149	6.56
27	Other Retail	58,870.374	10.84
28	Finance, Insurance, Real Estate	10,974.592	1.85
29	Amusement & Recreation	354.243	0.07
30	Medical Services	7,366.110	1.36
31	Educational Services	11,632.212	2.14
32	All Other Services	9,172.271	1.69
	TOTAL	543,143.873	100.00

Transactions Table

The transactions table found in Appendix B, Table I, shows the flow of goods and services, among the various sectors of the economy. Each row of the table represents the distributions of sales by the row sector to all the other sectors of the economy. These sales are given in dollar values for the year in which the study is being made. Conversely, each column of the table represents the distribution of purchases by the column sector. For example, the transactions table shows that in 1967, the chemicals sector (13) sold $2.5 million worth of goods to the irrigated crop sector (1), $1.07 million to the crude petroleum sector (5), and $114.7 million to exports. It also shows that the other retail sector purchased $1.26 million in services from the electric service sector, $1.36 million from finance, insurance, and real estate, and $58.9 million from sources outside the region (imports).

Direct Requirements Table

This table, found in Appendix B, Table 2, shows the percentage breakdown of all purchases made by each sector. It indicates the direct dependence of each column sector on each row sector for every dollar of inputs purchased. The values in this table represent the direct effects on every sector of the economy when total purchases by the column sector change. For example, for every $1.00 of total purchases by the livestock sector (3), it purchases 6.5¢ from

dryland crops, 5.2¢ from wholesale farm products (22), and 40.5¢ from imports.

Interdependence Coefficients Tables

These tables, Appendix B, Tables 3 and 4, are the heart of all analyses that are made using the input-output approach. They describe the interrelationship existing among the various sectors of the economy so that the total effect of an assumed change in final demand can be quantified. The values in these tables represent the increase in output that is required of the row sector to enable the column sector to sell an additional $1.00 of goods or services to final demand. For example, Appendix B, Table 3, shows that in order for dryland crops (2) to sell an additional $1.00 to final demand, the other agriculture sector (4) must increase its output by 7.5¢ the chemicals sector (13) by 17.1¢, and the lumber and hardware sector (25) by 6.0¢. The column total of 1.52340 is the total increase in output by all sectors of the economy.

Table 4 differs from Table 3 in that it is a "closed" model in which the effect of increased spending by households was included in the total effect. Any differences in values between Tables 3 and 4 are attributable to the induced effect described earlier.

Economic Effects of Weather Modification

The economic effects of weather modification are explained

primarily in two forms. The first is the effect of an assumed increase in rainfall on the total output of the region, and the second is the effect on total income of the region. Appendix B, Table 4 was used to estimate these effects.

The initial effect of increased rainfall, which is described in the previously cited report on crop response and in Chapter 1 of this report on range response, is both an output effect and an income effect, as the total value of the increased production is paid to households. The non-direct effects of that rainfall differ, however, as to the impacts on regional output and income. In Appendix B, Table 4, column 33 are shown the increased outputs by each sector required when households spend an additional $1.00 on consumer items. The major portion of the column total is the output of households themselves, where the output of households is actually a reflection of the income paid to households. This value of 1.19911, then, is the total income effect of an additional $1.00 spent by households, with 0.19911 being the household consumption effect and 1.00000 being the direct effect.

The difference between the column total and the total income effect is the increase in output by the processing sectors attributable to the household consumption effect.

As was explained earlier, the total economic effect of an assumed increase in rainfall is made up of the direct

Table 9.--Income Effects of a 10% Increase in March Rainfall in the Big Spring-Snyder Area. ($1000's)

Activity	Direct Effect	Household Consumption Effect	Total
Cotton	$512.22	$101.99	$614.21
Grain Sorghum	154.35	30.73	185.08
Wheat	6.29	1.25	7.54
Livestock	147.74	29.42	177.16
TOTAL EFFECTS	$820.60	$163.39	$983.99

Table 10.--Output Effects of a 10% Increase in March Rainfall in the Big Spring-Snyder Area. ($1000's)

Activity	Direct Effect	Household Consumption Effect	Stemming From Effect	Total
Cotton	$512.22	$284.30	$164.75	$ 961.27
Grain Sorghum	154.35	85.67	49.64	289.66
Wheat	6.29	3.49	2.02	11.80
Livestock	147.74	82.00	169.09	398.83
TOTAL EFFECTS	$820.60	$455.46	$385.50	$1,661.56

* Based on 1974 prices

effect, the household consumption effect, and the stemming-from effect. A method has not yet been developed for estimating the stemming-from income effect. Therefore, the total income effect described in this report will not include that effect. Table 9 outlines those income effects which have been estimated, and Table 10 describes the output effects to include the stemming-from effect. The effects of an increase in range condition as reflected by the livestock sector are based on the System II Range Management System described in Chapter 1. This system, again, is the one in which livestock graze 60% of available forage.

All the effects shown in Table 9 and 10 could be estimated with assumed increases in rainfall in January, February, March, April, May, or October, and under both System I and System II range management schemes. However, March was chosen because it is a month in which effects of rainfall on production of all three crops and livestock have been estimated. Also, System II was chosen because it would be more profitable for the livestock producer in the short run.

Total output effect of a 10% increase in March rainfall is estimated to be about twice the direct effect with the stemming-from effect amounting to 47% of the direct effect. In the livestock sector, however, the stemming-from effect is approximately 115% of the direct effect, owing to the fact that a large share of livestock production is purchased

by processors within the study area. The indirect and induced effects of the purchase made by the processors of livestock, too, have a large impact on the local economy. Appendix B, Table 4, Column 3 shows that the meats and dairies sector, the largest purchaser of livestock in the study area, has a total output effect of 2.53 whenever final demand for processed meats increases. This output effect is larger than those for all the other sectors in the Big Spring-Snyder area.

Summary

This phase of the study of the economic effects of weather modification activities in the Big Spring-Snyder area produced estimates of the interrelationships existing among the sectors of that regional economy. As in any regional economy, an increase in sales to final demand by any one sector is reflected in all the other sectors as a certain multiplier effect. In the Big Spring-Snyder area, this effect ranges from a low of 1.47 in the other manufacturing sector to a high of 2.53 in the meats and dairies sector. This means that as the meats and dairies industry sells an additional $1.00 in goods to exports, for example, that total output in the region would increase by $2.53. The major reason for the difference in the effects of the two industries mentioned is the level of purchases made by each from industries outside the region. The other manufacturing sector imports approximately 69% of its purchases

and the meats and dairies sector imports 24% of its purchases.

The indirect and induced effects of increased rainfall in the region were also estimated. Given the 10% increase in rainfall in the month of March as described earlier, the household consumption and stemming from effects were estimated.

Some of the major findings of this study were:

1. The household consumption effect resulting from increased spending by the producers of cotton, wheat, grain sorghum, and livestock following a 10% increase in March rainfall, is an increase in regional production of $455 thousand. This amounted to about 55% of the direct output effect.
2. The $820,000 increase in production in the four commodity areas listed above create "stemming-from" output in the region of the $385,000.
3. The total output benefits accruing to the Big Spring-Snyder area as a result of a 10% increase in March rainfall are about $1.7 million.
4. Total income in the Big Spring-Snyder area would increase by $984 thousand when March rainfall increases 10%.

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APPENDIX A

Sector Descriptions with Correlative Listing of SIC Codes

Regional Model Sector Number	Sector	SIC
1	Irrigated Crops	0112, 0113, 0313, 0122, 0123, 0119
2	Dryland Crops	0212, 0213, 0413, 0219, 0141
3	Livestock	0235, 0135, 0136
4	All Other Agriculture	nec,* all 01, 07, 08, 09
5	Crude Petroleum and Natural Gas	1311
6	Natural Gas Liquids, Oil & Gas Field Services	1321, 1381, 1382, 1389
7	Construction	15, 16, 17
8	Meats & Dairies	201, 202
9	Milling & Feeds	204
10	Foods & Beverages	203, 205, 206, 207, 208, 209
11	Textile Products	22, 23
12	Wood Products, Printing & Publishing	24, 25, 26, 27
13	Chemicals, Petroleum Products, Plastic, Leather, Glass Products	28, 29, 30, 31, 322, 323
14	Clay, Stone, Cement Products	32, exc. 322 & 323
15	Other Manufacturing	19, 33, 34, 35, 36 37, 38, 39
16	Local & Long Distance Trucking, Storage, and Arrangement	42

*Not Elsewhere Classified

Sector Descriptions with Correlative Listing of SIC Codes
(continued)

Regional Model Sector Number	Sector	SIC
17	Other Transportation	40, 41, 44, 45, 46, 47
18	Communications	48
19	Gas Services	492, 4933, 914, 924, 934
20	Electrical Services	491, 4931, 915, 925, 035
21	Water & Sanitary Services	494, 495, 496, 910, 920, 930
22	Wholesale Farm Products	505, 4731
23	Wholesale Petroleum Products	5092
24	Other Wholesale	501, 504, 508, 502, 503, 506, 507, 509, nec*
25	Lumber Yards, Hardware, etc.	52, 5962, 5969
26	Auto Dealers, Repair, & Service Stations	551, 553, 554, 753, 7542
27	Other Retail	53, 56, 54, 559, 57, 58, 59 exc. 5962 & 5969, 7733
28	Finance, Insurance, Real Estate	60, 61, 62, 63, 64, 65, 66, 67
29	Amusement & Recreation	7816, 7817, 7818, 783, 79
30	Medical Services	80
31	Educational Services	821, 822
32	All Other Services	70, 72, 73, 8921, 7813, 7814, 7815, 782, 739, 751, 752, 76, 81, 82, 86, 84, 8811, 89

APPENDIX B

Table B-1

INTERINDUSTRY TRANSACTIONS BIG SPRING-SNYDER AREA
(1000. DOLLARS)

	1	2	3	4	5	6	7	8
1 IRRIGATED CROPS	398.521	576.763	1118.330	130.983	.000	.000	.000	.058
2 DRYLAND CROPS	1.433	922.416	1575.615	772.524	.000	.000	.075	.000
3 LIVESTOCK	.000	.000	2761.406	41.311	.000	.000	.000	3226.659
4 OTHER AGRICUL.	1572.497	4017.806	595.306	2565.182	.000	.000	142.417	1761.795
5 CRUDE PETROLEUM	.000	.000	.000	.000	445.008	6607.950	.000	.000
6 OTHER MINING	.000	.000	.000	3.253	30585.524	3723.436	366.543	.821
7 CONSTRUCTION	47.214	135.898	36.416	88.275	66.055	97.490	31.794	2.184
8 MEATS + DAIRIES	.000	.000	.000	.884	.000	1.600	.044	14.052
9 MILLING + FEEDS	.000	.000	195.448	541.262	.000	.342	.001	10.383
10 FOOD + BEVERAGES	.000	.000	172.115	33.896	.000	2.811	.012	15.505
11 TEXTILES	.000	.000	.000	10.301	1.028	15.913	28.665	.152
12 WOOD PRODUCTS	1.630	4.695	46.098	32.700	45.544	24.276	78.865	24.109
13 CHEMICALS	2499.664	8659.372	504.285	917.450	1067.196	2335.191	636.592	23.520
14 CEMENT PRODUCTS	.000	198.029	.000	.077	119.115	82.354	2089.591	.185
15 OTHER MANUFACTUR	49.717	198.840	37.925	47.849	90.079	372.204	420.199	3.263
16 LOCAL + LD TRUCK	69.384	177.568	195.309	190.828	190.177	251.619	247.017	116.338
17 OTHER TRANSPORT	83.439	233.384	87.188	97.103	920.258	255.977	153.288	.747
18 COMMUNICATIONS	32.905	94.731	25.686	51.490	331.986	126.935	71.658	15.910
19 GAS SERVICE	243.031	.000	3.876	27.379	108.057	84.241	5.045	4.310
20 ELECTRIC SERVICE	187.479	127.166	42.300	177.278	959.533	439.864	29.208	18.470
21 WATER SERVICE	.000	.000	.000	5.355	12.559	37.839	11.369	5.870
22 WHSALE FARM PROD	82.892	328.052	1270.332	838.648	.000	.000	.000	52.877
23 WHSALE PETROLEUM	205.182	823.020	49.381	146.782	103.074	81.133	35.398	3.442
24 OTHER WHOLESALE	106.263	363.132	58.291	50.675	115.127	307.297	10.775	5.703
25 LUMBER + HARDWAR	1003.392	3488.316	852.708	866.120	11.291	24.780	342.559	.457
26 AUTO + SVC STATN	538.940	1996.970	227.002	261.476	326.860	426.311	107.027	9.065
27 OTHER RETAIL	.000	.000	.000	26.723	46.936	89.674	39.121	1.666
28 F.I.R.E.	213.968	492.944	264.453	144.372	692.013	307.010	308.577	6.566
29 AMUSE + RECREATE	.000	.000	.030	.117	52.989	7.883	.627	.035
30 MEDICAL SERVICE	.000	.000	.000	.000	6.567	20.637	.142	1.359
31 EDUC SERVICES	227.513	654.916	181.170	230.912	9654.653	635.974	69.447	5.657
32 OTHER SERVICES	43.145	19.045	8.153	98.733	607.970	383.424	178.457	15.021
33 HOUSEHOLDS	5754.769	16085.949	3780.428	2341.996	113521.596	19044.512	5862.949	670.778
34 FEDRL GOVERNMENT	200.770	550.593	106.101	125.326	28955.333	2865.125	1131.655	98.940
35 STATE GOVERNMENT	4.061	11.703	2.680	13.400	13824.027	717.196	41.413	1.129
36 LOCAL GOVERNMENT	364.382	1048.937	250.622	420.963	1295.667	189.241	45.656	4.229
37 IMPORTS	7985.778	22672.147	9843.533	7847.232	155022.672	39219.371	16816.912	1952.385
TOTAL VALUE ADDED	6323.982	17697.181	4139.831	2971.685	157596.610	22816.074	7081.673	777.076
TOTAL PURCHASES	21917.987	63882.387	24292.185	19218.854	359178.867	78779.603	29302.996	9105.639

Table B-1 (con't)

INTERINDUSTRY TRANSACTIONS BIG SPRING-SNYDER AREA
(1000. DOLLARS)

		9	10	11	12	13	14	15	16
1	IRRIGATED CROPS	527.136	315.049	190.264	.000	.499	.000	.000	.000
2	DRYLAND CROPS	303.028	185.319	51.927	.000	.016	.000	.000	.000
3	LIVESTOCK	.000	.000	18.343	.000	.000	.000	.000	.000
4	OTHER AGRICUL.	.000	168.061	.000	111.095	4.423	.000	.000	.000
5	CRUDE PETROLEUM	.000	.000	.000	.000	36361.685	.000	.302	.000
6	OTHER MINING	.154	1.991	.242	1.063	6003.999	966.487	31.581	.000
7	CONSTRUCTION	.452	2.554	1.011	8.828	781.402	10.054	13.268	9.189
8	MEATS + DAIRIES	3.888	20.856	.004	.000	5.746	.000	.115	.000
9	MILLING + FEEDS	7.724	35.246	.000	.000	.000	.000	.000	.000
10	FOOD + BEVERAGES	5.129	43.481	.000	.000	3.043	.312	.469	.000
11	TEXTILES	6.031	.650	243.507	10.269	16.466	.000	7.350	1.636
12	WOOD PRODUCTS	2.616	43.432	14.159	127.291	235.936	28.487	26.819	6.000
13	CHEMICALS	5.757	170.124	24.250	94.726	26034.486	56.196	257.710	508.038
14	CEMENT PRODUCTS	.747	1.105	.115	3.248	51.505	606.145	28.937	.000
15	OTHER MANUFACTUR	.202	21.717	18.155	9.622	333.826	6.471	240.287	45.903
16	LOCAL + LD TRUCK	14.268	54.963	46.877	48.273	550.895	123.276	78.345	163.013
17	OTHER TRANSPORT	15.702	19.951	9.749	34.828	4609.910	87.490	96.900	37.959
18	COMMUNICATIONS	2.759	29.124	19.139	20.941	263.135	29.507	51.289	321.996
19	GAS SERVICE	2.889	5.775	7.526	4.267	2025.431	113.140	31.375	62.998
20	ELECTRIC SERVICE	9.606	41.242	49.862	37.939	2188.494	109.775	106.515	137.242
21	WATER SERVICE	.722	5.264	3.254	9.706	144.224	4.703	4.678	5.246
22	WHSALE FARM PROD	5.494	6.741	1.627	.460	.000	.000	.000	.000
23	WHSALE PETROLEUM	.860	2.385	.975	1.929	69.395	8.196	7.378	52.370
24	OTHER WHOLESALE	1.592	10.649	12.779	13.491	530.917	41.961	114.834	42.903
25	LUMBER + HARDWAR	.077	.598	.288	1.612	3.877	.247	4.835	3.079
26	AUTO + SVC STATN	.667	10.741	5.630	6.033	99.133	15.703	20.481	121.835
27	OTHER RETAIL	.428	4.413	5.838	3.509	53.161	5.224	17.281	.000
28	F.I.R.E.	1.175	8.401	38.063	15.685	443.507	73.422	36.733	260.751
29	AMUSE + RECREATE	.013	.312	.361	.141	4.125	.489	.282	1.585
30	MEDICAL SERVICE	.000	1.021	.023	.069	1.202	.166	.460	.000
31	EDUC SERVICES	2.445	28.887	27.685	15.266	475.893	55.835	40.844	119.449
32	OTHER SERVICES	6.966	23.630	32.917	31.769	659.759	44.653	53.280	91.115
33	HOUSEHOLDS	179.299	1117.501	1980.613	1032.298	25306.843	1935.171	3550.624	2225.280
34	FEDRL GOVERNMENT	33.693	377.561	349.714	160.120	3803.683	343.233	754.653	269.830
35	STATE GOVERNMENT	1.098	19.499	15.967	5.696	268.364	36.382	22.243	104.166
36	LOCAL GOVERNMENT	2.217	16.278	19.336	15.625	343.498	32.271	33.356	24.848
37	IMPORTS	610.844	4387.595	6600.702	2959.292	61809.239	4635.378	12561.885	4374.279
TOTAL VALUE ADDED		216.307	1530.839	2365.630	1213.929	29722.387	2347.057	4360.876	2624.124
TOTAL PURCHASES		1755.678	7182.116	9790.903	4785.269	173487.705	9368.372	18195.168	8990.799

Table B-1 (con't)

INTERINDUSTRY TRANSACTIONS BIG SPRING-SNYDER AREA
(1000. DOLLARS)

		17	18	19	20	21	22	23	24
1	IRRIGATED CROPS	.000	.000	.000	.000	.000	.063	.000	.000
2	DRYLAND CROPS	.000	.000	.000	.000	.000	1.231	.000	.000
3	LIVESTOCK	.000	.000	.000	.000	.000	.000	.000	.000
4	OTHER AGRICUL.	.000	.000	.000	.000	.000	25.990	.000	.000
5	CRUDE PETROLEUM	66.184	.000	9417.568	.000	.000	.000	.000	.000
6	OTHER MINING	9.342	.000	.000	.000	.188	.000	1.134	3.596
7	CONSTRUCTION	61.754	1.071	6.148	8.998	38.173	29.207	.574	8.959
8	MEATS + DAIRIES	.000	.000	.000	.000	.000	.000	.000	.000
9	MILLING + FEEDS	.000	.000	.000	.000	.000	.192	.000	.000
10	FOOD + BEVERAGES	2.540	.000	.000	.000	.000	.000	.000	.000
11	TEXTILES	2.650	.241	1.011	3.264	1.316	25.873	.124	2.406
12	WOOD PRODUCTS	16.957	35.639	1.884	33.309	2.109	5.982	9.946	32.154
13	CHEMICALS	590.919	59.076	50.020	155.310	63.093	63.347	67.074	197.562
14	CEMENT PRODUCTS	79.003	2.132	.000	7.343	104.173	.125	.069	.290
15	OTHER MANUFACTUR	68.734	4.961	20.704	6.143	2.985	4.399	1.602	10.855
16	LOCAL + LD TRUCK	17.779	7.837	10.099	17.406	1.551	47.339	2.441	45.372
17	OTHER TRANSPORT	242.061	13.463	10.996	32.702	1.042	19.971	68.578	32.718
18	COMMUNICATIONS	70.942	24.339	25.814	51.456	4.704	48.480	42.900	186.961
19	GAS SERVICE	34.961	6.179	105.317	1623.024	31.251	19.784	7.021	19.478
20	ELECTRIC SERVICE	106.158	84.860	11.118	.000	110.400	59.696	17.505	164.001
21	WATER SERVICE	13.394	7.328	2.055	30.438	151.016	5.374	1.320	26.378
22	WHSALE FARM PROD	.000	.000	.000	.000	.000	60.323	.000	.437
23	WHSALE PETROLEUM	105.459	.330	3.042	8.813	2.540	3.675	3.380	12.041
24	OTHER WHOLESALE	49.292	3.241	12.567	24.396	13.672	10.290	.501	14.906
25	LUMBER + HARDWAR	5.941	.103	.108	3.935	.000	.104	.000	1.463
26	AUTO + SVC STATN	7.699	.871	32.960	190.320	4.747	16.791	20.450	87.352
27	OTHER RETAIL	14.137	3.667	.000	.000	.000	6.904	7.370	80.834
28	F.I.R.E.	199.401	40.734	45.947	59.633	9.504	114.652	25.974	187.185
29	AMUSE + RECREATE	.129	1.907	2.459	.117	.000	.173	.073	.705
30	MEDICAL SERVICE	.019	.170	.000	.000	.000	.000	.000	.616
31	EDUC SERVICES	76.747	186.136	384.606	316.066	.000	23.674	29.397	72.869
32	OTHER SERVICES	119.933	88.268	44.476	55.465	45.250	50.914	61.205	116.140
33	HOUSEHOLDS	4776.798	2907.419	1616.693	4370.399	730.736	1516.001	1417.889	6078.696
34	FEDRL GOVERNMENT	1152.819	1749.384	624.692	2246.982	18.790	367.777	393.827	1025.717
35	STATE GOVERNMENT	33.355	71.888	161.041	98.366	.000	13.057	5.569	51.328
36	LOCAL GOVERNMENT	74.406	186.040	354.136	367.921	.000	34.358	33.364	85.880
37	IMPORTS	7844.741	4852.986	2974.277	6385.656	1198.760	2443.311	1976.677	8376.789
TOTAL VALUE ADDED		6037.390	4914.731	2756.562	7083.668	749.526	1931.189	1950.749	7251.621
TOTAL PURCHASES		15844.275	13349.269	15919.739	16097.461	2536.700	5019.052	4096.064	16330.686

Table B-1 (con't)

INTERINDUSTRY TRANSACTIONS BIG SPRING-SNYDER AREA
(1000. DOLLARS)

	25	26	27	28	29	30	31	32
1 IRRIGATED CROPS	.000	.000	315.969	.000	.000	.000	.000	.000
2 DRYLAND CROPS	.000	.000	.364	.000	.000	.000	.000	.000
3 LIVESTOCK	.000	.000	32.351	.000	.000	.000	.000	.000
4 OTHER AGRICUL.	.000	.000	32.327	.000	.000	8.168	.000	.000
5 CRUDE PETROLEUM	.000	.000	.000	.000	.000	.000	.000	.000
6 OTHER MINING	.148	2.528	16.103	2.663	.000	.000	.000	.323
7 CONSTRUCTION	18.475	26.238	28.766	76.688	1.741	4.613	31.883	30.248
8 MEATS + DAIRIES	.000	.000	975.852	.000	.000	11.496	328.264	4.967
9 MILLING + FEEDS	.000	.000	5.794	.000	.014	.562	.136	.199
10 FOOD + BEVERAGES	.730	1.142	334.142	.615	.047	23.366	150.918	9.913
11 TEXTILES	.724	2.797	275.332	.892	.526	16.941	3.987	91.911
12 WOOD PRODUCTS	70.657	177.316	581.722	39.483	2.729	13.591	55.862	74.503
13 CHEMICALS	404.389	287.091	251.436	30.248	3.716	199.452	82.499	197.892
14 CEMENT PRODUCTS	.000	.456	.994	11.088	.299	5.519	5.091	4.553
15 OTHER MANUFACTUR	14.562	177.879	66.536	2.061	1.583	25.462	33.398	38.786
16 LOCAL + LD TRUCK	98.310	57.395	195.312	4.130	.360	20.275	65.593	29.662
17 OTHER TRANSPORT	61.297	58.981	104.741	14.715	2.560	19.091	22.900	72.310
18 COMMUNICATIONS	341.943	812.611	874.237	178.681	5.436	80.992	89.596	179.800
19 GAS SERVICE	68.693	57.043	145.981	35.662	1.356	21.989	59.644	21.907
20 ELECTRIC SERVICE	288.966	636.930	1261.960	243.341	10.552	125.804	304.066	137.156
21 WATER SERVICE	40.378	80.068	131.399	20.410	1.550	25.327	44.525	25.712
22 WHSALE FARM PROD	.000	.000	.000	.000	.000	.000	.000	.013
23 WHSALE PETROLEUM	175.728	22.351	25.851	2.353	.283	1.079	.802	16.675
24 OTHER WHOLESALE	102.626	113.798	309.720	24.450	3.275	108.724	46.316	50.369
25 LUMBER + HARDWAR	38.004	2.528	.655	.000	.032	.114	.000	.276
26 AUTO + SVC STATN	205.312	3726.585	160.179	18.634	2.931	4.804	2.359	50.892
27 OTHER RETAIL	64.132	58.728	206.693	83.034	2.639	40.303	4.956	115.499
28 F.I.R.E.	342.333	752.297	1364.968	448.530	6.454	111.576	34.689	133.249
29 AMUSE + RECREATE	1.117	1.085	93.583	2.213	1.321	.213	1.150	1.930
30 MEDICAL SERVICE	.000	.000	26.259	25.129	.385	100.811	.000	.073
31 EDUC SERVICES	163.016	172.652	580.759	256.139	4.543	38.489	.000	77.998
32 OTHER SERVICES	130.854	490.790	1120.630	287.826	6.330	124.776	66.912	263.693
33 HOUSEHOLDS	9504.068	24748.649	29971.273	7012.850	204.137	4812.843	7964.556	5202.215
34 FEDRL GOVERNMENT	1276.037	2276.088	5580.734	718.139	27.008	395.313	145.807	673.609
35 STATE GOVERNMENT	115.572	127.361	182.054	140.680	1.759	23.863	.000	59.446
36 LOCAL GOVERNMENT	340.851	158.238	497.683	186.579	4.535	25.271	4.764	68.771
37 IMPORTS	14769.584	35622.149	58870.374	10074.592	354.243	7366.110	11632.212	9172.271
TOTAL VALUE ADDED	11236.528	27310.335	36231.743	8058.248	237.430	5257.290	8115.127	6004.131
TOTAL PURCHASES	23638.505	70651.770	104622.724	19941.823	652.344	13756.935	21182.884	16806.908

Table B-1 (con't)

INTERINDUSTRY TRANSACTIONS BIG SPRING-SNYDER AREA
(1000. DOLLARS)

	HOUSEHOLDS	FEDERL GOVT	STATE GOVT	LOCAL GOVT	EXPORTS	CAPITAL FORM.
1 IRRIGATED CROPS	876.089	3496.565	.089	.193	13971.420	.000
2 DRYLAND CROPS	370.708	3235.455	.148	.295	56461.837	.000
3 LIVESTOCK	233.675	319.382	.000	.000	17659.057	.000
4 OTHER AGRICUL.	985.046	.000	19.991	.000	7208.751	.000
5 CRUDE PETROLEUM	.000	.000	.000	.000	306280.195	.000
6 OTHER MINING	405.977	1.574	80.232	.159	36570.555	.000
7 CONSTRUCTION	552.407	179.742	25.262	13.916	348.289	26477.767
8 MEATS + DAIRIES	4251.168	140.204	11.404	8.034	2327.063	.000
9 MILLING + FEEDS	36.945	57.624	1.046	.013	862.747	.000
10 FOOD + BEVERAGES	2666.595	31.611	48.411	.976	3634.340	.000
11 TEXTILES	1347.386	80.903	27.408	34.843	7528.378	.000
12 WOOD PRODUCTS	399.711	115.263	63.249	41.339	2164.153	104.996
13 CHEMICALS	9223.440	2356.922	538.521	150.892	114717.406	2.847
14 CEMENT PRODUCTS	236.072	35.655	119.948	41.861	5532.550	.000
15 OTHER MANUFACTUR	633.643	4688.443	70.368	26.174	8356.509	2043.064
16 LOCAL + LD TRUCK	3031.212	244.369	55.632	15.994	2305.723	198.848
17 OTHER TRANSPORT	2737.358	271.208	.699	.359	5189.573	123.065
18 COMMUNICATIONS	2977.384	130.136	69.586	36.189	2312.006	307.873
19 GAS SERVICE	1326.310	176.227	14.850	3.268	9410.452	.000
20 ELECTRIC SERVICE	5563.956	209.599	133.157	23.089	1045.175	.000
21 WATER SERVICE	979.842	177.554	15.537	4.415	501.192	.000
22 WHSALE FARM PROD	87.550	.000	.000	.000	2282.604	.000
23 WHSALE PETROLEUM	999.664	452.655	30.692	22.005	608.745	.000
24 OTHER WHOLESALE	6605.515	5.551	5.480	15.190	4918.083	2706.343
25 LUMBER + HARDWAR	1596.658	.000	.000	.000	19361.870	1022.478
26 AUTO + SVC STATN	16631.712	71.985	63.113	62.287	44273.463	842.456
27 OTHER RETAIL	50887.849	.000	.563	35.573	52646.107	69.771
28 F.I.R.E.	6613.734	19.987	121.253	242.193	5759.243	.636
29 AMUSE + RECREATE	410.230	.000	.000	.000	64.952	.000
30 MEDICAL SERVICE	10381.045	6.405	4.066	.000	3180.320	.000
31 EDUC SERVICES	5014.063	1359.188	.000	.000	.000	.000
32 OTHER SERVICES	5773.180	931.209	66.235	108.970	4534.035	21.783
33 HOUSEHOLDS	13839.297	31527.273	8914.204	2633.426	.008	.000
34 FEDRL GOVERNMENT	47381.483	1437.098	347.286	162.006	.000	.000
35 STATE GOVERNMENT	2374.656	4269.719	.000	.000	.000	.000
36 LOCAL GOVERNMENT	2037.416	898.271	.000	.000	.000	.000
37 IMPORTS	164671.033	98457.713	12338.851	4716.344	.000	6204.224
TOTAL VALUE ADDED	85632.851	38132.360	9261.490	2795.432	.008	.000
TOTAL PURCHASES	374139.992	155385.482	23157.260	8400.003	742916.719	40126.219

Table B-1 (con't)

INTERINDUSTRY TRANSACTIONS BIG SPRING-SNYDER AREA
(1000. DOLLARS)

		FINAL DEMAND	TOTAL SALES
1	IRRIGATED CROPS	18344.356	21917.990
2	DRYLAND CROPS	60068.442	63882.388
3	LIVESTOCK	18212.114	24292.183
4	OTHER AGRICUL.	8213.788	19218.854
5	CRUDE PETROLEUM	306280.195	359178.887
6	OTHER MINING	37058.497	78779.605
7	CONSTRUCTION	27597.383	29303.000
8	MEATS + DAIRIES	6737.873	8105.641
9	MILLING + FEEDS	958.375	1755.678
10	FOOD + BEVERAGES	6381.933	7182.118
11	TEXTILES	9018.918	9790.899
12	WOOD PRODUCTS	2868.711	4785.290
13	CHEMICALS	126990.027	173487.674
14	CEMENT PRODUCTS	5966.086	9368.371
15	OTHER MANUFACTUR	15818.201	18195.105
16	LOCAL + LD TRUCK	5851.778	8990.787
17	OTHER TRANSPORT	8322.262	15844.279
18	COMMUNICATIONS	5833.174	10340.266
19	GAS SERVICE	10931.107	15919.735
20	ELECTRIC SERVICE	7874.976	16097.460
21	WATER SERVICE	1678.540	2536.001
22	WHSALE FARM PROD	2370.154	5018.050
23	WHSALE PETROLEUM	2113.761	4096.062
24	OTHER WHOLESALE	14256.162	16930.681
25	LUMBER + HARDWAR	21981.006	28638.501
26	AUTO + SVC STATN	61945.015	70651.761
27	OTHER RETAIL	103639.862	104622.720
28	F.I.R.E.	12757.046	19941.828
29	AMUSE + RECREATE	475.182	652.345
30	MEDICAL SERVICE	13571.836	13756.934
31	EDUC SERVICES	6373.251	21182.887
32	OTHER SERVICES	11435.412	16806.908
33	HOUSEHOLDS	56914.207	374139.996
34	FEDRL GOVERNMENT	49327.872	108196.999
35	STATE GOVERNMENT	6644.375	22820.824
36	LOCAL GOVERNMENT	2935.687	9465.807
37	IMPORTS	286388.230	829531.992
TOTAL VALUE ADDED		115822.141	514623.621
TOTAL PURCHASES		1344155.672	2545426.250

Table B-2

DIRECT REQUIREMENTS BIG SPRING-SNYDER AREA

		1	2	3	4	5	6	7	8
1	IRRIGATED CROPS	.01818	.00903	.04604	.00682	.00000	.00000	.00000	.00001
2	DRYLAND CROPS	.00007	.01444	.06486	.04020	.00000	.00000	.00000	.00000
3	LIVESTOCK	.00000	.00000	.11367	.00215	.00000	.00000	.00000	.39808
4	OTHER AGRICUL.	.07174	.06289	.02451	.13347	.00000	.00000	.00486	.21735
5	CRUDE PETROLEUM	.00000	.00000	.00000	.00000	.00124	.08388	.00000	.00000
6	OTHER MINING	.00000	.00000	.00000	.00017	.08515	.04726	.01251	.00010
7	CONSTRUCTION	.00215	.00213	.00150	.00459	.00018	.00124	.00109	.00027
8	MEATS + DAIRIES	.00000	.00000	.00000	.00005	.00000	.00002	.00000	.00173
9	MILLING + FEEDS	.00000	.00000	.00805	.02816	.00000	.00000	.00000	.00128
10	FOOD + BEVERAGES	.00000	.00000	.00709	.00176	.00000	.00004	.00000	.00191
11	TEXTILES	.00000	.00000	.00000	.00054	.00000	.00020	.00098	.00002
12	WOOD PRODUCTS	.00007	.00007	.00190	.00170	.00013	.00031	.00269	.00297
13	CHEMICALS	.11405	.13555	.02076	.04774	.00297	.02964	.02172	.00290
14	CEMENT PRODUCTS	.00000	.00310	.00000	.00000	.00033	.00105	.07131	.00002
15	OTHER MANUFACTUR	.00227	.00311	.00156	.00249	.00025	.00472	.01434	.00040
16	LOCAL + LD TRUCK	.00317	.00278	.00804	.00993	.00053	.00319	.00843	.01435
17	OTHER TRANSPORT	.00381	.00365	.00359	.00505	.00256	.00325	.00523	.00009
18	COMMUNICATIONS	.00150	.00148	.00106	.00268	.00092	.00161	.00245	.00196
19	GAS SERVICE	.01109	.00000	.00016	.00142	.00030	.00107	.00017	.00053
20	ELECTRIC SERVICE	.00855	.00199	.00174	.00922	.00267	.00558	.00100	.00229
21	WATER SERVICE	.00000	.00000	.00000	.00028	.00003	.00048	.00039	.00072
22	WHSALE FARM PROD	.00378	.00514	.05229	.04364	.00000	.00000	.00000	.00652
23	WHSALE PETROLEUM	.00936	.01288	.00203	.00764	.00029	.00103	.00121	.00042
24	OTHER WHOLESALE	.00485	.00568	.00240	.00264	.00032	.00390	.00037	.00070
25	LUMBER + HARDWAR	.04578	.05461	.03510	.04507	.00003	.00031	.01169	.00006
26	AUTO + SVC STATN	.02459	.03126	.00934	.01361	.00091	.00541	.00365	.00113
27	OTHER RETAIL	.00000	.00000	.00000	.00139	.00013	.00114	.00134	.00021
28	F.I.R.E.	.00976	.00772	.01089	.00751	.00193	.00390	.01053	.00081
29	AMUSE + RECREATE	.00000	.00000	.00000	.00001	.00015	.00010	.00002	.00000
30	MEDICAL SERVICE	.00000	.00000	.00000	.00000	.00002	.00026	.00000	.00017
31	EDUC SERVICES	.01038	.01025	.00746	.01201	.02688	.00807	.00237	.00070
32	OTHER SERVICES	.00197	.00030	.00034	.00514	.00169	.00487	.00609	.00185
33	HOUSEHOLDS	.26256	.25181	.15562	.12186	.31606	.24174	.20008	.08275
34	FEDRL GOVERNMENT	.00916	.00862	.00437	.01016	.08062	.03637	.03862	.01221
35	STATE GOVERNMENT	.00019	.00018	.00011	.00070	.03849	.00910	.00141	.00039
36	LOCAL GOVERNMENT	.01662	.01642	.01032	.02190	.00361	.00240	.00156	.00052
37	IMPORTS	.36435	.35490	.40521	.40831	.43160	.49784	.57389	.24457
TOTAL DIR REQ		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table B-2 (con't)

DIRECT REQUIREMENTS BIG SPRING-SNYDER AREA

		9	10	11	12	13	14	15	16
1	IRRIGATED CROPS	.30025	.04387	.01943	.00000	.00000	.00000	.00000	.00000
2	DRYLAND CROPS	.17260	.02580	.00530	.00000	.00000	.00000	.00000	.00000
3	LIVESTOCK	.00000	.00000	.00187	.00000	.00000	.00000	.00000	.00000
4	OTHER AGRICUL.	.00000	.02340	.00000	.02322	.00003	.00000	.00000	.00000
5	CRUDE PETROLEUM	.00000	.00000	.00000	.00000	.20959	.00000	.00002	.00000
6	OTHER MINING	.00009	.00028	.00002	.00022	.03461	.10316	.00174	.00000
7	CONSTRUCTION	.00026	.00036	.00010	.00184	.00450	.00107	.00073	.00102
8	MEATS + DAIRIES	.00221	.00290	.00000	.00000	.00003	.00000	.00001	.00000
9	MILLING + FEEDS	.00440	.00491	.00000	.00000	.00000	.00000	.00000	.00000
10	FOOD + BEVERAGES	.00292	.00605	.00000	.00000	.00002	.00003	.00003	.00000
11	TEXTILES	.00344	.00009	.02487	.00215	.00009	.00000	.00040	.00018
12	WOOD PRODUCTS	.00149	.00605	.00145	.02660	.00136	.00304	.00147	.00068
13	CHEMICALS	.00328	.02369	.00248	.01980	.15007	.00600	.01416	.05651
14	CEMENT PRODUCTS	.00043	.00015	.00001	.00068	.00030	.06470	.00159	.00000
15	OTHER MANUFACTUR	.00012	.00302	.00185	.00201	.00192	.00069	.01321	.00511
16	LOCAL + LD TRUCK	.00813	.00765	.00479	.01009	.00318	.01316	.00431	.01817
17	OTHER TRANSPORT	.00894	.00278	.00100	.00728	.02657	.00934	.00533	.00422
18	COMMUNICATIONS	.00158	.00406	.00195	.00438	.00152	.00304	.00282	.03581
19	GAS SERVICE	.00165	.00080	.00077	.00089	.01167	.01208	.00172	.00701
20	ELECTRIC SERVICE	.00547	.00574	.00509	.00793	.01261	.01161	.00585	.01526
21	WATER SERVICE	.00041	.00073	.00033	.00203	.00083	.00050	.00026	.00058
22	WHSALE FARM PROD	.00313	.00094	.00017	.00010	.00000	.00000	.00000	.00000
23	WHSALE PETROLEUM	.00049	.00033	.00010	.00040	.00040	.00087	.00041	.00582
24	OTHER WHOLESALE	.00090	.00148	.00131	.00282	.00306	.00448	.00631	.00477
25	LUMBER + HARDWAR	.00004	.00008	.00003	.00034	.00002	.00003	.00027	.00034
26	AUTO + SVC STATN	.00038	.00150	.00058	.00126	.00057	.00168	.00113	.01355
27	OTHER RETAIL	.00024	.00061	.00060	.00073	.00031	.00056	.00095	.00000
28	F.I.R.E.	.00067	.00117	.00389	.00328	.00256	.00784	.00202	.02900
29	AMUSE + RECREATE	.00001	.00004	.00004	.00003	.00002	.00005	.00002	.00018
30	MEDICAL SERVICE	.00000	.00014	.00000	.00001	.00001	.00002	.00003	.00000
31	EDUC SERVICES	.00139	.00402	.00283	.00319	.00274	.00596	.00224	.01329
32	OTHER SERVICES	.00397	.00329	.00336	.00664	.00380	.00477	.00293	.01013
33	HOUSEHOLDS	.10213	.15559	.20229	.21572	.14587	.20656	.19514	.24751
34	FEDRL GOVERNMENT	.01919	.05257	.03572	.03346	.02192	.03664	.04148	.03001
35	STATE GOVERNMENT	.00063	.00271	.00163	.00119	.00155	.00388	.00122	.01150
36	LOCAL GOVERNMENT	.00126	.00227	.00197	.00331	.00198	.00344	.00183	.00276
37	IMPORTS	.34792	.61091	.67417	.61841	.35627	.49479	.69040	.48657
TOTAL DIR REQ		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table B-2 (con't)

DIRECT REQUIREMENTS BIG SPRING-SNYDER AREA

	17	18	19	20	21	22	23	24
1 IRRIGATED CROPS	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00000
2 DRYLAND CROPS	.00000	.00000	.00000	.00000	.00000	.00025	.00000	.00000
3 LIVESTOCK	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
4 OTHER AGRICUL.	.00000	.00000	.00000	.00000	.00000	.00518	.00000	.00000
5 CRUDE PETROLEUM	.00418	.00000	.59157	.00000	.00000	.00000	.00000	.00000
6 OTHER MINING	.00059	.00000	.00000	.00000	.00007	.00000	.00028	.00021
7 CONSTRUCTION	.00390	.00010	.00039	.00056	.01505	.00582	.00014	.00057
8 MEATS + DAIRIES	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
9 MILLING + FEEDS	.00000	.00000	.00000	.00000	.00000	.00004	.00000	.00000
10 FOOD + BEVERAGES	.00016	.00000	.00000	.00000	.00000	.00000	.00000	.00000
11 TEXTILES	.00017	.00002	.00006	.00020	.00052	.00516	.00003	.00014
12 WOOD PRODUCTS	.00107	.00345	.00012	.00207	.00083	.00119	.00243	.00190
13 CHEMICALS	.03730	.00571	.00314	.00965	.02488	.01262	.01638	.01167
14 CEMENT PRODUCTS	.00499	.00021	.00000	.00046	.04108	.00002	.00002	.00002
15 OTHER MANUFACTUR	.00434	.00048	.00130	.00038	.00118	.00088	.00039	.00064
16 LOCAL + LD TRUCK	.00112	.00076	.00063	.00108	.00061	.00943	.00060	.00268
17 OTHER TRANSPORT	.01528	.00130	.00069	.00203	.00041	.00398	.01674	.00193
18 COMMUNICATIONS	.00448	.00235	.00162	.00320	.00185	.00966	.01047	.01104
19 GAS SERVICE	.00221	.00060	.00662	.10082	.01232	.00394	.00171	.00115
20 ELECTRIC SERVICE	.00670	.00821	.00070	.00000	.04353	.01170	.00427	.00960
21 WATER SERVICE	.00085	.00071	.00013	.00189	.05955	.00107	.00032	.00156
22 WHSALE FARM PROD	.00000	.00000	.00000	.00000	.00000	.01202	.00000	.00003
23 WHSALE PETROLEUM	.00666	.00003	.00019	.00055	.00100	.00073	.00083	.00112
24 OTHER WHOLESALE	.00311	.00031	.00079	.00152	.00539	.00205	.00012	.00088
25 LUMBER + HARDWAR	.00037	.00001	.00001	.00024	.00000	.00002	.00000	.00009
26 AUTO + SVC STATN	.00049	.00008	.00207	.01182	.00187	.00335	.00499	.00516
27 OTHER RETAIL	.00089	.00035	.00000	.00000	.00000	.00138	.00180	.00477
28 F.I.R.E.	.01259	.00394	.00289	.00370	.00375	.02285	.00634	.01106
29 AMUSE + RECREATE	.00001	.00018	.00015	.00001	.00000	.00003	.00002	.00004
30 MEDICAL SERVICE	.00000	.00002	.00000	.00000	.00000	.00000	.00000	.00004
31 EDUC SERVICES	.00484	.01800	.02416	.01963	.00000	.00472	.00718	.00430
32 OTHER SERVICES	.00757	.00854	.00279	.00345	.01784	.01015	.01494	.00686
33 HOUSEHOLDS	.30148	.28117	.10155	.27150	.28815	.30211	.34616	.35903
34 FEDRL GOVERNMENT	.07276	.16918	.03924	.13959	.00741	.07329	.09615	.06058
35 STATE GOVERNMENT	.00211	.00695	.01012	.00611	.00000	.00260	.00138	.00303
36 LOCAL GOVERNMENT	.00470	.01799	.02225	.02286	.00000	.00685	.00815	.00507
37 IMPORTS	.49512	.46933	.18683	.39669	.47270	.48690	.45817	.49477
TOTAL DIR REQ	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table B-2 (con't)

DIRECT REQUIREMENTS BIG SPRING-SNYDER AREA

	25	26	27	28	29	30	31	32
1 IRRIGATED CROPS	.00000	.00000	.00302	.00000	.00000	.00000	.00000	.00000
2 DRYLAND CROPS	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
3 LIVESTOCK	.00000	.00000	.00031	.00000	.00000	.00000	.00000	.00000
4 OTHER AGRICUL.	.00000	.00000	.00031	.00000	.00000	.00059	.00000	.00000
5 CRUDE PETROLEUM	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
6 OTHER MINING	.00001	.00004	.00015	.00013	.00000	.00000	.00000	.00002
7 CONSTRUCTION	.00065	.00037	.00027	.00385	.00267	.00034	.00151	.00180
8 MEATS + DAIRIES	.00000	.00000	.00933	.00000	.00000	.00084	.01550	.00030
9 MILLING + FEEDS	.00000	.00000	.00006	.00000	.00002	.00004	.00001	.00001
10 FOOD + BEVERAGES	.00003	.00002	.00319	.00003	.00007	.00170	.00712	.00052
11 TEXTILES	.00003	.00004	.00263	.00004	.00081	.00123	.00019	.00547
12 WOOD PRODUCTS	.00247	.00251	.00556	.00198	.00418	.00099	.00264	.00443
13 CHEMICALS	.01412	.00406	.00240	.00152	.00570	.01450	.00389	.01177
14 CEMENT PRODUCTS	.00000	.00001	.00001	.00056	.00046	.00040	.00024	.00027
15 OTHER MANUFACTUR	.00051	.00252	.00064	.00010	.00243	.00185	.00158	.00231
16 LOCAL + LD TRUCK	.00343	.00081	.00187	.00021	.00055	.00147	.00310	.00176
17 OTHER TRANSPORT	.00214	.00083	.00100	.00074	.00392	.00139	.00108	.00430
18 COMMUNICATIONS	.01194	.01150	.00836	.00896	.00833	.00589	.00423	.01070
19 GAS SERVICE	.00240	.00081	.00140	.00179	.00208	.00160	.00282	.00130
20 ELECTRIC SERVICE	.01009	.00902	.01206	.01220	.01618	.00914	.01435	.00816
21 WATER SERVICE	.00141	.00113	.00126	.00102	.00238	.00184	.00210	.00153
22 WHSALE FARM PROD	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
23 WHSALE PETROLEUM	.00614	.00032	.00025	.00012	.00043	.00008	.00004	.00099
24 OTHER WHOLESALE	.00358	.00161	.00296	.00123	.00502	.00790	.00219	.00300
25 LUMBER + HARDWAR	.00133	.00004	.00001	.00000	.00005	.00001	.00000	.00002
26 AUTO + SVC STATN	.00717	.05275	.00153	.00093	.00449	.00035	.00011	.00303
27 OTHER RETAIL	.00224	.00083	.00198	.00416	.00405	.00293	.00023	.00687
28 F.I.R.E.	.01195	.01065	.01305	.02249	.00989	.00811	.00164	.00793
29 AMUSE + RECREATE	.00004	.00002	.00089	.00011	.00203	.00002	.00005	.00011
30 MEDICAL SERVICE	.00000	.00000	.00025	.00126	.00059	.00733	.00000	.00000
31 EDUC SERVICES	.00569	.00244	.00555	.01284	.00696	.00280	.00000	.00464
32 OTHER SERVICES	.00457	.00695	.01071	.01443	.00970	.00907	.00316	.01569
33 HOUSEHOLDS	.33186	.35029	.28647	.35167	.31293	.34985	.37599	.30953
34 FEDRL GOVERNMENT	.04456	.03222	.05334	.03601	.04140	.02874	.00688	.04008
35 STATE GOVERNMENT	.00404	.00180	.00174	.00705	.00270	.00173	.00000	.00354
36 LOCAL GOVERNMENT	.01190	.00224	.00476	.00936	.00695	.00184	.00022	.00400
37 IMPORTS	.51572	.50419	.56269	.50520	.54303	.53545	.54913	.54574
TOTAL DIR REQ	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table B-2 (con't)

DIRECT REQUIREMENTS BIG SPRING-SNYDER AREA

	HOUSEHOLDS	FEDERL GOVT	STATE GOVT	LOCAL GOVT	EXPORTS	CAPITAL FORM.
1 IRRIGATED CROPS	.00234	.02250	.00000	.00002	.01881	.00000
2 DRYLAND CROPS	.00099	.02082	.00001	.00004	.07600	.00000
3 LIVESTOCK	.00062	.00206	.00000	.00000	.02377	.00000
4 OTHER AGRICUL.	.00263	.00000	.00086	.00000	.00970	.00000
5 CRUDE PETROLEUM	.00000	.00000	.00000	.00000	.41227	.00000
6 OTHER MINING	.00109	.00001	.00346	.00002	.04923	.00000
7 CONSTRUCTION	.00148	.00116	.00109	.00166	.00047	.65986
8 MEATS + DAIRIES	.01136	.00090	.00049	.00096	.00313	.00000
9 MILLING + FEEDS	.00010	.00037	.00005	.00000	.00116	.00000
10 FOOD + BEVERAGES	.00713	.00020	.00209	.00012	.00489	.00000
11 TEXTILES	.00360	.00052	.00118	.00415	.01013	.00000
12 WOOD PRODUCTS	.00107	.00074	.00273	.00492	.00291	.00262
13 CHEMICALS	.02465	.01517	.02322	.01796	.15441	.00007
14 CEMENT PRODUCTS	.00063	.00023	.00517	.00498	.00745	.00000
15 OTHER MANUFACTUR	.00169	.03017	.00303	.00312	.01125	.05092
16 LOCAL + LD TRUCK	.00810	.00157	.00240	.00190	.00310	.00496
17 OTHER TRANSPORT	.00732	.00175	.00003	.00004	.00699	.00307
18 COMMUNICATIONS	.00796	.00084	.00300	.00431	.00311	.00767
19 GAS SERVICE	.00354	.00113	.00064	.00039	.01267	.00000
20 ELECTRIC SERVICE	.01487	.00135	.00574	.00275	.00262	.00000
21 WATER SERVICE	.00262	.00114	.00067	.00053	.00067	.00000
22 WHSALE FARM PROD	.00023	.00000	.00000	.00000	.00307	.00000
23 WHSALE PETROLEUM	.00267	.00291	.00132	.00262	.00082	.00000
24 OTHER WHOLESALE	.01766	.00004	.00024	.00181	.00662	.06745
25 LUMBER + HARDWAR	.00427	.00000	.00000	.00000	.02606	.02548
26 AUTO + SVC STATN	.04445	.00046	.00272	.00742	.05959	.02100
27 OTHER RETAIL	.13601	.00000	.00002	.00423	.07086	.00174
28 F.I.R.E.	.01768	.00013	.00523	.02683	.00775	.00002
29 AMUSE + RECREATE	.00110	.00000	.00000	.00000	.00009	.00000
30 MEDICAL SERVICE	.02775	.00004	.00018	.00000	.00428	.00000
31 EDUC SERVICES	.01340	.00875	.00000	.00000	.00000	.00000
32 OTHER SERVICES	.01543	.00599	.00286	.01297	.00610	.00054
33 HOUSEHOLDS	.03699	.20290	.38444	.31350	.00000	.00000
34 FEDRL GOVERNMENT	.12664	.00925	.01498	.01929	.00000	.00000
35 STATE GOVERNMENT	.00635	.02748	.00000	.00000	.00000	.00000
36 LOCAL GOVERNMENT	.00545	.00578	.00000	.00000	.00000	.00000
37 IMPORTS	.44013	.63364	.53214	.56147	.00000	.15462
TOTAL DIR REQ	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table B-3

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
OPEN MODEL

		1	2	3	4	5	6	7	8
1	IRRIGATED CROPS	1.01991	.01056	.05748	.01887	.00002	.00002	.00012	.02753
2	DRYLAND CROPS	.00398	1.01811	.07808	.05335	.00003	.00002	.00028	.04374
3	LIVESTOCK	.00032	.00029	1.12847	.00301	.00020	.00010	.00005	.45063
4	OTHER AGRICUL.	.08491	.07495	.04309	1.16014	.00014	.00009	.00576	.27003
5	CRUDE PETROLEUM	.04015	.03887	.01327	.02040	1.01098	.09857	.00932	.01145
6	OTHER MINING	.00900	.01020	.00328	.00517	.09069	1.06000	.02336	.00200
7	CONSTRUCTION	.00351	.00357	.00299	.00640	.00041	.00160	1.00151	.00297
8	MEATS + DAIRIES	.00025	.00024	.00025	.00043	.00044	.00022	.00008	1.00104
9	MILLING + FEEDS	.00241	.00212	.01038	.03286	.00001	.00001	.00016	.01260
10	FOOD + BEVERAGES	.00028	.00025	.00825	.00232	.00021	.00013	.00006	.00574
11	TEXTILES	.00016	.00015	.00043	.00112	.00005	.00027	.00108	.00050
12	WOOD PRODUCTS	.00086	.00092	.00284	.00274	.00030	.00056	.00326	.00487
13	CHEMICALS	.14543	.17139	.05404	.08087	.00723	.03836	.02920	.04414
14	CEMENT PRODUCTS	.00045	.00382	.00060	.00084	.00053	.00143	.07650	.00053
15	OTHER MANUFACTUR	.00321	.00412	.00273	.00376	.00079	.00531	.01494	.00245
16	LOCAL + LD TRUCK	.00516	.00485	.01137	.01351	.00100	.00378	.01007	.02229
17	OTHER TRANSPORT	.00899	.00960	.00709	.00958	.00321	.00496	.00724	.00532
18	COMMUNICATIONS	.00379	.00397	.00387	.00593	.00137	.00239	.00372	.00554
19	GAS SERVICE	.01493	.00340	.00274	.00500	.00100	.00250	.00203	.00324
20	ELECTRIC SERVICE	.01314	.00695	.00602	.01464	.00386	.00728	.00332	.00844
21	WATER SERVICE	.00040	.00043	.00034	.00075	.00018	.00067	.00059	.00112
22	WHSALE FARM PROD	.00770	.00867	.06230	.05186	.00002	.00001	.00026	.04277
23	WHSALE PETROLEUM	.01078	.01440	.00469	.01037	.00043	.00122	.00157	.00467
24	OTHER WHOLESALE	.00612	.00709	.00426	.00436	.00081	.00445	.00120	.00351
25	LUMBER + HARDWAR	.05087	.05961	.04856	.05634	.00008	.00037	.01203	.03175
26	AUTO + SVC STATN	.02884	.03597	.01683	.02022	.00159	.00641	.00462	.01264
27	OTHER RETAIL	.00048	.00050	.00044	.00206	.00028	.00134	.00160	.00088
28	F.I.R.E.	.01313	.01124	.01718	.01294	.00259	.00501	.01243	.01123
29	AMUSE + RECREATE	.00002	.00002	.00002	.00003	.00016	.00013	.00004	.00002
30	MEDICAL SERVICE	.00002	.00002	.00003	.00002	.00005	.00020	.00003	.00019
31	EDUC SERVICES	.01472	.01426	.01228	.01728	.02815	.01181	.00412	.00986
32	OTHER SERVICES	.00443	.00287	.00274	.00844	.00245	.00597	.00747	.00521
TOTAL DIR/IND REQ		1.49834	1.52340	1.60693	1.62557	1.15926	1.26531	1.23803	2.05005

Table B-3 (con't)

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
OPEN MODEL

	9	10	11	12	13	14	15	16
1 IRRIGATED CROPS	.30969	.04735	.02050	.00050	.00002	.00002	.00002	.00002
2 DRYLAND CROPS	.17791	.02888	.00577	.00129	.00002	.00002	.00001	.00003
3 LIVESTOCK	.00118	.00145	.00220	.00011	.00011	.00007	.00003	.00012
4 OTHER AGRICUL.	.03938	.03420	.00225	.02772	.00019	.00015	.00007	.00012
5 CRUDE PETROLEUM	.02155	.01092	.00272	.00746	.26331	.02176	.00572	.02095
6 OTHER MINING	.00509	.00290	.00057	.00207	.06672	.11830	.00323	.00447
7 CONSTRUCTION	.00207	.00100	.00027	.00230	.00569	.00153	.00090	.00161
8 MEATS + DAIRIES	.00239	.00305	.00007	.00009	.00023	.00016	.00006	.00026
9 MILLING + FEEDS	1.00556	.00594	.00008	.00079	.00001	.00001	.00000	.00001
10 FOOD + BEVERAGES	.00311	1.00624	.00005	.00010	.00012	.00012	.00006	.00013
11 TEXTILES	.00367	.00020	1.02554	.00235	.00019	.00009	.00045	.00029
12 WOOD PRODUCTS	.00208	.00654	.00163	1.02758	.00191	.00358	.00166	.00124
13 CHEMICALS	.07902	.04265	.00762	.02758	1.18237	.01394	.01798	.06954
14 CEMENT PRODUCTS	.00137	.00045	.00010	.00110	.00123	1.06955	.00186	.00029
15 OTHER MANUFACTUR	.00196	.00362	.00209	.00242	.00302	.00158	1.01753	.00563
16 LOCAL + LD TRUCK	.01092	.00889	.00523	.01110	.00442	.01494	.00463	1.01896
17 OTHER TRANSPORT	.01380	.00478	.00148	.00871	.03302	.01120	.00611	.00668
18 COMMUNICATIONS	.00397	.00511	.00247	.00539	.00282	.00450	.00332	.03763
19 GAS SERVICE	.00757	.00288	.00180	.00246	.01596	.01495	.00275	.01005
20 ELECTRIC SERVICE	.01119	.00785	.00590	.00950	.01678	.01415	.00659	.01790
21 WATER SERVICE	.00070	.00093	.00042	.00233	.00122	.00076	.00035	.00089
22 WHSALE FARM PROD	.00712	.00291	.00050	.00134	.00002	.00001	.00001	.00001
23 WHSALE PETROLEUM	.00639	.00158	.00046	.00082	.00090	.00127	.00051	.00607
24 OTHER WHOLESALE	.00414	.00232	.00161	.00327	.00423	.00553	.00657	.00536
25 LUMBER + HARDWAR	.02583	.00545	.00147	.00173	.00016	.00011	.00029	.00039
26 AUTO + SVC STATN	.01564	.00468	.00161	.00224	.00177	.00312	.00147	.01508
27 OTHER RETAIL	.00055	.00078	.00069	.00092	.00061	.00089	.00105	.00033
28 F.I.R.E.	.00724	.00305	.00474	.00454	.00480	.01006	.00261	.03125
29 AMUSE + RECREATE	.00002	.00005	.00004	.00004	.00008	.00008	.00002	.00020
30 MEDICAL SERVICE	.00001	.00015	.00001	.00002	.00004	.00006	.00003	.00004
31 EDUC SERVICES	.00890	.00633	.00371	.00462	.01201	.00915	.00297	.01622
32 OTHER SERVICES	.00626	.00437	.00387	.00772	.00504	.00655	.00342	.01210
TOTAL DIR/IND REQ	1.78627	1.25753	1.10749	1.17021	1.63100	1.32820	1.08820	1.28386

Table B-3 (con't)

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
OPEN MODEL

	17	18	19	20	21	22	23	24
1 IRRIGATED CROPS	.00002	.00002	.00004	.00003	.00002	.00025	.00002	.00003
2 DRYLAND CROPS	.00002	.00002	.00004	.00003	.00001	.00058	.00001	.00001
3 LIVESTOCK	.00005	.00013	.00029	.00017	.00003	.00008	.00007	.00006
4 OTHER AGRICUL.	.00010	.00019	.00020	.00018	.00015	.00623	.00012	.00010
5 CRUDE PETROLEUM	.01649	.00261	.60310	.06363	.01910	.00720	.00613	.00469
6 OTHER MINING	.00447	.00054	.05427	.00625	.00844	.00143	.00163	.00121
7 CONSTRUCTION	.00430	.00023	.00072	.00080	.01636	.00620	.00040	.00072
8 MEATS + DAIRIES	.00011	.00029	.00065	.00038	.00005	.00012	.00015	.00013
9 MILLING + FEEDS	.00000	.00001	.00001	.00001	.00000	.00022	.00000	.00000
10 FOOD + BEVERAGES	.00022	.00014	.00031	.00018	.00004	.00007	.00008	.00006
11 TEXTILES	.00025	.00009	.00012	.00026	.00072	.00545	.00014	.00022
12 WOOD PRODUCTS	.00138	.00369	.00042	.00233	.00142	.00153	.00274	.00217
13 CHEMICALS	.04577	.00739	.00842	.01289	.03361	.01731	.02076	.01468
14 CEMENT PRODUCTS	.00585	.00031	.00038	.00071	.04803	.00063	.00019	.00019
15 OTHER MANUFACTUR	.00472	.00059	.00188	.00072	.00179	.00121	.00062	.00079
16 LOCAL + LD TRUCK	.00156	.00095	.00136	.00143	.00176	.01007	.00083	.00290
17 OTHER TRANSPORT	1.01714	.00166	.00281	.00279	.00225	.00487	.01775	.00254
18 COMMUNICATIONS	.00517	1.00270	.00271	.00392	.00292	.01081	.01105	.01161
19 GAS SERVICE	.00381	.00169	1.00753	.10195	.01913	.00578	.00264	.00253
20 ELECTRIC SERVICE	.00811	.00884	.00357	1.00122	.04787	.01312	.00525	.01057
21 WATER SERVICE	.00104	.00085	.00032	.00214	1.06355	.00130	.00047	.00176
22 WHSALE FARM PROD	.00001	.00002	.00003	.00002	.00001	1.01245	.00001	.00004
23 WHSALE PETROLEUM	.00685	.00007	.00047	.00065	.00124	.00094	1.00099	.00119
24 OTHER WHOLESALE	.00349	.00046	.00139	.00182	.00630	.00237	.00037	1.00107
25 LUMBER + HARDWAR	.00045	.00003	.00008	.00028	.00022	.00043	.00003	.00011
26 AUTO + SVC STATN	.00087	.00028	.00321	.01290	.00312	.00416	.00547	.00573
27 OTHER RETAIL	.00110	.00045	.00022	.00010	.00028	.00164	.00198	.00492
28 F.I.R.E.	.01368	.00430	.00469	.00466	.00543	.02457	.00715	.01183
29 AMUSE + RECREATE	.00002	.00019	.00026	.00004	.00002	.00005	.00003	.00005
30 MEDICAL SERVICE	.00002	.00002	.00003	.00001	.00001	.00003	.00001	.00005
31 EDUC SERVICES	.00625	.01850	.04128	.02417	.00271	.00631	.00809	.00527
32 OTHER SERVICES	.00862	.00897	.00454	.00439	.02030	.01141	.01579	.00760
TOTAL DIR/IND REQ	1.16194	1.06628	1.74536	1.25105	1.30690	1.15882	1.11096	1.09483

Table B-3 (con't)

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
OPEN MODEL

	25	26	27	28	29	30	31	32
1 IRRIGATED CROPS	.00002	.00001	.00360	.00003	.00005	.00017	.00077	.00019
2 DRYLAND CROPS	.00001	.00001	.00059	.00002	.00003	.00014	.00088	.00008
3 LIVESTOCK	.00006	.00003	.00462	.00012	.00008	.00043	.00700	.00022
4 OTHER AGRICUL.	.00012	.00010	.00346	.00017	.00020	.00105	.00452	.00030
5 CRUDE PETROLEUM	.00616	.00247	.00283	.00260	.00417	.00571	.00411	.00483
6 OTHER MINING	.00124	.00050	.00062	.00064	.00081	.00126	.00069	.00111
7 CONSTRUCTION	.00086	.00053	.00048	.00405	.00288	.00055	.00166	.00202
8 MEATS + DAIRIES	.00013	.00006	.00948	.00026	.00017	.00094	.01556	.00046
9 MILLING + FEEDS	.00000	.00000	.00022	.00001	.00003	.00008	.00025	.00003
10 FOOD + BEVERAGES	.00009	.00005	.00333	.00016	.00015	.00177	.00727	.00067
11 TEXTILES	.00008	.00010	.00280	.00016	.00092	.00135	.00024	.00574
12 WOOD PRODUCTS	.00277	.00289	.00599	.00231	.00455	.00123	.00293	.00484
13 CHEMICALS	.01781	.00576	.00483	.00273	.00795	.01824	.00641	.01520
14 CEMENT PRODUCTS	.00018	.00014	.00015	.00100	.00089	.00061	.00052	.00058
15 OTHER MANUFACTUR	.00068	.00277	.00081	.00027	.00264	.00203	.00176	.00254
16 LOCAL + LD TRUCK	.00370	.00101	.00235	.00042	.00081	.00175	.00369	.00209
17 OTHER TRANSPORT	.00293	.00120	.00142	.00104	.00444	.00209	.00150	.00504
18 COMMUNICATIONS	.01265	.01253	.00899	.00960	.00895	.00645	.00467	.01137
19 GAS SERVICE	.00390	.00204	.00296	.00332	.00408	.00298	.00455	.00258
20 ELECTRIC SERVICE	.01110	.01012	.01297	.01314	.01712	.01008	.01496	.00919
21 WATER SERVICE	.00162	.00136	.00147	.00123	.00267	.00208	.00232	.00176
22 WHSALE FARM PROD	.00001	.00001	.00048	.00002	.00002	.00008	.00069	.00003
23 WHSALE PETROLEUM	.00623	.00038	.00039	.00017	.00052	.00016	.00018	.00109
24 OTHER WHOLESALE	.00379	.00184	.00319	.00142	.00525	.00817	.00238	.00325
25 LUMBER + HARDWAR	1.00136	.00006	.00054	.00007	.00011	.00010	.00056	.00008
26 AUTO + SVC STATN	.00791	1.05590	.00215	.00129	.00512	.00069	.00065	.00351
27 OTHER RETAIL	.00239	.00101	1.00217	.00441	.00424	.00312	.00031	.00709
28 F.I.R.E.	.01285	.01180	.01395	1.02347	.01073	.00886	.00221	.00879
29 AMUSE + RECREATE	.00005	.00002	.00091	.00012	1.00204	.00002	.00006	.00013
30 MEDICAL SERVICE	.00002	.00002	.00027	.00130	.00061	1.00740	.00001	.00002
31 EDUC SERVICES	.00683	.00338	.00662	.01389	.00804	.00371	1.00093	.00564
32 OTHER SERVICES	.00543	.00792	.01153	.01538	.01054	.00982	.00364	1.01661
TOTAL DIR/IND REQ	1.11299	1.12602	1.11618	1.10482	1.11080	1.10310	1.09786	1.11708

Table B-4

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
CLOSED MODEL

	1	2	3	4	5	6	7	8
1 IRRIGATED CROPS	1.02126	.01204	.05864	.02006	.00148	.00128	.00116	.02855
2 DRYLAND CROPS	.00483	1.01855	.07895	.05366	.00091	.00078	.00091	.04364
3 LIVESTOCK	.00335	.00330	1.13129	.00490	.00312	.00264	.00213	.45302
4 OTHER AGRICUL.	.08852	.07834	.04641	1.16185	.00338	.00290	.00823	.27225
5 CRUDE PETROLEUM	.04549	.04433	.01750	.02389	1.01568	.10316	.01295	.01553
6 OTHER MINING	.01063	.01185	.00456	.00610	.09197	1.06106	.02494	.00393
7 CONSTRUCTION	.00418	.00426	.00304	.00741	.00089	.00194	1.00191	.00313
8 MEATS + DAIRIES	.00587	.00581	.00469	.00427	.00583	.00490	.00392	1.00629
9 MILLING + FEEDS	.00254	.00225	.01045	.03273	.00014	.00012	.00026	.01234
10 FOOD + BEVERAGES	.00377	.00371	.01091	.00500	.00353	.00300	.00242	.00837
11 TEXTILES	.00227	.00223	.00208	.00308	.00203	.00179	.00252	.00210
12 WOOD PRODUCTS	.00188	.00191	.00381	.00381	.00124	.00115	.00432	.00582
13 CHEMICALS	.16099	.18736	.06685	.09206	.02225	.05177	.04013	.05575
14 CEMENT PRODUCTS	.00102	.00428	.00104	.00124	.00076	.00183	.07661	.00092
15 OTHER MANUFACTUR	.00415	.00524	.00419	.00406	.00175	.00660	.01546	.00300
16 LOCAL + LD TRUCK	.00918	.00920	.01461	.01647	.00547	.00711	.01246	.02495
17 OTHER TRANSPORT	.01323	.01398	.01077	.01234	.00742	.00806	.00968	.00831
18 COMMUNICATIONS	.00952	.00867	.00788	.00991	.00637	.00706	.00675	.00935
19 GAS SERVICE	.01806	.00656	.00510	.00671	.00377	.00511	.00402	.00582
20 ELECTRIC SERVICE	.02242	.01571	.01328	.02050	.01261	.01504	.00932	.01461
21 WATER SERVICE	.00205	.00206	.00163	.00154	.00170	.00153	.00135	.00255
22 WHSALE FARM PROD	.00833	.00892	.06232	.05249	.00037	.00032	.00052	.04348
23 WHSALE PETROLEUM	.01187	.01594	.00583	.01178	.00158	.00240	.00237	.00539
24 OTHER WHOLESALE	.01498	.01603	.01073	.01083	.00878	.01175	.00670	.01002
25 LUMBER + HARDWAR	.05325	.06211	.05023	.05773	.00211	.00185	.01381	.03319
26 AUTO + SVC STATN	.05091	.05711	.03347	.03563	.02225	.02394	.01968	.02803
27 OTHER RETAIL	.06195	.06137	.04903	.04427	.05902	.05253	.04321	.04509
28 F.I.R.E.	.02364	.02171	.02540	.02065	.01237	.01357	.01981	.01898
29 AMUSE + RECREATE	.00051	.00051	.00041	.00036	.00049	.00043	.00035	.00037
30 MEDICAL SERVICE	.01271	.01259	.01006	.00883	.01215	.01060	.00866	.00921
31 EDUC SERVICES	.02168	.02127	.01752	.02232	.03523	.01784	.00871	.01523
32 OTHER SERVICES	.01295	.01099	.00901	.01417	.01083	.01316	.01314	.01127
33 HOUSEHOLDS	.45005	.44573	.35581	.31242	.43053	.37545	.30653	.32577
TOTAL DIR/IND REQ	2.15806	2.17594	2.12752	2.08306	1.78803	1.81266	1.68495	2.52625

Table B-4 (con't)

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
CLOSED MODEL

		9	10	11	12	13	14	15	16
1	IRRIGATED CROPS	.31044	.04837	.02097	.00153	.00125	.00118	.00088	.00132
2	DRYLAND CROPS	.17885	.02958	.00602	.00189	.00076	.00072	.00054	.00081
3	LIVESTOCK	.00347	.00322	.00421	.00217	.00257	.00241	.00178	.00273
4	OTHER AGRICUL.	.04204	.03570	.00424	.02975	.00288	.00275	.00201	.00303
5	CRUDE PETROLEUM	.02584	.01416	.00593	.01116	.26832	.02584	.00891	.02569
6	OTHER MINING	.00622	.00354	.00148	.00299	.06849	.11935	.00449	.00591
7	CONSTRUCTION	.00234	.00107	.00059	.00296	.00680	.00198	.00158	.00224
8	MEATS + DAIRIES	.00660	.00635	.00350	.00390	.00477	.00448	.00330	.00509
9	MILLING + FEEDS	1.00526	.00610	.00017	.00087	.00012	.00011	.00008	.00013
10	FOOD + BEVERAGES	.00593	1.00817	.00217	.00245	.00292	.00274	.00203	.00311
11	TEXTILES	.00486	.00130	1.02695	.00362	.00175	.00166	.00123	.00187
12	WOOD PRODUCTS	.00240	.00713	.00185	1.02877	.00235	.00438	.00182	.00251
13	CHEMICALS	.09097	.05195	.01640	.03837	1.19503	.02596	.02672	.08355
14	CEMENT PRODUCTS	.00132	.00061	.00045	.00189	.00133	1.07038	.00267	.00083
15	OTHER MANUFACTUR	.00269	.00426	.00298	.00322	.00406	.00287	1.01403	.00656
16	LOCAL + LD TRUCK	.01405	.01162	.00799	.01385	.00773	.01798	.00673	1.02243
17	OTHER TRANSPORT	.01710	.00730	.00387	.01111	.03684	.01387	.00805	.00991
18	COMMUNICATIONS	.00851	.00798	.00563	.00846	.00756	.00841	.00641	.04222
19	GAS SERVICE	.01034	.00492	.00395	.00473	.01890	.01737	.00487	.01280
20	ELECTRIC SERVICE	.01774	.01313	.01112	.01550	.02450	.02138	.01176	.02529
21	WATER SERVICE	.00157	.00217	.00108	.00345	.00276	.00257	.00105	.00281
22	WHSALE FARM PROD	.00732	.00319	.00055	.00149	.00031	.00029	.00022	.00033
23	WHSALE PETROLEUM	.00696	.00208	.00125	.00142	.00159	.00254	.00096	.00759
24	OTHER WHOLESALE	.01117	.00679	.00656	.00932	.01112	.01168	.01123	.01301
25	LUMBER + HARDWAR	.02760	.00661	.00274	.00284	.00186	.00171	.00128	.00191
26	AUTO + SVC STATN	.03229	.01643	.01514	.01653	.01977	.01995	.01372	.03405
27	OTHER RETAIL	.04868	.03608	.03848	.04279	.05017	.04859	.03651	.05307
28	F.I.R.E.	.01570	.00868	.01101	.01111	.01362	.01802	.00840	.03996
29	AMUSE + RECREATE	.00040	.00029	.00031	.00035	.00042	.00039	.00030	.00044
30	MEDICAL SERVICE	.01000	.00721	.00772	.00859	.01032	.00974	.00731	.01092
31	EDUC SERVICES	.01410	.01044	.00830	.00935	.01831	.01479	.00692	.02221
32	OTHER SERVICES	.01288	.00886	.00860	.01379	.01323	.01330	.00833	.01922
33	HOUSEHOLDS	.35401	.25554	.27331	.30421	.36532	.34486	.25889	.38589
TOTAL DIR/IND REQ		2.29965	1.63083	1.50552	1.61441	2.16774	1.83419	1.46503	1.84926

Table B-4 (con't)

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
CLOSED MODEL

	17	18	19	20	21	22	23	24
1 IRRIGATED CROPS	.00139	.00123	.00138	.00135	.00150	.00160	.00154	.00159
2 DRYLAND CROPS	.00085	.00076	.00085	.00083	.00091	.00115	.00094	.00096
3 LIVESTOCK	.00283	.00257	.00299	.00283	.00299	.00288	.00312	.00319
4 OTHER AGRICUL.	.00318	.00288	.00319	.00313	.00344	.00910	.00350	.00359
5 CRUDE PETROLEUM	.02103	.00716	.60824	.06851	.02415	.01222	.01149	.01018
6 OTHER MINING	.00634	.00184	.05558	.00763	.00890	.00294	.00294	.00267
7 CONSTRUCTION	.00507	.00071	.00085	.00182	.01702	.00705	.00096	.00194
8 MEATS + DAIRIES	.00524	.00479	.00563	.00530	.00552	.00529	.00579	.00592
9 MILLING + FEEDS	.00013	.00012	.00014	.00013	.00014	.00030	.00015	.00015
10 FOOD + BEVERAGES	.00322	.00292	.00338	.00321	.00342	.00327	.00356	.00363
11 TEXTILES	.00197	.00174	.00189	.00186	.00326	.00720	.00220	.00222
12 WOOD PRODUCTS	.00232	.00415	.00123	.00325	.00269	.00238	.00343	.00345
13 CHEMICALS	.05962	.02020	.02217	.02692	.04896	.03202	.03594	.03117
14 CEMENT PRODUCTS	.00645	.00060	.00068	.00079	.04856	.00119	.00078	.00089
15 OTHER MANUFACTUR	.00549	.00109	.00254	.00139	.00278	.00245	.00145	.00242
16 LOCAL + LD TRUCK	.00525	.00454	.00574	.00508	.00625	.01347	.00544	.00755
17 OTHER TRANSPORT	1.02048	.00453	.00688	.00630	.00566	.00855	.02197	.00670
18 COMMUNICATIONS	.00934	1.00642	.00769	.00823	.00805	.01581	.01569	.01682
19 GAS SERVICE	.00654	.00463	1.01061	.10494	.02195	.00880	.00607	.00570
20 ELECTRIC SERVICE	.01641	.01565	.01185	1.00894	.05695	.02146	.01374	.01992
21 WATER SERVICE	.00275	.00251	.00163	.00371	1.06573	.00277	.00182	.00397
22 WHSALE FARM PROD	.00034	.00031	.00035	.00034	.00036	1.01276	.00038	.00039
23 WHSALE PETROLEUM	.00854	.00124	.00144	.00236	.00270	.00258	1.00267	.00261
24 OTHER WHOLESALE	.01124	.00707	.00908	.00986	.01429	.01027	.00892	1.01010
25 LUMBER + HARDWAR	.00205	.00177	.00197	.00194	.00233	.00239	.00220	.00227
26 AUTO + SVC STATN	.01996	.01740	.02226	.03187	.02420	.02355	.02703	.02769
27 OTHER RETAIL	.05718	.04928	.05465	.05377	.05996	.05770	.06378	.06835
28 F.I.R.E.	.02333	.01245	.01386	.01382	.01558	.03400	.01695	.02219
29 AMUSE + RECREATE	.00047	.00041	.00045	.00045	.00050	.00047	.00052	.00053
30 MEDICAL SERVICE	.01157	.01015	.01125	.01108	.01232	.01167	.01272	.01305
31 EDUC SERVICES	.01304	.02433	.04769	.03089	.00981	.01330	.01521	.01246
32 OTHER SERVICES	.01674	.01617	.01241	.01134	.02867	.01899	.02429	.01642
33 HOUSEHOLDS	.40932	.35961	.39863	.39248	.43629	.41280	.45041	.46212
TOTAL DIR/IND REQ	1.75969	1.59123	2.32919	1.82638	1.94684	1.76238	1.76758	1.77284

Table B-4 (con't)

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
CLOSED MODEL

	25	26	27	28	29	30	31	32
1 IRRIGATED CROPS	.00149	.00159	.00480	.00158	.00144	.00171	.00235	.00157
2 DRYLAND CROPS	.00090	.00097	.00129	.00096	.00087	.00110	.00183	.00091
3 LIVESTOCK	.00301	.00320	.00669	.00324	.00288	.00357	.01000	.00286
4 OTHER AGRICUL.	.00339	.00363	.00585	.00363	.00330	.00498	.00797	.00331
5 CRUDE PETROLEUM	.01103	.00811	.00693	.00827	.00907	.01115	.00983	.00955
6 OTHER MINING	.00277	.00213	.00174	.00223	.00225	.00280	.00238	.00252
7 CONSTRUCTION	.00190	.00087	.00079	.00493	.00386	.00093	.00290	.00288
8 MEATS + DAIRIES	.00559	.00592	.01390	.00602	.00533	.00678	.02102	.00530
9 MILLING + FEEDS	.00014	.00015	.00026	.00015	.00014	.00020	.00038	.00014
10 FOOD + BEVERAGES	.00343	.00365	.00606	.00368	.00327	.00558	.01081	.00425
11 TEXTILES	.00208	.00224	.00493	.00225	.00304	.00321	.00226	.00716
12 WOOD PRODUCTS	.00339	.00460	.00739	.00350	.00541	.00238	.00451	.00543
13 CHEMICALS	.03273	.02194	.01742	.01924	.02263	.03332	.02299	.02968
14 CEMENT PRODUCTS	.00081	.00077	.00065	.00214	.00098	.00079	.00097	.00091
15 OTHER MANUFACTUR	.00237	.00456	.00220	.00142	.00334	.00341	.00348	.00335
16 LOCAL + LD TRUCK	.00733	.00558	.00600	.00451	.00511	.00549	.00801	.00615
17 OTHER TRANSPORT	.00663	.00550	.00473	.00537	.00815	.00566	.00561	.00834
18 COMMUNICATIONS	.01762	.01836	.01293	.01482	.01329	.01167	.00981	.01632
19 GAS SERVICE	.00657	.00556	.00523	.00678	.00690	.00656	.00806	.00517
20 ELECTRIC SERVICE	.01947	.01923	.02026	.02188	.02497	.01874	.02385	.01704
21 WATER SERVICE	.00282	.00296	.00262	.00293	.00382	.00395	.00400	.00380
22 WHSALE FARM PROD	.00036	.00039	.00074	.00039	.00035	.00048	.00106	.00035
23 WHSALE PETROLEUM	.00754	.00161	.00139	.00159	.00146	.00158	.00172	.00246
24 OTHER WHOLESALE	.01259	.01125	.01052	.01004	.01318	.01696	.01134	.01113
25 LUMBER + HARDWAR	1.00314	.00228	.00231	.00230	.00206	.00231	.00285	.00205
26 AUTO + SVC STATN	.02856	1.07855	.02072	.02334	.02433	.02195	.02323	.02308
27 OTHER RETAIL	.06169	.06510	1.05390	.06708	.06058	.06501	.06500	.06320
28 F.I.R.E.	.02267	.02270	.02240	1.03329	.02012	.01889	.01325	.01808
29 AMUSE + RECREATE	.00050	.00053	.00143	.00053	1.00248	.00052	.00054	.00047
30 MEDICAL SERVICE	.01230	.01320	.01068	.01400	.01265	1.01981	.01340	.01156
31 EDUC SERVICES	.01416	.01051	.01316	.02149	.01475	.01124	1.00861	.01263
32 OTHER SERVICES	.01400	.01675	.01888	.02353	.01856	.01821	.01236	1.02461
33 HOUSEHOLDS	.43526	.46725	.37804	.45949	.41227	.45198	.47468	.40934
TOTAL DIR/IND REQ	1.74824	1.81164	1.66688	1.77660	1.71282	1.76292	1.79105	1.71560

Table B-4 (con't)

INTERDEPENDENCE COEFFICIENTS BIG SPRING-SNYDER AREA
CLOSED MODEL

		33
1	IRRIGATED CROPS	.00405
2	DRYLAND CROPS	.00246
3	LIVESTOCK	.00815
4	OTHER AGRICUL.	.00905
5	CRUDE PETROLEUM	.01417
6	OTHER MINING	.00428
7	CONSTRUCTION	.00187
8	MEATS + DAIRIES	.01505
9	MILLING + FEEDS	.00038
10	FOOD + BEVERAGES	.00927
11	TEXTILES	.00560
12	WOOD PRODUCTS	.00306
13	CHEMICALS	.04159
14	CEMENT PRODUCTS	.00173
15	OTHER MANUFACTUR	.00330
16	LOCAL + LD TRUCK	.01120
17	OTHER TRANSPORT	.01057
18	COMMUNICATIONS	.01358
19	GAS SERVICE	.00847
20	ELECTRIC SERVICE	.02338
21	WATER SERVICE	.00448
22	WHSALE FARM PROD	.00098
23	WHSALE PETROLEUM	.00402
24	OTHER WHOLESALE	.02310
25	LUMBER + HARDWAR	.00584
26	AUTO + SVC STATN	.05737
27	OTHER RETAIL	.15402
28	F.I.R.E.	.02696
29	AMUSE + RECREATE	.00137
30	MEDICAL SERVICE	.03384
31	EDUC SERVICES	.01941
32	OTHER SERVICES	.02246
33	HOUSEHOLDS	1.19911
TOTAL DIR/IND REQ		1.75415

APPENDIX C

Mathematical Description of an Input-Output Model

Leontief Matrix

The flow of goods and services from one sector of the economy to another sector can be represented mathematically as follows. Let X_i be the total output of section k, x_{ij} be the flow of goods or services from sector i to sector j, and Y_i be the final demand for the output of section i, then:

$$(1) \quad X_i = x_{i1} + x_{i2} + \ldots + x_{im} + Y_i$$

where:

m = number of processing sectors in the economy.

Since each x_{ij} value also represents the purchase by sector j from sector i, then the direct requirement of sector j on sector i becomes:

$$(1.5) \quad a_{ij} = \frac{x_{ij}}{X_j}$$

and solving for x_{ij}:

$$(2) \quad x_{ij} = a_{ij}X_j$$

Substituting equation (2) into equation (1) yields:

$$(3) \quad X_i = a_{i1}X_1 + a_{i2}X_2 + \ldots + a_{im}X_m + Y_i$$

To define the relationship between output and final demand, equation (3) is rewritten as:

$$(4) \quad Y_i = X_i - a_{i1}X_1 - a_{i2}X_2 - \ldots - a_{im}X_m$$

In a representative three sector model, equation (4) can be shown as:

$$(5)\quad X_1 - a_{11}X_1 - a_{12}X_2 - a_{13}X_3 = Y_1$$

$$-a_{21}X_1 + X_2 - a_{22}X_2 - a_{23}X_3 = Y_2$$

$$-a_{31}X_1 - a_{32}X_2 + X_3 - a_{33}X_3 = Y_3$$

Equation (5) can be rewritten as:

$$(6)\quad (1-a_{11})X_1 - a_{12}X_2 - a_{13}X_3 = Y_1$$

$$-a_{21}X_1 + (1-a_{22})X_2 - a_{23}X_3 = Y_2$$

$$-a_{31}X_1 - a_{32}X_2 + (1-a_{33})X_3 = Y_3$$

Finally in matrix form equation (6) is shown as:

$$(7)\quad \begin{vmatrix} 1-a_{11} & -a_{12} & -a_{13} \\ -a_{21} & 1-a_{22} & -a_{23} \\ -a_{31} & -a_{32} & 1-a_{33} \end{vmatrix} \times \begin{vmatrix} X_1 \\ X_2 \\ X_3 \end{vmatrix} = \begin{vmatrix} Y_1 \\ Y_2 \\ Y_3 \end{vmatrix}$$

or symbolically as:

$$(8)\quad (\underline{I} - \underline{A})\underline{X} = \underline{Y}$$

where:

$\underline{I}$ = identity matrix

$\underline{A}$ = matrix of direct requirements

$\underline{X}$ = matrix of total sector outputs

$\underline{Y}$ = matrix of sector final demands

The purpose of input-output analysis, however, is to define the effects of changes in final demand on sector output; therefore, solving equation (8) for $\underline{X}$ yields the

basic Leontief equation:

$$(9) \quad \underline{X} = (\underline{I} - \underline{A})^{-1}\underline{Y}$$

The elements of the $(\underline{I} - \underline{A})^{-1}$ matrix are the interdependence coefficients, and define the relationship between final demand ($\underline{Y}$) and sector output ($\underline{X}$). Each element of this matrix represents the total increase in output of its row sector required for its column sector to meet an additional $1.00 sale to final demand.

Multipliers

Two types of multipliers can be determined directly from this interdependence coefficients table. The first type is the final demand multiplier, or the total change in output of a region as a result of a change in final demand. This type of multiplier is found by adding together all the individual sector effects of each column of the interdependence coefficients table. This is represented mathematically as:

$$(10) \quad FDM_j = \sum_{i=1}^{m} A_{ij}$$

where:

m = number of processing sectors

A_{ij} = element of the interdependence coefficients table

As can be noted in Appendix B, Table 3, whenever final demand for the product of a sector increases by $1.00, that sector must not only produce that $1.00 sale to final demand, but must also produce an additional amount to support the

production processes of other sectors of the economy. At times, however, a sector is limited in its productive capability. The output effect of the sector's limited production can also be explained by the output multiplier. This situation allows only a portion of its production to go to final demand with the rest going to other processing sectors. The multiplier effect on total output of the region is then adjusted downward from the final demand multiplier as follows and yields the output multiplier.

$$(11)\quad OM_j = \left(\sum_{i=1}^{m} A_{ij}\right)/A_{jj} = FDM_j/A_{jj}$$

Stemming From Effects

This procedure defines that effect on the regional economy when a commodity related sector processes an increased amount of that commodity. The first step requires determining how much of the given commodity must be produced to support current sales to final demand by the commodity related sector. This is found by multiplying the total sales to final demand, excluding households, for the commodity-related sector, by the interdependence coefficient located at the commodity row and commodity-related column intersection of the interdependence coefficients table.

$$(1)\quad P_i = FDM_j \times A_{ij}$$

where:

P_i = production of commodity i required to support sales to final demand by commodity-related sector j

Then, the percentage of total production of the given commodity required to support sales to final demand by the commodity-related sector is computed.

$$(2) \quad P_i = \frac{P_i}{TO_i}$$

where:

TO_i = total output of commodity i

The amount of increased output which goes to support sales to final demand by the commodity-related sectors is then found:

(3) R_i = increased output x P_i

The amount of increased sales to final demand by the commodity-related sector, supported by the increased commodity yield is found by dividing the value found in (3) above by the same interdependence coefficient used in (1) above:

$$(4) \quad D_j = R_i / A_{ij}$$

The total economic effect is then the D_j value multiplied by the final demand multiplier for sector j.

$$(5) \quad TE_j = D_j \text{ X } FDM_j$$

This total effect, however, includes the output effect of the R_i value in (3) above, and this effect must be subtracted to obtain the stemming-from effect.

$$(6) \quad SFE_j = TE_j - (R_i \text{ x } OM_i)$$