INPUT-OUTPUT ANALYSIS APPLIED TO RURAL RESOURCE DEVELOPMENT PLANNING

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This report presents results of an input-output (I-O) model generated from secondary data and application of the model to RC&D and small watershed program planning. Methodology, procedures, and data for developing and using an I-O model in a small planning area are analyzed and discussed. Two resource development measures are used to illustrate the use and value of I-O in evaluating resource projects. The project measures selected are in the Twin Valley and Trailblazer-4 RC&D areas in northwest Louisiana, a 9-parish area around Shreveport. The report includes the 38-sector I-O model developed for the 9-parish area, including output, income, and employment multipliers.

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SUMMARY

The RC&D and Small Watershed Programs of the U.S. Department of Agriculture help farmers and rural communities promote economic growth through development, improvement, and use of their natural resources, including the use, conservation, and control of water. The combined activities of the two programs present a wide range of proposals for economic development and community improvement. Such questions as, "What are the project impacts of alternative actions, how do they relate and contribute to project goals, and how do likely results of each alternative compare to costs of each alternative?" should be answered before public funds are spent. This report presents results of a study which examined input-output (I-O) techniques as a means for predicting the likely economic impacts of proposed projects under the RC&D and Small Watershed Programs.

This study develops from secondary data an I-O model for a small test area to show how the model can be used in a typical planning situation for estimating economic impacts of proposed project action and appraises problems of model development and application and the general value of I-O as a planning tool. The report presents a 38-sector I-O model developed for a 9-parish area in northwest Louisiana. Output, income, and employment multipliers are computed from the model and used in evaluating project impacts. Two sets of I-O multipliers, one with households endogenous and one with households exogenous, are computed and compared to illustrate the effects of including households in the processing sector of an I-O model. The comparison shows that treating households endogenously practically doubled the size of the multipliers for most sectors in the 9-parish economy, illustrating: (1) the effect of local consumer spending on sector output as household income changes, and (2) that the 9-parish economy is somewhat self-sufficient.

The 38-sector I-O model (with households endogenous) was used to estimate the local economic impacts of two selected projects. Local impacts were based on project expenditures and project-associated activity (i.e., returns on project investment after installation). Project installation expenditures were estimated at \$9.7 million and annual operation and maintenance expenditures, \$90,441. Project installation expenditures were estimated to create 235 man-years of employment and increase the personal income of the area by more than \$2 million annually during the 4-year installation period. After installation, project-induced activity was estimated to create 254 man-years of employment and raise annual personal income by \$1.6 million.

The import/export problem as it relates to small area I-O models developed from national models and other secondary data was examined. Primary data were used to adjust three sectors of the northwest Louisiana model for imports and exports. Results indicated that secondary data techniques used in adjusting data from large area models to approximate small area models may not accurately account for import/export relationships existing in the small area economy. The sector I-O multipliers of the adjusted model and unadjusted model (based on secondary data alone) showed sizeable differences for those sectors which were adjusted for imports and exports using primary data, and differed by varying degrees among other sectors, depending upon their relationship to the adjusted sectors.

As with most analytical models developed from secondary data, the validity of the I-O model developed for this study was questioned because of the age of the data upon which it is based. The I-O coefficients of the northwest Louisiana I-O model are based on the technology of the 1963 U.S. I-O model developed by the Bureau of Economic Analysis (BEA) (28). The 1967 U.S. I-O model was not available at the outset of the study, and the most recent U.S. I-O model, one based on the 1972 economy, will not be available until 1978. In reviewing the northwest Louisiana RC&D area's economic structure, it is believed that no dynamic changes occurred in the area's industrial technology or trade patterns during the time span between the 1963 and 1967 U.S. I-O models that would appreciably change the model's coefficients and sector multipliers.

Results of the study indicate that the I-O technique, although not flawless, can provide project planners and decisionmakers valuable information for comparing and evaluating alternative project proposals, including an assessment of their relative differences in impacts and costs as they relate to program/project goals. One of the useful features of I-O analysis in plan evaluation is that it enables planners and decisionmakers to identify the incidence of project impacts in terms of impacts on individual sectors of the economy, including resource supply sectors.

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by

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INTRODUCTION

Research results in this report are a contribution of the Economics, Statistics, and Cooperatives Service (ESCS) to the Department's Resource Conservation and Development (RC&D) and Small Watershed Programs. ESCS develops economic information and analytical techniques that can be used in evaluating economic effects of the two programs and, in some cases, provides technical assistance to the planning units in project areas. This report represents work initiated as part of a broad research and information generating program to provide local leaders more meaningful economic data on which to base planning decisions relating to RC&D and small watershed projects.

The main objective of the study was to develop an input-output (I-O) model and illustrate its use in estimating the economic impacts of RC&D and small watershed measures. A subobjective was to examine I-O techniques as a practical tool for project evaluation and assess weaknesses in its application. A 9-parish area in northwest Louisiana, the focus of this report, consists of two RC&D areas: Trailblazer-4 and Twin Valley RC&D projects. Besides RC&D activities, there is considerable Small Watershed Program activity in this area, making it a desirable location for testing I-O's use in the two programs.

RC&D

The U.S. Department of Agriculture's RC&D program, developed in the early sixties, has active areas in all States except Alaska. Authority for the program is found in P.L. 87-703, Section 102 of the Food and Agriculture Act of 1962. Under Secretary of Agriculture Memorandum No. 1665, the Soil Conservation Service (SCS) is the administering agency.

Basic objectives of the RC&D program are to: (1) promote orderly development, improvement, conservation, and use of natural resources in rural areas; (2) assist local leadership in promoting economic development and environmental improvement in rural areas; (3) promote full employment through development and use of natural resources and related economic opportunities; and (4) encourage and assist local leaders in preparing long-range comprehensive plans for natural resource conservation, development and use, and economic growth.

Local leaders in rural areas decide if RC&D can solve some of the local problems and, if so, indicate how. They take the initiative in starting an RC&D area and continue in the leadership role, with SCS assistance, as the area is organized and put into operation.

There are three phases involved in creating an RC&D area: (1) preparing and making an application for planning assistance, (2) planning, and (3) operation. Each phase is under local leadership with State and Federal assistance provided as needed and authorized. Assistance is channeled through a coordinator provided by SCS.

If an area is successful in acquiring assistance under the RC&D program, it will emerge from the first two phases with a work plan. This plan describes the area, comments on the current level of natural resource development and use, identifies socioeconomic and land use problems in the area, states area objectives, and lists proposed measures for achieving objectives. During the third phase, the local community puts the plan into operation.

A typical RC&D area involves numerous local groups working together with local, State, and Federal agencies to achieve area goals. Approved activities are called measures. Each RC&D area has an area work plan stating development goals of the local leadership and recommending measures for achieving these goals. The plan is a flexible instrument and can be changed as needed to meet new circumstances. It is a very important part of the RC&D program since it provides local leaders with a blueprint for action and expenditure of funds.

It is important to select the proper alternatives for development. Experience indicates that an objective system for problem identification, goal setting, and alternative goal selection is needed. Local leaders recognize the general problems of their area, characterized by the general economic ebb of the communities, low incomes, and a deteriorating infrastructure. However, identification of specific underlying problems and establishment of specific goals and action to overcome or counter these problems remains difficult. Generally, there is a lack of sufficient knowledge to adequately assess problems and develop criteria and standards for selecting alternatives to meet area goals.

The importance of selecting desirable development alternatives is accentuated by the size and growth of the RC&D program, and consequently, the number of people affected by RC&D action. About 42 percent of the Nation's land area is involved in the RC&D program.

Small Watershed Program

The Small Watershed Program, also administered by SCS, provides Federal technical and financial assistance to communities to carry out projects for flood control, control of erosion and sedimentation, agricultural water management, recreation, fish and wildlife development, and development of municipal and industrial water supplies. Authority for the program is provided in P.L. 83-566 and its amendments. The program is limited to watershed areas of 250,000 acres or less. As of May 1976, a total of 2,895 applications for assistance under the program had been filed with SCS. These applications covered 226 million acres. Planning authorizations have been issued covering 127 million acres, and watershed plans approved for areas in the various States cover over 72 million acres.

Report Objectives

The RC&D and small watershed study programs together can extensively influence rural economic development, land and water use, and development and conservation practices in the United States. Often, small watershed program areas and activities coincide with RC&D areas.

A major obstacle to efficient planning in small areas has been a shortage of meaningful data on the economic structure of the areas and the interrelationships among sectors within the small area economies. Without sufficient economic knowledge of the structural and functional relationships of the area economy, estimates of the economic effects of development alternatives (area measures) are inadequate and often without useful meaning to decisionmakers in planning units (local leaders, project coordinators, and program administrators). Decisionmakers in the planning process need more efficient methods for identifying economic problems, setting goals to overcome problems, and predicting goal achievement. Data are needed to strengthen the criteria, standards, and general methodology used in selecting alternatives to meet goals.

Sound planning in RC&D and small watershed areas includes accurate identification of economic problems, solid goals for solving problems, and proper action for achieving goals. This kind of community planning requires a thorough knowledge of the community's assets and liabilities, and a clear understanding of the ultimate effects of action proposed to make the best of them.

An area's economic system is a very complex mechanism, consisting of interrelated component sectors. A change in one sector triggers, directly or indirectly, changes in other sectors. To measure the total impact of changes in the economy, both direct and indirect effects should be taken into account. For example, a new plywood plant will hire employees and buy timber products, equipment, and materials for operation. Direct economic effects of such hiring and buying can be estimated rather easily, once size of plant and output are known. However, indirect effects will occur in other economic sectors as the total economic system adjusts to the new plant. Retail trade and other service sectors will adjust to meet the increased demand for goods and services resulting from new employment and new households. Expenditure patterns will vary among sectors. Some goods and services will be purchased locally, while others will be imported from outside the area. Local use of natural resources may be altered and more may be brought into production. Such changes within the economic structure may cause adjustment problems within the economy. Indirect effects such as these, which can outweigh the direct effects, must be considered to get an estimate of the total impact of an economic change.

This report illustrates the use of input-output techniques in analyzing the impact of economic development measures. The study objectives were: (1) develop an I-O model for the northwest Louisiana study area; (2) demonstrate the use of the study area model in estimating economic impacts of RC&D and small watershed measures; and (3) appraise the usefulness of I-O as a practical planning tool using the study area model and its application as a basis of evaluation.

INPUT-OUTPUT ANALYSIS

I-O analysis (or interindustry analysis) is concerned with the interdependence among economic sectors. Although its rudiments can be found in the works of other economists, development of I-O analysis is attributed largely to Wassily W. Leontief. In the thirties, Leontief, Harvard professor of economics, developed a general theory of production based on the idea of economic interdependence, gave his theory empirical content, and published the first I-O table for the American economy. His first book on I-O economics, The Structure of the American Economy, 1919-1929, was published in 1941.

Earlier works on economic interdependence can be found in Tableau economique, 1758, in which Francois Quesnay stressed the interdependence of economic activities. In 1874, Leon Walras published his Elements d'economie politique pure in which he developed his general equilibrium theory. Gustav Cassel of Sweden and Vilfredo Pareto of Italy are also credited for contributions to the theory of general equilibrium and, therefore, indirectly to the development of I-O theory (13). 1/

Quesnay illustrated graphically his interpretation of how the circulation of wealth takes place. He divided the economy into three social classes: (1) a productive class consisting of agriculturists and perhaps fishermen and miners, (2) a proprietary class which included landed proprietors and those with title to sovereignty of any kind, and (3) a sterile class consisting of merchants, manufacturers, domestic servants, and members of the liberal professions. He stressed the economic interdependence among these classes in discussing trade patterns and in attempting a synthesis of distribution (15).

Walras, in development of his theory of general equilibrium, attempted to include every aspect of economic activity within a system of equations dealing with prices and production. "Walras was first to show the importance of these equations, especially in the case of free competition," according to Pareto (15). Walras' general market equilibrium is defined by four sets of equations in which he interwove the economic relationship of quantities of productive services offered, quantities of finished goods demanded, prices of productive services, and prices of finished goods. His model stressed economic interdependence as the economy reacted to various changes in prices, demand, and supply in its tendency toward equilibrium. He included in his work analyses of technical coefficients of production and consumer income expenditures (21).

It was not, however, until Professor Leontief's work emerged that I-O analysis became a popular analytical tool in economics and gained fame as a method of measuring economic interdependence. Since Leontief's work, I-O models have been developed for study of national economies, regions, interregional relationships, State economies, small multicounty areas, and communities. The character and size of the I-O models depend upon the purpose at hand; many are designed for specific economic sectors. An inventory of regional I-O models in the United States can be found in Bourque and Cox's publication (2).

1/ Underscored numerals in parenthesis refer to items in the Bibliography.

All I-O models consist of three fundamental parts: the flow table, 2/ the table of technical (or direct) coefficients, 3/ and the table of interdependence (or direct and indirect) coefficients. 4/ These, with their mathematical formulation, are discussed next.

The I-O Model

The first step in I-O analysis is to develop a flow table. This table is the essence of I-O analysis since it is an empirical model of the economy under study. The flow table records total transactions occurring in a given economy during a given time period, showing final demand for goods and services and the interindustry transactions required to satisfy this demand. It is from the flow table that the technical coefficients and interdependence coefficients are derived. To develop a flow table, economic activities in the area under study are divided into functionally homogeneous groups called sectors and industries. According to Miernyk, industries are defined as aggregates of firms producing similar products, while sectors refer to the kinds of markets that industries serve (13). 5/

Entries in an I-O flow table are arranged in rows and columns (table 1). Rows represent sales and columns represent purchases. The table is made up of four sections called quadrants.

Quadrant I (final demand) contains all exogenous sectors of the model and is made up mostly of household expenditures, exports, capital expenditures, and government purchases. This is the autonomous sector which determines the level of output of the economy under study. Entries in quadrant I represent the value of output purchased from the processing sectors. Changes in final demand are transmitted throughout the rest of the flow table.

Quadrant II (processing sectors) contains those sectors (or industries) producing goods and services for final demand. These are the endogenous sectors of the model. All output of the processing sectors is either sold to final demand or to other processing sectors. The processing sectors must comprise a square matrix (there must be as many rows as there are

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2/ Also called transactions or interindustry transactions table or matrix and I-O table.

3/ Also called input coefficients and direct requirements table or matrix.

4/ Also called inverse coefficients matrix and total requirements table.

5/ However, the two terms, industry and sector, are used interchangeably in this report. As Miernyk says, the meaning of each term should be clear from the context of its use (13).

Table 1--Input-output flow table

Producing industries (sellers)	Outputs to 1/ / Inputs from 2/	A	B	C	D	Households	Government purchases	Exports and other	Total final demand	Total gross output
		Purchasing industries (buyers): Processing sector				Final demand				
Processing sector		Quadrant II				Quadrant I				
	Industry A	10	20	10	5	10	5	10	25	70
	Industry B	12	4	6	5	10	3	5	18	45
	Industry C	3	6	4	10	17	10	3	30	53
	Industry D	10	5	10	5	2	5	23	30	60
Payments sector		Quadrant III				Quadrant IV				
	Government	8	3	5	5	8	1	2	11	32
	Households	15	4	10	10	1	6	0	7	46
	Other payments and imports	12	3	8	20	3	2	0	5	48
	Total payments	35	10	23	35	12	9	2	23	126
	Total gross outlay	70	45	53	60	51	32	43	126	354

1/ Reading across a row, sales to sectors along the top of the table by those listed in each row at the left.

2/ Reading down a column, purchases from sectors at the left of the table by sectors at the top of each column.

columns). 6/ The corresponding row and column totals for each sector (or industry) in quadrant II must be equal.

Quadrant III (payments sectors) accounts for primary and exogenous inputs purchased by the processing sectors. It shows purchases by processing sectors for inputs they do not produce. Entries in quadrant III include payments to households in the form of wages, salaries, rental income, interest income, and profits; payments to government; imports of goods and services; inventory depletion; and capital consumption or depreciation.

Quadrant IV shows the direct transactions between the exogenous and primary input sectors (payments sectors) and the final demand sectors. This includes outputs of the local economy as well as imports that enter directly into final use without any intermediate processing by the endogenous sectors (for example, services of household employees, local labor commuting out of the area for work, intergovernment transfers, direct household purchases of nonlocal goods, etc.).

In developing an I-O flow table, the way in which economic activities or business firms in the area under study are grouped together or aggregated into sectors (sectoring) depends upon how the model is to be used and data availability. According to Leven, (10) there is no right way to sector, there are only useful ways. Sectoring is simply an arbitrary process of abstraction and will depend upon the purpose to be served by the model. Whether variables should be endogenous or exogenous depends upon the model. Exogenous variables are those elements in the model whose value must be specified independently. They are sorted and put into the autonomous section of the model. Endogenous variables are those elements in the model whose value is determined by the model, i.e., the dependent variables. In the case of area growth studies, the I-O analyst will be interested in identifying and studying causal elements, which will influence his decisions as to what variables should be classified as endogenous (dependent) and exogenous (independent). In any case, it will be a judgment decision, based on available knowledge and conjecture, as to whether a given variable is influenced most by the model or for the most part its value is influenced by forces outside the model (10).

The inputs and outputs of sectors in the I-O model are of two kinds: intermediate and final in the case of output, and intermediate and primary in the case of inputs. Intermediate output is that output sold to other processing sectors to produce other goods and services. Final output is that output sold to final demand and does not re-enter the production processes. Intermediate inputs are those which processing sectors purchase from other processing sectors (or industries). Primary inputs are distinguished from inter-

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6/ The derivation of the interdependence coefficients requires that the processing matrix be a square matrix. Only nonsingular matrices (square matrices with nonzero determinants) have inverses. The logic of this can readily be seen in the formula defining the inverse of matrix A; where $A^{-1} = \frac{1}{\det A} \operatorname{adj} A$. Since division by zero is undefined, in the inverse formula det A cannot equal zero. Therefore, only nonsingular matrices have inverses.

mediate inputs in that they are directly employed by the using industry and their values constitute the value added by that industry (30).

Value added is included in quadrants III and IV (the payments sector) of an I-O flow table, and is comprised of wages, salaries, rent, interest, profit or loss, business taxes, and depreciation. Final demand (quadrant I) consists of personal consumption, fixed capital formation, inventory accumulation, government purchases, and exports. The sum of all kinds of final demand is equal to total value added plus imports by the economy (the total value of all rows in the payments sector must equal the total value of all columns in the final demand sector of the I-O model) (13, 30).

The interdependence of industries in the processing sector is the main concern of the I-O analyst. Each such industry produces a certain amount of output or provides a certain service which may be used within the industry itself, sold to other processing industries as inputs, or sold to final demand. To produce its output, an industry may purchase inputs from itself, from other processing industries, and from primary and exogenous input sectors.

Each element in a row represents total sales by the industry or sector named at the beginning of the row to the industry or sector listed at the head of the column. Conversely, each element in a column represents total purchases by the industry or sector named at the head of the column from the industry listed at the beginning of the row. For example, industry A (table 1) produced 70 units of output; 10 were used by A itself, 20 sold to industry B, 10 to C, 5 to D, and 25 to final demand. To produce these 70 units of output, industry A purchased 10 units of its own output, 12 units from industry B, 3 from C, 10 from D, and 35 from payments. These purchases and sales of industries in the processing sector are used in computing the technical and interdependence coefficients tables.

The technical coefficients, developed from the data in the flow table, relate inputs of an industry to its total output. Technical coefficients show the amount of inputs required from each industry in the flow table to produce a dollar's worth of output of a given industry in the processing sector. 7/ Calculation of the technical coefficients involves dividing all entries (purchases) in each industry's column by the gross output (total sales) for that industry. Therefore, the table of technical coefficients, arranged on the order of the processing sector of the flow table, consists of the ratios of industry purchases to total output, arranged in rows and columns. Each column shows the inputs that the industry named at the top of that column required from each of the industries named at the beginning of the rows to produce a dollar of its output.

7/ Technical coefficients may be expressed in either monetary or physical units. They are expressed as dollars in this report. They are also called input coefficients and direct requirement coefficients, although technically, it can be argued that they may not be the same, depending upon the size of the area modeled and the I-O model in question. However, in this report, this semantic distinction has no important consequence.

Technical coefficients show only direct purchases made by a given industry from all other industries for each dollar's worth of current output. This, however, does not account for the total change in output resulting from a change in sales (an increase or decrease) to final demand. An increase in final demand for goods and services of an industry within the processing sector will lead to both direct and indirect increases in the output of all industries in the processing sector. For instance, assume an increase in final demand for the products of industry A (table 1). Industry A, as it expands production to meet this new demand, must increase its purchases of inputs from supporting industries B, C, and D. These are direct purchases.

However, as A increases its purchases from industries B, C, and D, they must also increase their purchases of inputs from other industries in order to expand their output to satisfy A's needs. If there are other industries in the processing sector, their sales and purchases may also increase, depending upon their linkage to industry A and its supporting industries. These interactions represent indirect purchases and sales or indirect effects and spread throughout the processing sector (as well as into the payments input sector outside the processing sector).

I-O coefficients which measure both direct and indirect effects of changes in final demand are called interdependence coefficients or direct and indirect coefficients. They are computed from the table of technical coefficients through a matrix inversion process. The table of interdependence coefficients or inverse matrix shows total expansion of output in all industries as a result of the delivery of a dollar's worth of output to final demand by each industry in the processing sector. The table format follows that of the technical coefficients table. Entries are arranged in rows and columns representing each industry in the processing sector. Each column shows the output required both directly and indirectly from the industry named at the left (beginning of each row) for each dollar of deliveries to final demand by the industry named at the head of the column (top of table). 8/

Only technical coefficients calculated for the processing sector of an I-O model flow table are used in computing the inverse matrix (for example, quadrant II of table 1, shown below).

	A	B	C	D
A	10	20	10	5
B	12	4	6	5
C	3	6	4	10
D	10	5	10	5

8/ Not true for a transposed inverse matrix. In a transposed inverse, the rows of the inverse matrix show total requirements from column industries necessary to support a dollar's worth of sales to final demand by the row industry.

The matrix of technical coefficients is subtracted from an identity matrix to get a Leontief I-O matrix which is inverted to obtain a table of direct and indirect requirements (inverse matrix). The latter is used in assessing the effects of changes in final demand on the economy modeled. Numerical examples appear in footnotes below and on page 11.

Table 2 exhibits the technical coefficients for the processing sector (quadrant II, table 1). These were obtained by dividing each entry in columns A, B, C, and D by the column totals 70, 45, 53, and 60, respectively. This matrix of technical coefficients 9/ was subtracted from an identity matrix 10/ of equal size to obtain the Leontief I-O matrix. 11/ The Leontief I-O matrix was then inverted to obtain the inverse matrix 12/ (table 3). The sum of each column of entries in table 3 will yield the industry output multiplier. In our numerical example, the output multipliers (rounded to two decimal places) for industries A, B, C, and D are 2.14, 2.71, 2.25, and 1.94, respectively.

9/ Also identified as the A matrix.

10/ Often referred to as the I matrix, in this example, it would appear as follows:

Identity or I matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

11/ Also called the (I-A) matrix, in this example, it would appear as follows:

The Leontief I-O matrix or I-A matrix:

$$\begin{bmatrix} .8571 & -.4444 & -.1887 & -.0833 \\ -.1714 & .9111 & -.1132 & -.0833 \\ -.0429 & -.1333 & .9245 & -.1667 \\ -.1429 & -.1111 & -.1887 & .9167 \end{bmatrix}$$

12/ Also identified as the $(I-A)^{-1}$ matrix.

Table 2--I-O technical coefficients

Industry	A	B	C	D
		Coefficients		
A	.1429	.4444	.1887	.0833
B	.1714	.0889	.1132	.0833
C	.0429	.1333	.0755	.1667
D	.1429	.1111	.1887	.0833

Table 3--I-O inverse matrix or direct and indirect requirements

Industry	A	B	C	D
		Coefficients		
A	1.3894	.7749	.4348	.2757
B	.3076	1.3098	.2629	.1948
C	.1606	.2858	1.2023	.2592
D	.2869	.3384	.3471	1.2108
Total 1/	2.1445	2.7089	2.2471	1.9405

1/ Column totals are industry output multipliers.

Mathematical Formulation

A simple mathematical formulation of the flow table and technical and interdependence coefficients tables follow (3, 13).

(1) Flow table. This table defines the interrelationships which exist in an economy during a given time frame and may be expressed mathematically as follows:

$$X_i = \sum_{j=1}^{n} X_{ij} + Y_i$$

where, X_i = the total output, in dollars, of industry i during the base period,

X_{ij} = total sales, in dollars, of industry i to industry j during the base period,

Y_i = amount of final demand, in dollars, for industry i.

where, i and j = rows and columns, respectively, of the flow table.

n = number of rows and columns or size of matrix.

(2) Technical coefficients. Derivation of these coefficients assumes a linear relationship between purchases of an endogenous sector and the level of output of that sector. The equation for calculating these coefficients is:

$$a_{ij} = \frac{X_{ij}}{X_j}$$

which equals the amount of industry i's output necessary to produce one unit of industry j's output,

where, a_{ij} = technical coefficient,

X_{ij} = value of sales from industry i to industry j,

X_j = total output of industry j; (the value of X_j is the same as X_i in equation for flow table above where i = j, i.e., corresponding row and column totals in the processing sector are equal).

Technical coefficients are computed as indicated above for each industry in the processing sector. These computations yield the following matrix of technical coefficients:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

where there are n sectors in the processing sector, and A represents the complete matrix of technical coefficients.

(3) Interdependence coefficients. Calculation of these coefficients yields a table of direct and indirect requirements per dollar of final demand. They are obtained by subtracting the matrix of technical coefficients from an identity matrix of the same order to get the Leontief matrix, (I-A), and then inverting this matrix. The resulting matrix, $(I-A)^{-1}$, is the table of interdependence coefficients which may be expressed as follows:

$$(I-A)^{-1} = \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1n} \\ A_{21} & A_{22} & \cdots & A_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ A_{n1} & A_{n2} & \cdots & A_{nn} \end{bmatrix}$$

where the I-O model contains n processing sectors.

The I-O problem is that of determining the interindustry transactions or output required to sustain a given level of final demand. The solution may be written as follows, using the above:

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

where, X = total output vector of economy,

Y = final demand vector facing economy,

$(I-A)^{-1}$ = matrix of interdependence coefficients.

Using the above formula, 13/ changes in output resulting from changes in final demand can be determined for each sector in the economy (i.e., the solution to the I-O problem).

The flow table, technical coefficients table, and interdependence coefficients table are the basic analytical tools of the I-O model. They can be used in making impact analyses, predictions of economic activity, and in estimating productive requirements resulting from changes in final demand for an

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13/ $X = (I-A)^{-1}\ Y$ is equivalent to $X = AX + Y$, where X and Y equal output and final demand vectors, respectively, A equals a matrix of technical coefficients as defined on page 12, and $(I-A)^{-1}$ equals an inverse matrix or table of interdependence coefficients as defined on this page.

area's goods and services. They have many other uses, including development of coefficients for estimating detailed requirements of factors of production such as labor, capital, and raw material for a given industry. Of course, there are limitations inherent in I-O models that prohibit their unrestricted or unqualified use.

Limitations and Weaknesses of I-O Models

I-O models have several limiting assumptions and weaknesses:

(1) There is the assumption that, in a given I-O model, input purchases of each sector from other sectors remain constant over time. This assumption implies that physical inputs for economic sectors change in the same proportion as the output (i.e., constant production coefficients for each sector). This precludes substitution of one input for another. Assumption of constant coefficients implies that relative prices of all goods and services remain constant. The assumption also implies that the purchasing patterns of firms remain constant (i.e., they do not shift their purchases from local to nonlocal firms or vice versa) (4).

In regional I-O models, assumption of constant prices and purchasing patterns of firms is more critical than for a national model where price fluctuations tend to cancel out and changes in sources of purchases are of no consequence; a different source of purchases will still be in the same supplying sector. I-O critics question the stability of trade coefficients more than the stability of technological coefficients, according to Schaffer (19).

(2) Another limiting assumption is that each sector produces only one product, with one process (i.e., assumption of homogeneity of output and production techniques for each sector in the model). Firms producing the same product will not likely use identical processes and few firms are single product firms. Lack of product and processing conformity of firms within sectors weakens the predictive power of the model and reduces the meaningfulness of sectors. Therefore, sector definition and assignment of firms to sectors is an important activity in constructing the I-O model (4).

(3) Normally, the more aggregated the sectors of an economy (i.e., the fewer the sectors or industrial divisions within a sector), the less meaningful will be the data in each sector and analytical results based on the data. Errors of aggregation can be reduced by giving careful attention to the construction of the I-O model. It may be possible to adjust analytical procedures and data outside of the model to offset problems of aggregation if structural weaknesses are apparent, and data are available for such adjustment. Otherwise, results of the model should be used in light of potential errors and uncertainty present in the model (i.e., results should be qualified as to their restrictive use and validity).

(4) The above discussions were indirectly concerned with data generation for the I-O model. However, since the quantity and quality of data used in structuring the model is critical to its usefulness, data availability deserves special recognition as a limiting factor in using input-output, especially in small areas and regions. The quality of the data used may limit the model's use as a tool for regional economic analysis, and consequently, when a data weakness exists in the model, results and decisions based on the model should be qualified accordingly.

Uses of I-O Models in RC&D and Small Watershed Planning

I-O models, if used in RC&D and small watershed areas, could provide a means for estimating likely effects of project measures prior to installation. This capability would aid in selecting the most efficient measures for economic development and allow for more efficient planning of development programs. I-O analysis can reveal the total impact of a development proposal as well as disclose input requirements and identify development bottlenecks. It might indicate that the area's current resources and economic structure could not support the proposed measure, unless other action is taken along with the main proposal.

An I-O model must be developed specifically for the area under study and with the purpose of the model in mind. The model's sectors must reflect the area's important economic activities, and sectors must be disaggregated sufficiently to provide the sectoral detail necessary for use of the model as a practical economic tool in project evaluation.

Multipliers are the primary products of an I-O model which enable analysts to identify and evaluate project impacts. The most common I-O multipliers are the output, income, and employment multipliers. Since these will be used in this report to illustrate I-O's capability in project analysis, they are defined here.

Output Multiplier

This multiplier measures the total output (direct and indirect) required of the economy to support a one-dollar change in final demand of a given sector. It is derived from an I-O model by summing the interdependence coefficients in columns of the inverse matrix (see, for example, table 7). The sum of each column is the output multiplier for the sector named at the head of the column.

The value of the total change in output of an economy resulting from a change in final demand for a given sector's output can be estimated by multiplying the sector's change in final demand by the output multiplier for that sector. However, this provides only an estimate of the total economic effect.

To appraise the effect of the change on individual sectors of the economy, one must multiply the sector's column of interdependence coefficients by the change in final demand (illustrated in table 12). Each product of the above multiplication will indicate the effect of the given final demand change on that particular sector in terms of output requirements. The sum of these individual sector output changes will equal the total change acquired originally by multiplying the sector output multiplier by the change in final demand. This is because the interdependence coefficients are merely the individual components of the output multiplier.

Income Multiplier

The income multiplier measures the total change in personal income throughout the economy resulting from a one-dollar change in income in a given sector in response to a final demand change. The most common I-O income multipliers are the Type I and the Type II. The basis of the income multipliers is that a certain amount of income is generated with each change in output of the economy. Type I and Type II income multipliers are computed from the direct, indirect, and induced income effects (see below) estimated via an I-O model.

The Type I income multiplier is the ratio of direct and indirect income effects to direct income effects resulting from sectoral changes in final demand. The Type II income multiplier is the ratio of direct, indirect, and induced income effects to the direct income effects per unit change in final demand of a given sector. It is computed for an I-O sector by dividing the household row entry in that sector's column of inverse coefficients by the direct income coefficient for that sector. As noted above, total change in income per unit change in output can be broken down into direct, indirect, and induced income effects.

Direct income represents an estimate of the initial impact on household income per dollar change in output. It is the proportion of each dollar of output which goes to households in the form of wages and salaries, proprietor income, interest, rental income, or other forms of income. The direct income effect for each sector is found in the household row of the technical coefficients matrix (this matrix shows direct purchases per dollar of output), where households are endogenous, or in the household row of the payments sector where households are exogenous.

Indirect income is obtained by subtracting the direct income from the combined direct and indirect income of households. The direct and indirect income effects are the total changes in income resulting from a one-dollar change in final demand in a particular sector. To compute the direct and indirect income effects of a sector, each column entry for that sector in the interdependence coefficients (inverse) matrix is multiplied by the corresponding household row entry of direct income coefficients vector. This multiplication is carried out for each sector in the inverse matrix. The sums of the products of this multiplication represent the direct and indirect income effects of changes in final demand for each column sector in the inverse matrix.

Induced income effects are computed by making households an endogenous sector and calculating interdependence coefficients for the new flow table (with households endogenous). The household row of the new matrix yields the direct, indirect, and induced income effects for each column sector.

Induced income is the direct, indirect, and induced income combined minus the direct and indirect income (computed with households exogenous). The induced income effect results from changes in household purchases of locally produced goods and services as household income changes. It takes into account consumer expenditures, and that a change in household receipts initiates a change in the level of local household expenditures. These household expenditure changes cause output adjustments in the endogenous sectors and further changes in payments to local households in the economy. The somewhat questionable assumption underlying this income estimate is that changes in consumer spending are assumed proportional to changes in income, both in terms of quantity of income spent and expenditure patterns.

Employment Multiplier

The employment multiplier, as computed from an I-O model, is used to estimate changes in employment resulting from changes in final demand for the output of each endogenous sector. Employment multipliers define the change in total employment in the economy resulting from a one-unit change in the employment for a particular sector. The basic assumption underlying the employment multipliers is that, for each endogenous sector, a linear relationship exists between employment and output. There are Type I and Type II employment multipliers, which are similar to the Type I and Type II income multipliers.

The Type I employment multiplier for a sector is computed by dividing the direct and indirect employment effects resulting from a unit (one dollar, for example) change in final demand by the direct employment coefficient. The Type II employment multiplier is computed by dividing the direct, indirect, and induced employment effects resulting from a unit change in final demand by the direct employment coefficient.

The direct employment coefficient is obtained for each sector of the I-O model by dividing total sector employment by total sector output. The direct and indirect employment effects are estimated for each sector by multiplying the inverse matrix, with households exogenous, by a row vector of direct employment coefficients (which is merely a matrix of ratios of employment to output for each sector in the model), and summing the products for each sector (column) in the inverse matrix. Direct, indirect, and induced employment effects are estimated by multiplying the inverse matrix, with households endogenous, by a row vector of direct employment coefficients, and summing the products for each column in the inverse matrix.

The Moore-Petersen method of computing employment multipliers is commonly used in regional I-O models (13). They are based on employment production functions which are computed for each industry in the table. The employment production function measures the relationship between total employment (in man-years) in each industry and the gross output of that industry expressed in dollars of output. This relationship approximates the rate of change in employment as output changes (the direct employment coefficient). It is used to estimate the direct change in employment of a sector as final demand changes.

The direct employment coefficient of a sector multiplied by that sector's change in final demand provides an estimate of direct employment effects resulting from the final demand change. This estimate multiplied by that sector's employment multiplier equals total estimated employment changes in the economy due to the given change in final demand.

The total effect of a change in final demand on employment within the economy being modeled can be broken down into three components: direct employment changes which result from a specific sector's response to a change in its final demand; indirect employment changes which result from endogenous output adjustments required to directly and indirectly support a change in final demand of a given sector; and induced employment changes arising from a change in the level of local household consumption expenditures.

THE NORTHWEST LOUISIANA I-O MODEL

The 9-parish study area covers about 4,718,000 acres; 72 percent is in woodland and 22 percent is in crops and pasture. Agriculture, forestry, and mineral production are the main sources of economic activity. Major agricultural enterprises are poultry and eggs, meat animals, dairy products, cotton, and soybeans. Timber production supports a significant portion of the economy's industrial activity, characterized by many logging operations, saw mills, wood chip mills, plywood plants, and paper mills. Mineral production consists mostly of oil and gas production.

The Shreveport metropolitan area is the major trade center in the area. In 1971, there were about 453,500 people living in the study area. Aggregate annual personal income of the population, at that time, was estimated at $1,362.2 million. There were an estimated 152,040 people employed in the various economic pursuits of the area in 1971. Of these, 30,314 are government employees, including military personnel.

The economy is diversified and complex as illustrated by the distribution of employment (table 4). Economic activity varies from small-farm operations to large manufacturing plants that process both locally produced products and products from other parts of the Nation. Local firms trade with each other, sell goods to local consumers, and export products to the rest of the State and to other areas in the United States. The study area I-O model helps identify and measure these economic relationships and linkages the various sectors of the local economy have with each other and with businesses outside the area. This I-O capability makes it a valuable technique in analyzing the economic structure of an area and in appraising various alternatives proposed for its development.

The import-export relationships of the economic sectors of an economy can affect the size and extent of project impacts, especially in small areas. Consequently, assessment of local import-export patterns is important in building I-O models for use in small area planning activities. The northwest Louisiana I-O model was adjusted for local import-export conditions using nonsurvey techniques and secondary data. However, three sectors of the model (forestry, lumber and wood products, and paper and allied products) were adjusted for imports and exports using primary data.

The study area I-O model has 38 processing (endogenous) sectors (see table 4); 5 final demand (exogenous) sectors (net inventory change, private capital formation, Federal Government purchases, State and local government purchases, and exports); and 2 final payments (exogenous) sectors (other value added and imports). Industry delineation in the model emphasized detail in the agriculture sector to which a majority of the project proposals in the RC&D and small watershed programs will relate. Twelve of the model's 38 processing sectors are agricultural sectors. Ten of the agricultural sectors are at the 4-digit SIC code level and two, agricultural services and forestry, are at the 2-digit SIC code level. Appendix A provides a detailed description of each sector in the model.

Table 4--Employment by economic sector in the Twin Valley and Trailblazer-4 RC&D areas, 1971 1/

Sector	Employment	Proportion of total
	Number	Percent
(1) Cotton	739	.59
(2) Grains	38	.03
(3) Other field crops	70	.06
(4) Fruits and tree nuts	105	.08
(5) Vegetables	36	.03
(6) Dairy products	689	.55
(7) Poultry and eggs	640	.51
(8) Meat animals and miscellaneous livestock	557	.45
(9) Horticultural specialties	9	.01
(10) Fisheries	51	.04
(11) Agricultural services	260	.21
(12) Forestry	152	.12
(13) Mining	4,469	3.58
(14) New construction	6,434	5.15
(15) Maintenance and repair construction	1,237	1.00
(16) Food and kindred products	2,951	2.36
(17) Apparel and other textile products	693	.55
(18) Lumber and wood products (except furniture)	2,626	2.10
(19) Paper and allied products	2,757	2.21
(20) Printing and publishing	1,570	1.26
(21) Chemicals and allied products	570	.46
(22) Stone, clay, glass, concrete, and metal	738	.59
(23) Primary metal industries	1,095	.88
(24) Fabricated metal products	2,126	1.70
(25) Machinery (except electric)	2,669	2.14
(26) Other manufacturing	11,070	8.86
(27) Transportation and warehousing	6,733	5.39
(28) Communication (except broadcasting)	1,744	1.40
(29) Radio and television	390	.31
(30) Utilities (electricity, gas, water, and sewage)	4,855	3.88
(31) Eating and drinking places	3,455	2.76
(32) Wholesale and retail trade (except eating and drinking places)	28,665	23.83
(33) Finance, insurance, and real estate	6,285	5.03
(34) Lodging places	965	.77
(35) Services (except lodging places)	16,287	13.03
(36) State and local government enterprises	450	.36
(37) Federal government enterprises	1,557	1.26
(38) Households	7,996 2/	6.46
Total	123,733	100.00

1/ Government employees (except those in government enterprises), including military, are not included. These were treated as an exogenous sector.
2/ Private household workers.

Sector delineation was based on the importance of the various economic sectors to the economy as ascertained by employment and sales data from secondary sources, such as County Business Patterns' employment and sales data for the area (25) and the Louisiana Directory of Manufacturers' listing of industrial firms by county in the study area (11). Annual employment and sales by industry were the major criteria used in evaluating an industry's importance to the local economy. Also, a special effort was made to sector the model of the economy so that it could be used to evaluate the project effects of RC&D and small watershed plans. The basic data sources, methodology, and techniques used in developing the study area model are presented in the appendices.

The transactions or flow table (table 5) shows the interindustry flow of goods and services among economic sectors of northwest Louisiana. It shows the estimated sales and purchase patterns of each sector in the economy (to whom sectors sell goods and services and from whom they buy goods and services). It is similar to the simple hypothetical flow table (table 1). The direct requirements table shows the direct purchases of each processing sector from each other per dollar of output (table 6). Each column shows the value of inputs that the sector named at the top of the column required directly from each of the sectors named at the beginning of the rows to produce a dollar of its output. This table is similar to table 2, except that it is much larger. The direct and indirect requirements table shows the total effects (direct, indirect, and induced) on the 9-parish economy resulting from changes in the final demand sales of endogenous sectors (table 7). Each column of table 7 shows the output required both directly and indirectly from the sector named at the beginning of each row for each dollar of delivery to final demand by the sector named at the head of the column. Coefficients in table 7 can be used to estimate the impact of changes in final demand on the local economy as a whole, and on the various sectors within the local economy. Table 7 is similar to the simple inverse matrix table (table 3).

Table 8 shows the set of economic multipliers computed from the study area I-O model that can be used to estimate impacts on output, employment, and personal income in the study area as a result of RC&D and small watershed planning measures.

Table 5--Interindustry transactions, Twin Valley and Trailblazer-4 RC&D areas, 1971

Sector 1/	Sector 1/									
	1	2	3	4	5	6	7	8	9	10
	Dollars 2/									
1	48812	0	0	0	0	0	0	0	0	0
2	0	3723	0	0	0	322535	174310	389118	0	0
3	0	0	23042	0	0	0	0	13369	0	0
4	0	0	0	442	0	0	0	0	0	0
5	0	0	0	0	711	0	0	2554	0	0
6	60893	21653	18166	4404	3711	0	0	83096	1300	0
7	27118	6011	7421	5600	1136	0	0	0	600	0
8	197489	47439	77335	4692	5814	0	0	2828025	907	29822
9	0	0	0	328	0	0	0	0	274	2307
10	0	0	0	0	0	0	0	0	0	4281
11	896443	42555	37367	49612	9229	102337	1501212	0	1215	32775
12	0	0	0	0	0	0	0	0	0	57599
13	27118	9017	2734	2799	1079	0	2848	0	228	0
14	0	0	0	0	0	0	0	0	0	0
15	59976	12766	9077	5811	1371	61620	56299	66562	659	0
16	0	0	0	0	192	1216753	5904152	1287699	0	18985
17	177	688	29	20	6	3526	326	414	58	6263
18	35	7	5	3	1	50	64	82	0	0
19	0	0	0	0	0	597	7739	0	72	28
20	2337	358	196	396	42	2490	1074	2730	64	116
21	208618	50687	29927	17797	5341	44960	87500	55851	1575	5361
22	1490	456	249	167	54	8468	0	1740	1264	222
23	0	0	0	0	0	0	0	0	0	0
24	7747	3480	1562	787	255	66024	29910	10857	128	15073
25	8755	3404	2662	376	173	592	255	973	105	55
26	5412	1596	1212	475	154	4270	1105	4213	88	13981
27	72056	20724	9504	10850	2555	417051	290557	327537	1615	19479
28	21694	4904	3124	2625	709	33012	28486	28953	800	0
29	0	0	0	0	0	0	0	0	0	0
30	75155	13130	4426	4987	2158	60521	86882	43430	1144	77
31	8522	1740	1041	874	170	8803	22788	10857	42	463
32	203772	49516	30466	32025	8406	318015	712150	522974	4976	24426
33	898928	129691	93517	10923	10636	200570	142250	239470	1391	1221
34	0	0	0	0	0	0	0	0	0	0
35	230890	73721	58329	18112	5651	280601	47001	247915	4833	3323
36	0	0	0	22	0	0	0	0	3	39
37	774	316	260	87	28	1100	2848	1809	28	154
38	2584334	606663	501047	461634	131940	2089422	1753999	2074647	86049	139999
Subtotal 3/	5648545	1104245	912698	635848	191522	5243317	10853755	8244875	109418	376049
Imports	1089738	271593	219626	125139	55472	4326644	2666167	7492858	14948	327419
O.V.A. 4/	1009717	206162	169676	114013	37006	1434039	723078	2358267	18634	69532
Total	7748000	1582000	1302000	875000	284000	11004000	14243000	18096000	143000	773000

See footnotes at end of table.

Continued

Table 5--Interindustry transactions, Twin Valley and Trailblazer-4 RC&D areas, 1971
--Continued

Sector 1/	11	12	13	14	15	16	17	18	19	20
					Dollars 2/					
1	235150	0	0	0	0	657068	833622	0	0	0
2	65760	0	0	2401	0	437745	0	0	0	0
3	51765	0	0	0	0	1084889	0	0	0	0
4	67936	0	0	0	0	461196	0	0	0	0
5	17837	0	0	1134	0	105655	85	0	0	0
6	0	0	0	0	0	10105785	0	0	0	0
7	654069	0	0	0	0	4088425	0	0	0	0
8	0	708552	0	0	0	13040992	80701	0	0	0
9	1029	54838	0	33147	0	0	0	26241	0	0
10	0	101763	0	0	0	192148	0	475084	0	0
11	0	778718	0	0	0	0	0	0	0	0
12	0	1368519	0	0	0	2584032	0	16570662	0	0
13	0	0	4379788	1173336	430557	36503	0	0	426941	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	2680778	26472	7216	180365	14570	72673	195326	25319
16	113261	451090	0	62414	3190	40399040	31621	0	736842	23879
17	31825	148820	8532	44149	752	16711	995501	0	146590	11260
18	0	0	0	396383	54584	830	0	816150	227716	2238
19	53431	665	20254	93159	21430	846306	20758	38314	6596684	875456
20	0	2770	0	0	0	757299	1820	3122	679950	3801712
21	4442	127406	1347683	1526053	776754	702824	426248	244129	2039340	291926
22	0	5300	1434469	12432879	619772	1738438	0	178802	330886	0
23	0	0	605113	5479499	562660	0	0	146509	148769	11343
24	449748	358136	465934	16699953	1097757	4690738	6032	699585	1043635	46120
25	0	1317	501476	544923	125578	19643	15364	37121	76584	12685
26	0	332199	1186392	4766423	918526	42506	35587	93182	487945	236301
27	87048	462823	4398426	5255903	815101	5420814	188198	1279125	3961072	322843
28	0	0	149099	433973	131468	438045	27747	107628	367644	338216
29	0	0	0	0	0	0	0	0	0	0
30	3022	1836	2963346	498266	147901	1095114	103750	306327	1885660	150660
31	1813	11019	37274	514339	124894	18251	1206	4139	11859	15373
32	142057	580365	2609235	12858477	2701667	5785852	423446	985216	3249502	639537
33	133325	29041	25159872	1444761	407585	1412744	96390	502754	1115366	1479119
34	0	0	0	0	0	0	0	0	0	0
35	3022	78973	2553323	7972257	673773	6004875	135116	633352	2063553	1054622
36	0	946	19211	16567	4234	14110	310	2133	9168	2376
37	1208	3673	93187	48219	13146	127763	12063	20697	94876	319768
38	1438688	2584091	74309579	54399993	16760003	31367200	2760663	13018000	30999995	7400000
Subtotal 3/	3556436	8192860	124922971	126725080	26398548	133873906	6210798	36260945	56895903	17060753
Imports	1700785	7779687	31099803	16179243	3506032	33526224	5307836	11390398	16339909	3082051
O.V.A. 4/	787779	2393453	30351226	17826677	2962420	15118870	545366	6588657	45359188	10604196
Total	6045000	18366000	186374000	160731000	32867000	182519000	12064000	54240000	118595000	30747000

See footnotes at end of table.

Continued

Table 5--Interindustry transactions, Twin Valley and Trailblazer-4 RC&D areas, 1971
--Continued

Sector 1/	21	22	23	24	25	26	27	28	29	30
	Dollars 2/									
1	0	16880	0	0	0	26793	0	0	0	0
2	0	0	0	0	0	0	15962	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	2570	0	0	0
5	878	0	0	0	0	3782	754	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	10682	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	4596	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	61835	0	0	0	0	0	0	0	0	0
13	6335981	1876146	114332	7444	27329	26793	64091	0	0	13616718
14	0	0	0	0	0	0	0	0	0	0
15	170847	63547	175091	57219	67517	205937	1724146	857158	0	3413521
16	378643	4682	11683	14454	13265	130056	342211	0	0	0
17	80730	17663	8264	35785	6255	263722	9780	0	0	4744
18	2454	3072	3559	17275	9326	42669	486	0	0	943
19	135277	112690	14168	175292	53213	674572	9673	6921	114	30031
20	15650	1819	4539	235878	10308	343621	96701	4118	1915	15634
21	3034539	355134	419209	682752	461921	3520541	1422388	121954	1679	584851
22	151695	2647213	98419	193384	295801	747563	10276	0	0	0
23	263312	165488	15066038	15793500	4300523	16331029	267996	20141	0	382336
24	531110	183273	607767	5747230	1803753	8172108	267049	0	0	0
25	27538	40661	87432	353883	1983014	1369787	44070	979	0	3717
26	177160	125426	868877	2300138	5113047	37689648	389743	550926	18726	144802
27	1157654	1331147	2148247	1101800	737899	2598998	9229245	65509	3174	3979315
28	120329	113340	192559	312673	314290	1420071	1004107	398514	281851	559591
29	0	0	0	0	0	0	0	0	35548	0
30	730276	839202	1341902	580678	505597	1607628	672965	589582	62845	38715421
31	8298	7234	6017	22333	20497	80381	74773	16377	4443	20725
32	1074668	581171	1594637	2054709	2186368	8975923	2755956	485859	69193	1139907
33	611252	291023	445736	1022346	870036	3188916	3476179	1231297	173821	2225202
34	0	0	0	0	0	0	0	0	0	0
35	1659719	595640	728117	1488919	1332317	7743408	3674608	1446661	1929157	3813510
36	2138	6835	3101	1918	1760	6904	222981	7033	327	3797590
37	37343	21703	30087	67001	88821	428700	245686	262036	8252	559591
38	9881817	9547325	14209481	22413535	20507166	96890320	49573131	32797155	1978773	45519327
Subtotal 3/	26655739	18948314	38179262	54680146	40710023	192489870	75608209	38862220	4569818	118527476
Imports	9832865	2422358	16661644	13106484	18994315	50018186	16116635	2248168	210620	37231419
O.V.A. 4/	5004396	2744328	5334094	6659370	8619662	25429944	15095156	13480612	1567562	51497105
Total	41493000	24115000	60175000	74446000	68324000	267938000	106820000	54591000	6348000	207256000

See footnotes at end of table

Continued

Table 5--Interindustry transactions, Twin Valley and Trailblazer-4 RC&D areas, 1971
--Continued

Sector 1/	Sector 1/ 31	32	33	34	35	36	37	38
	Dollars 2/							
1	0	0	575230	0	0	0	0	0
2	0	0	167389	0	0	43	0	223
3	0	0	111836	0	0	0	0	3887
4	0	0	43714	0	6484	0	0	242344
5	0	0	25647	0	3804	0	0	120001
6	0	0	507968	0	0	0	0	132659
7	0	0	333028	0	26946	0	0	1157264
8	0	0	890410	0	31079	0	0	51600
9	0	0	5428	0	0	51	0	19074
10	0	0	0	0	0	0	0	4750
11	0	571867	30275	0	0	575	0	0
12	0	0	0	0	0	0	0	429281
13	0	38124	242202	0	0	47774	0	59386
14	0	0	0	0	0	0	0	0
15	90112	669774	10338396	165577	1242683	773897	45813	0
16	7411	2331699	235129	0	784795	0	0	122867472
17	0	43633	13860	3672	37008	0	7394	9851265
18	0	13877	2755	0	0	0	0	29729
19	94029	773395	109672	2711	107376	3648	12676	593742
20	25916	575217	753701	10488	15307340	434	60921	6221928
21	123424	2005971	738642	54072	1718836	39591	45893	11586866
22	11016	440150	58255	0	362953	18827	5179	1056266
23	0	196925	67019	0	19884	0	1985	46320
24	34354	876863	181651	0	727563	0	8075	266785
25	2738	212001	86892	0	406032	206	482	830673
26	44448	1686974	282032	14943	5146025	13851	12537	40593200
27	87795	2973711	908259	129409	943138	25902	3004159	29269266
28	301558	4041197	2633950	175397	3880339	24175	43070	18962241
29	0	0	30275	0	6009136	0	0	0
30	851235	6443040	1998169	236359	4554008	322911	234195	34523939
31	7634	152498	211927	9625	242521	575	8075	23772880
32	366451	6824285	4026615	201066	7949306	29931	169589	236804952
33	2506655	21703664	28297008	942648	14443288	133179	625080	180146096
34	0	0	59333	0	3772	0	0	2345970
35	1893331	22684078	12927553	1084473	18647180	253263	632596	141708207
36	55088	353701	483739	2755	138888	593	2774	419191
37	519139	3659951	2512849	48127	2640785	3453	8075	2193407
38	26703615	237000037	166306089	4780094	131907987	1801999	8765002	23988341
Subtotal 3/	33725949	316272632	236196897	7861416	217289156	3494878	13693570	890299710
Imports	1266616	19299391	25877125	843560	26343457	796475	1930490	107419085
O.V.A. 4/	3179435	45672977	40678978	1990024	25835387	1464647	11294940	364481205
Total	38172000	381245000	302753000	10695000	269468000	5756000	26919000	1362200000

See footnotes at end of table

Continued

Table 5--Interindustry transactions, Twin Valley and Trailblazer-4 RC&D areas, 1971
--Continued

Sector 1/	Total intermediate sales	Net inventory change	Capital accumulation	Federal Government purchases	State/local government purchases	Exports	Total output
				Dollars 2/			
1	2393555	839501	0	-157047	278308	4393682	7748000
2	1579209	932	0	-2406	4257	0	1582000
3	1288788	6367	0	-8874	15715	0	1302000
4	824686	47030	0	-4239	7518	0	875000
5	282842	829	0	-408	728	0	284000
6	10939635	34463	0	18230	11667	0	11004000
7	6318300	115469	0	26702	17067	7765459	14243000
8	17994857	69148	0	19525	12461	0	18096000
9	142717	174	0	-128	227	0	143000
10	782622	3636	0	-13573	302	0	773000
11	4054180	184533	0	12249	-189530	1983567	6045000
12	21071928	1192249	0	-4371131	105630	367319	18366000
13	28949268	1594907	0	-19955	40954	155808826	186374000
14	0	0	131683936	1119682	27927328	0	160731000
15	23538095	0	0	1515497	7813364	0	32867000
16	177370618	11987	0	2991096	2145210	0	182519000
17	11799422	18905	38512	56214	150928	0	12064000
18	1624293	2039	0	74	784	52612800	54240000
19	11484093	228017	0	51780	95616	106735488	118595000
20	28942604	189283	0	11683	1603419	0	30747000
21	34912685	202506	6652	4534328	1836772	0	41493000
22	22851653	1011184	0	26932	225194	0	24115000
23	59876389	269312	0	16734	12521	0	60175000
24	45101042	818957	23914258	288010	0	4323731	74446000
25	6802146	421651	60526560	192768	380718	0	68324000
26	103304070	3260859	155577392	3683672	2111842	0	267938000
27	83057908	327268	5551521	10866117	3601472	3415702	106820000
28	36897379	0	3469847	819331	1635608	11768826	54591000
29	6074959	0	0	0	83198	189844	6348000
30	102257744	0	0	431556	3821316	100745399	207256000
31	25462280	52373	4002609	189420	70719	8394598	38172000
32	309172666	523469	39928386	1887432	704688	29028384	381245000
33	295842980	0	2485422	603124	3821026	0	302753000
34	2409075	0	0	146793	117879	8021250	10695000
35	246385979	31820	0	8866920	7120175	7063117	269468000
36	5576435	0	0	155696	23838	0	5756000
37	14077010	0	0	208561	841889	11791543	26919000
38	1150039053	0	0	75354000	107674000	29132947	1362200000

1/ Sector numbers correspond to those listed in table 4.
2/ At producers' prices.
3/ Total intermediate inputs.
4/ Other value added which is total value added less household income.

Table 6--Direct requirements per dollar of gross output, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971

Sector 1/	Sector 1/ 1	2	3	4	5	6	7	8	9	10
					Coefficient					
1	0.00630	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.00235	0.0	0.0	0.0	0.02931	0.01224	0.02150	0.0	0.0
3	0.0	0.0	0.01770	0.0	0.0	0.0	0.0	0.00074	0.0	0.0
4	0.0	0.0	0.0	0.00051	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.00250	0.0	0.0	0.00014	0.0	0.0
6	0.00786	0.01369	0.01395	0.00503	0.01307	0.0	0.0	0.00459	0.00909	0.0
7	0.00350	0.00380	0.00570	0.00640	0.00400	0.0	0.0	0.0	0.00420	0.0
8	0.02549	0.02999	0.05940	0.00536	0.02047	0.0	0.0	0.15628	0.00634	0.03858
9	0.0	0.0	0.0	0.00037	0.0	0.0	0.0	0.0	0.00192	0.00298
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00554
11	0.11570	0.02690	0.02870	0.05670	0.03250	0.00930	0.10540	0.0	0.00850	0.04240
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.07451
13	0.00350	0.00570	0.00210	0.00320	0.00380	0.0	0.00020	0.0	0.00159	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.00774	0.00807	0.00697	0.00664	0.00483	0.00560	0.00395	0.00368	0.00461	0.0
16	0.0	0.0	0.0	0.0	0.00068	0.11057	0.41453	0.07116	0.0	0.02456
17	0.00002	0.00043	0.00002	0.00002	0.00002	0.00032	0.00002	0.00002	0.00041	0.00810
18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.00005	0.00054	0.0	0.00050	0.00004
20	0.00030	0.00023	0.00015	0.00045	0.00015	0.00023	0.00008	0.00015	0.00045	0.00015
21	0.02693	0.03204	0.02299	0.02034	0.01881	0.00409	0.00614	0.00309	0.01101	0.00694
22	0.00019	0.00029	0.00019	0.00019	0.00019	0.00077	0.0	0.00010	0.00884	0.00029
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.00100	0.00220	0.00120	0.00090	0.00090	0.00600	0.00210	0.00060	0.00090	0.01950
25	0.00113	0.00215	0.00204	0.00043	0.00061	0.00005	0.00002	0.00005	0.00073	0.00007
26	0.00070	0.00101	0.00093	0.00054	0.00054	0.00039	0.00008	0.00023	0.00062	0.01809
27	0.00930	0.01310	0.00730	0.01240	0.00900	0.03790	0.02040	0.01810	0.01129	0.02520
28	0.00280	0.00310	0.00240	0.00300	0.00250	0.00300	0.00200	0.00160	0.00559	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.00970	0.00830	0.00340	0.00570	0.00760	0.00550	0.00610	0.00240	0.00800	0.00010
31	0.00110	0.00110	0.00080	0.00100	0.00060	0.00080	0.00160	0.00060	0.00029	0.00060
32	0.02630	0.03130	0.02340	0.03660	0.02960	0.02890	0.05000	0.02890	0.03480	0.03160
33	0.11602	0.08198	0.07183	0.01248	0.03745	0.01823	0.00999	0.01323	0.00973	0.00158
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.02980	0.04660	0.04480	0.02070	0.01990	0.02550	0.00330	0.01370	0.03380	0.00430
36	0.0	0.0	0.0	0.00003	0.0	0.0	0.0	0.0	0.00002	0.00005
37	0.00010	0.00020	0.00020	0.00010	0.00010	0.00010	0.00020	0.00010	0.00020	0.00020
38	0.33355	0.38348	0.38483	0.52758	0.46458	0.18988	0.12315	0.11465	0.60174	0.18111

See footnote at end of table.

Continued

Table 6--Direct requirements per dollar of gross output, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971--Continued

Sector 1/	Sector 1/ 11	12	13	14	15	16	17	18	19	20
	Coefficient									
1	0.03890	0.0	0.0	0.0	0.0	0.00360	0.06910	0.0	0.0	0.0
2	0.01088	0.0	0.0	0.00001	0.0	0.00240	0.0	0.0	0.0	0.0
3	0.00856	0.0	0.0	0.0	0.0	0.00594	0.0	0.0	0.0	0.0
4	0.01124	0.0	0.0	0.0	0.0	0.00253	0.0	0.0	0.0	0.0
5	0.00295	0.0	0.0	0.00001	0.0	0.00058	0.00001	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.05537	0.0	0.0	0.0	0.0
7	0.10820	0.0	0.0	0.0	0.0	0.02240	0.0	0.0	0.0	0.0
8	0.0	0.03858	0.0	0.0	0.0	0.07145	0.00669	0.0	0.0	0.0
9	0.00017	0.00299	0.0	0.00021	0.0	0.0	0.0	0.00048	0.0	0.0
10	0.0	0.00554	0.0	0.0	0.0	0.00105	0.0	0.00876	0.0	0.0
11	0.0	0.04240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.07451	0.0	0.0	0.0	0.01416	0.0	0.30551	0.0	0.0
13	0.0	0.0	0.02350	0.00730	0.01310	0.00020	0.0	0.0	0.00360	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.01438	0.00016	0.00022	0.00099	0.00121	0.00134	0.00165	0.00082
16	0.01874	0.02456	0.0	0.00039	0.00010	0.22134	0.00262	0.0	0.00621	0.00078
17	0.00526	0.00810	0.00005	0.00027	0.00002	0.00009	0.08252	0.0	0.00124	0.00037
18	0.0	0.0	0.0	0.00247	0.00166	0.00000	0.0	0.01505	0.00192	0.00007
19	0.00884	0.00004	0.00011	0.00058	0.00065	0.00464	0.00172	0.00071	0.05562	0.02847
20	0.0	0.00015	0.0	0.0	0.0	0.00415	0.00015	0.00006	0.00573	0.12364
21	0.00073	0.00694	0.00723	0.00949	0.02363	0.00385	0.03533	0.00450	0.01720	0.00949
22	0.0	0.00029	0.00770	0.07735	0.01886	0.00952	0.0	0.00330	0.00279	0.0
23	0.0	0.0	0.00325	0.03409	0.01712	0.0	0.0	0.00270	0.00125	0.00037
24	0.07440	0.01950	0.00250	0.10390	0.03340	0.02570	0.00050	0.01290	0.00880	0.00150
25	0.0	0.00007	0.00269	0.00339	0.00382	0.00011	0.00127	0.00068	0.00065	0.00041
26	0.0	0.01809	0.00637	0.02965	0.02795	0.00023	0.00295	0.00172	0.00411	0.00769
27	0.01440	0.02520	0.02360	0.03270	0.02480	0.02970	0.01560	0.02358	0.03340	0.01050
28	0.0	0.0	0.00080	0.00270	0.00400	0.00240	0.00230	0.00198	0.00310	0.01100
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.00050	0.00010	0.01590	0.00310	0.00450	0.00600	0.00860	0.00565	0.01590	0.00490
31	0.00030	0.00060	0.00020	0.00320	0.00380	0.00010	0.00010	0.00008	0.00010	0.00050
32	0.02350	0.03160	0.01400	0.08000	0.08220	0.03170	0.03510	0.01816	0.02740	0.02080
33	0.02206	0.00158	0.13500	0.00899	0.01240	0.00774	0.00799	0.00927	0.00940	0.04811
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.00050	0.00430	0.01370	0.04960	0.02050	0.03290	0.01120	0.01168	0.01740	0.03430
36	0.0	0.00005	0.00010	0.00010	0.00013	0.00008	0.00003	0.00004	0.00008	0.00008
37	0.00020	0.00020	0.00050	0.00030	0.00040	0.00070	0.00100	0.00038	0.00080	0.01040
38	0.23800	0.14070	0.39871	0.33845	0.50993	0.17186	0.22883	0.24001	0.26139	0.24067

See footnote at end of table.

Continued

Table 6--Direct requirements per dollar of gross output, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971--Continued

Sector 1/	Sector 1/									
	21	22	23	24	25	26	27	28	29	30
	Coefficient									
1	0.0	0.00070	0.0	0.0	0.0	0.00010	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.00015	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.0	0.0	0.0
5	0.00002	0.0	0.0	0.0	0.0	0.00001	0.00001	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.00010	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.00011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.00149	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.15270	0.07780	0.00190	0.00010	0.00040	0.00010	0.00060	0.0	0.0	0.06570
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.00412	0.00264	0.00291	0.00077	0.00099	0.00077	0.01614	0.01570	0.0	0.01647
16	0.00913	0.00019	0.00019	0.00019	0.00019	0.00049	0.00320	0.0	0.0	0.0
17	0.00195	0.00073	0.00014	0.00048	0.00009	0.00098	0.00009	0.0	0.0	0.00002
18	0.00006	0.00013	0.00006	0.00023	0.00014	0.00016	0.00000	0.0	0.0	0.00000
19	0.00326	0.00467	0.00024	0.00235	0.00078	0.00252	0.00009	0.00013	0.00002	0.00014
20	0.00038	0.00008	0.00008	0.00317	0.00015	0.00128	0.00091	0.00008	0.00030	0.00008
21	0.07313	0.01473	0.00697	0.00917	0.00676	0.01314	0.01332	0.00223	0.00026	0.00282
22	0.00366	0.10977	0.00164	0.00260	0.00433	0.00279	0.00010	0.0	0.0	0.0
23	0.00635	0.00686	0.25037	0.21215	0.06294	0.06095	0.00251	0.00037	0.0	0.00184
24	0.01280	0.00760	0.01010	0.07720	0.02640	0.03050	0.00250	0.0	0.0	0.0
25	0.00066	0.00169	0.00145	0.00475	0.02902	0.00511	0.00041	0.00002	0.0	0.00002
26	0.00427	0.00520	0.01444	0.03090	0.07484	0.14067	0.00365	0.01009	0.00295	0.00070
27	0.02790	0.05520	0.03570	0.01480	0.01080	0.00970	0.08640	0.00120	0.00050	0.01920
28	0.00290	0.00470	0.00320	0.00420	0.00460	0.00530	0.00940	0.00730	0.04440	0.00270
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00560	0.0
30	0.01760	0.03480	0.02230	0.00780	0.00740	0.00600	0.00630	0.01080	0.00990	0.18680
31	0.00020	0.00030	0.00010	0.00030	0.00030	0.00030	0.00070	0.00030	0.00070	0.00010
32	0.02590	0.02410	0.02650	0.02760	0.03200	0.03350	0.02580	0.00890	0.01090	0.00550
33	0.01473	0.01207	0.00741	0.01373	0.01273	0.01190	0.03254	0.02255	0.02738	0.01074
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.04000	0.02470	0.01210	0.02000	0.01950	0.02890	0.03440	0.02650	0.30390	0.01840
36	0.00005	0.00028	0.00005	0.00003	0.00003	0.00003	0.00209	0.00013	0.00005	0.01832
37	0.00090	0.00090	0.00050	0.00090	0.00130	0.00160	0.00230	0.00480	0.00130	0.00270
38	0.23816	0.39591	0.23614	0.30107	0.30015	0.36161	0.46408	0.60078	0.31172	0.21963

See footnote at end of table.

Continued

Table 6--Direct requirements per dollar of gross output, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971--Continued

Sector 1/	Sector 1/							
	31	32	33	34	35	36	37	38
	Coefficient							
1	0.0	0.0	0.00190	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.00055	0.0	0.0	0.00001	0.0	0.00000
3	0.0	0.0	0.00037	0.0	0.0	0.0	0.0	0.00000
4	0.0	0.0	0.00014	0.0	0.00002	0.0	0.0	0.00018
5	0.0	0.0	0.00008	0.0	0.00001	0.0	0.0	0.00009
6	0.0	0.0	0.00168	0.0	0.0	0.0	0.0	0.00010
7	0.0	0.0	0.00110	0.0	0.00010	0.0	0.0	0.00085
8	0.0	0.0	0.00294	0.0	0.00012	0.0	0.0	0.00004
9	0.0	0.0	0.00002	0.0	0.0	0.00001	0.0	0.00001
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000
11	0.0	0.00150	0.00010	0.0	0.0	0.00010	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00032
13	0.0	0.00010	0.00080	0.0	0.0	0.00830	0.0	0.00004
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.00236	0.00176	0.03415	0.01548	0.00461	0.13445	0.00170	0.0
16	0.00019	0.00612	0.00078	0.0	0.00291	0.0	0.0	0.09020
17	0.0	0.00011	0.00005	0.00034	0.00014	0.0	0.00027	0.00723
18	0.0	0.00004	0.00001	0.0	0.0	0.0	0.0	0.00002
19	0.00246	0.00203	0.00036	0.00025	0.00040	0.00063	0.00047	0.00044
20	0.00068	0.00151	0.00249	0.00098	0.05681	0.00008	0.00226	0.00457
21	0.00323	0.00526	0.00244	0.00506	0.00638	0.00688	0.00170	0.00851
22	0.00029	0.00115	0.00019	0.0	0.00135	0.00327	0.00019	0.00078
23	0.0	0.00052	0.00022	0.0	0.00007	0.0	0.00007	0.00003
24	0.00090	0.00230	0.00060	0.0	0.00270	0.0	0.00030	0.00020
25	0.00007	0.00056	0.00029	0.0	0.00151	0.00004	0.00002	0.00061
26	0.00116	0.00442	0.00093	0.00140	0.01910	0.00241	0.00047	0.02980
27	0.00230	0.00780	0.00300	0.01210	0.00350	0.00450	0.11160	0.02149
28	0.00790	0.01060	0.00870	0.01640	0.01440	0.00420	0.00160	0.01392
29	0.0	0.0	0.00010	0.0	0.02230	0.0	0.0	0.0
30	0.02230	0.01690	0.00660	0.02210	0.01690	0.05610	0.00870	0.02534
31	0.00020	0.00040	0.00070	0.00090	0.00090	0.00010	0.00030	0.01745
32	0.00960	0.01790	0.01330	0.01880	0.02950	0.00520	0.00630	0.17384
33	0.06567	0.05693	0.09347	0.08814	0.05360	0.02314	0.02322	0.13225
34	0.0	0.0	0.00020	0.0	0.00001	0.0	0.0	0.00172
35	0.04960	0.05950	0.04270	0.10140	0.06920	0.04400	0.02350	0.10403
36	0.00144	0.00093	0.00160	0.00026	0.00052	0.00010	0.00010	0.00031
37	0.01360	0.00960	0.00830	0.00450	0.00980	0.00060	0.00030	0.00161
38	0.69956	0.62165	0.54931	0.44695	0.48951	0.31306	0.32561	0.01761

1/ Sector numbers correspond to those listed in table 4.

Table 7--Direct and indirect requirements per dollar of delivery to final demand, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971

Sector 1/	Sector 1/ 1	2	3	4	5	6	7	8	9	10
	Coefficient									
1	1.01274	0.00277	0.00281	0.00396	0.00289	0.00192	0.00750	0.00116	0.00217	0.00350
2	0.00350	1.00498	0.00348	0.00219	0.00241	0.03106	0.01780	0.02689	0.00177	0.00246
3	0.00202	0.00120	1.01927	0.00151	0.00124	0.00152	0.00500	0.00198	0.00114	0.00118
4	0.00192	0.00088	0.00091	1.00179	0.00095	0.00083	0.00305	0.00055	0.00077	0.00094
5	0.00056	0.00029	0.00030	0.00039	1.00281	0.00024	0.00080	0.00032	0.00026	0.00028
6	0.01636	0.02188	0.02267	0.01385	0.02131	1.01318	0.03694	0.01548	0.01840	0.00683
7	0.02081	0.01113	0.01343	0.01743	0.01199	0.00708	1.02754	0.00462	0.01019	0.00835
8	0.04370	0.04829	0.08453	0.02019	0.03709	0.02088	0.05740	1.20121	0.02205	0.06013
9	0.00005	0.00003	0.00003	0.00041	0.00003	0.00003	0.00007	0.00002	1.00195	0.00327
10	0.00017	0.00016	0.00017	0.00018	0.00017	0.00026	0.00075	0.00020	0.00019	1.00615
11	0.12028	0.02931	0.03183	0.05988	0.03502	0.01174	0.11116	0.00192	0.01071	0.04795
12	0.00252	0.00248	0.00250	0.00274	0.00251	0.00368	0.01031	0.00279	0.00289	0.08296
13	0.01598	0.01895	0.01322	0.01453	0.01444	0.00632	0.00880	0.00471	0.01284	0.00546
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.02346	0.02270	0.02095	0.01915	0.01734	0.01453	0.01513	0.01104	0.01800	0.00695
16	0.13535	0.13187	0.13444	0.14717	0.13503	0.22250	0.64901	0.16855	0.15556	0.11209
17	0.00859	0.00870	0.00811	0.00942	0.00846	0.00541	0.00685	0.00375	0.01041	0.01440
18	0.00010	0.00010	0.00009	0.00010	0.00009	0.00007	0.00009	0.00005	0.00010	0.00006
19	0.00398	0.00317	0.00311	0.00360	0.00310	0.00269	0.00669	0.00192	0.00392	0.00240
20	0.01973	0.02089	0.02035	0.02082	0.01888	0.01388	0.01766	0.01023	0.02335	0.01062
21	0.04630	0.05171	0.04193	0.04014	0.03696	0.01725	0.02401	0.01356	0.03158	0.01911
22	0.00426	0.00440	0.00415	0.00441	0.00406	0.00485	0.00896	0.00314	0.01433	0.00301
23	0.01104	0.00961	0.00900	0.00990	0.00866	0.00828	0.01378	0.00486	0.00936	0.01426
24	0.01977	0.01382	0.01273	0.01504	0.01232	0.01705	0.03381	0.00820	0.01157	0.03349
25	0.00289	0.00396	0.00381	0.00223	0.00226	0.00126	0.00156	0.00095	0.00268	0.00127
26	0.04308	0.04452	0.04345	0.04791	0.04365	0.02775	0.03386	0.02044	0.05245	0.04752
27	0.05206	0.05528	0.04866	0.05726	0.05012	0.07141	0.07555	0.04598	0.05901	0.05557
28	0.02663	0.02730	0.02602	0.02855	0.02602	0.01867	0.02217	0.01362	0.03356	0.01358
29	0.00423	0.00467	0.00456	0.00433	0.00400	0.00295	0.00328	0.00215	0.00498	0.00214
30	0.05907	0.05819	0.05095	0.05862	0.05656	0.03794	0.04931	0.02687	0.06623	0.02757
31	0.01869	0.01901	0.01843	0.02110	0.01889	0.01189	0.01520	0.00896	0.02229	0.01064
32	0.22650	0.23286	0.22249	0.25989	0.23305	0.15902	0.22528	0.13105	0.27719	0.15080
33	0.31175	0.27617	0.26209	0.21886	0.22772	0.13986	0.16395	0.10701	0.23320	0.10794
34	0.00172	0.00175	0.00172	0.00196	0.00179	0.00107	0.00130	0.00080	0.00215	0.00097
35	0.18743	0.20687	0.20211	0.19205	0.17736	0.13102	0.14549	0.09551	0.22093	0.09507
36	0.00235	0.00230	0.00212	0.00231	0.00218	0.00151	0.00192	0.00110	0.00254	0.00124
37	0.00943	0.00953	0.00918	0.00932	0.00872	0.00599	0.00780	0.00460	0.01025	0.00516
38	0.96082	0.98248	0.96622	1.11131	1.00967	0.60500	0.73608	0.44956	1.21865	0.54776

See footnote at end of table

Continued

Table 7--Direct and indirect requirements per dollar of delivery to final demand, households endogenous, Twin Valley and Trail-blazer-4 RC&D areas, 1971--Continued

Sector 1/	Sector 1/ 11	12	13	14	15	16	17	18	19	20
	Coefficient									
1	0.04169	0.00340	0.00172	0.00166	0.00178	0.00617	0.07715	0.00187	0.00110	0.00117
2	0.01377	0.00240	0.00104	0.00104	0.00114	0.00897	0.00104	0.00127	0.00069	0.00072
3	0.01003	0.00113	0.00090	0.00091	0.00102	0.00878	0.00068	0.00081	0.00061	0.00063
4	0.01206	0.00090	0.00056	0.00058	0.00065	0.00382	0.00047	0.00058	0.00038	0.00039
5	0.00320	0.00026	0.00020	0.00021	0.00023	0.00094	0.00016	0.00018	0.00013	0.00014
6	0.01099	0.00632	0.00761	0.00793	0.00891	0.07955	0.00587	0.00596	0.00537	0.00540
7	0.11539	0.00807	0.00417	0.00433	0.00486	0.03341	0.00403	0.00472	0.00286	0.00294
8	0.01847	0.05933	0.01205	0.01248	0.01400	0.12271	0.01914	0.02511	0.00845	0.00852
9	0.00020	0.00327	0.00003	0.00024	0.00003	0.00009	0.00002	0.00155	0.00002	0.00002
10	0.00021	0.00615	0.00015	0.00019	0.00020	0.00163	0.00011	0.01093	0.00013	0.00011
11	1.01897	0.04787	0.00126	0.00144	0.00157	0.00704	0.00984	0.01593	0.00090	0.00091
12	0.00303	1.08280	0.00232	0.00333	0.00338	0.02209	0.00168	0.33783	0.00237	0.00172
13	0.00653	0.00504	1.03447	0.02482	0.02789	0.00887	0.01247	0.00676	0.01323	0.00743
14	0.0	0.0	0.0	1.00000	0.0	0.0	0.0	0.0	0.0	0.0
15	0.01053	0.00629	0.03101	0.01402	1.01454	0.01245	0.01041	0.00984	0.01037	0.01125
16	0.17682	0.10346	0.12370	0.13279	0.14949	1.41456	0.08744	0.09901	0.09042	0.08914
17	0.01189	0.01383	0.00820	0.00917	0.00993	0.00649	1.09541	0.00876	0.00684	0.00629
18	0.00010	0.00005	0.00011	0.00264	0.00180	0.00010	0.00006	1.01534	0.00212	0.00021
19	0.01224	0.00223	0.00286	0.00455	0.00434	0.00909	0.00405	0.00295	1.06105	0.03645
20	0.01402	0.00948	0.01864	0.02287	0.02247	0.02291	0.01273	0.01308	0.01972	1.15650
21	0.01760	0.01807	0.02516	0.03221	0.04670	0.02126	0.05489	0.01980	0.03130	0.02436
22	0.00387	0.00279	0.01280	0.09157	0.02595	0.01720	0.00270	0.00661	0.00597	0.00278
23	0.02975	0.01382	0.01409	0.09074	0.04583	0.01712	0.00628	0.01633	0.01049	0.00754
24	0.09118	0.03299	0.01176	0.12457	0.04783	0.04513	0.00763	0.02919	0.01625	0.00845
25	0.00174	0.00117	0.00457	0.00635	0.00633	0.00172	0.00265	0.00203	0.00189	0.00175
26	0.03463	0.04465	0.05092	0.08738	0.08624	0.03543	0.03227	0.03966	0.03405	0.04139
27	0.05281	0.05309	0.06557	0.08764	0.07680	0.08079	0.04644	0.06384	0.06549	0.04303
28	0.01835	0.01207	0.02504	0.03014	0.03286	0.02762	0.01849	0.01845	0.01924	0.03010
29	0.00277	0.00191	0.00392	0.00513	0.00478	0.00385	0.00270	0.00275	0.00279	0.00348
30	0.03873	0.02451	0.06744	0.06290	0.06511	0.04863	0.04442	0.04010	0.05260	0.04177
31	0.01384	0.00938	0.01840	0.02254	0.02556	0.01385	0.01206	0.01271	0.01203	0.01341
32	0.18409	0.13713	0.21609	0.30291	0.32575	0.20269	0.17319	0.16912	0.16237	0.16737
33	0.17015	0.09560	0.33445	0.21729	0.24048	0.15980	0.14285	0.13913	0.13520	0.19288
34	0.00130	0.00084	0.00179	0.00188	0.00212	0.00131	0.00116	0.00121	0.00116	0.00126
35	0.12285	0.08482	0.17344	0.22783	0.21190	0.17083	0.11985	0.12220	0.12384	0.15440
36	0.00160	0.00112	0.00267	0.00261	0.00273	0.00197	0.00163	0.00162	0.00185	0.00175
37	0.00679	0.00465	0.00985	0.01058	0.01107	0.00820	0.00700	0.00642	0.00676	0.01866
38	0.73215	0.47741	0.99987	1.06325	1.20378	0.74195	0.65497	0.68578	0.65790	0.70704

See footnote at end of table

Continued

Table 7--Direct and indirect requirements per dollar of delivery to final demand, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971--Continued

Sector 1/	Sector 1/									
	21	22	23	24	25	26	27	28	29	30
	Coefficient									
1	0.00147	0.00247	0.00112	0.00139	0.00121	0.00164	0.00163	0.00169	0.00155	0.00103
2	0.00088	0.00105	0.00072	0.00087	0.00077	0.00093	0.00122	0.00110	0.00099	0.00066
3	0.00078	0.00093	0.00064	0.00077	0.00069	0.00083	0.00095	0.00098	0.00088	0.00058
4	0.00048	0.00059	0.00041	0.00049	0.00044	0.00053	0.00062	0.00063	0.00056	0.00037
5	0.00019	0.00021	0.00014	0.00017	0.00015	0.00020	0.00021	0.00022	0.00020	0.00013
6	0.00681	0.00810	0.00560	0.00674	0.00599	0.00727	0.00824	0.00859	0.00762	0.00507
7	0.00363	0.00442	0.00305	0.00367	0.00326	0.00396	0.00456	0.00467	0.00417	0.00276
8	0.01079	0.01274	0.00878	0.01058	0.00940	0.01142	0.01294	0.01346	0.01201	0.00796
9	0.00003	0.00003	0.00002	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.00002
10	0.00027	0.00017	0.00012	0.00014	0.00012	0.00015	0.00017	0.00017	0.00015	0.00010
11	0.00118	0.00144	0.00095	0.00114	0.00101	0.00124	0.00136	0.00137	0.00124	0.00083
12	0.00386	0.00260	0.00179	0.00221	0.00193	0.00236	0.00258	0.00268	0.00236	0.00159
13	0.17706	0.10333	0.01211	0.01051	0.00882	0.01065	0.01104	0.00885	0.00831	0.08887
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.01830	0.01887	0.01391	0.01285	0.01100	0.01262	0.03073	0.02850	0.01459	0.03301
16	0.11399	0.13543	0.09382	0.11282	0.10029	0.12195	0.13784	0.14393	0.12692	0.08455
17	0.00896	0.00982	0.00638	0.00807	0.00681	0.00927	0.00889	0.00948	0.00833	0.00560
18	0.00015	0.00025	0.00015	0.00036	0.00024	0.00029	0.00012	0.00011	0.00008	0.00010
19	0.00618	0.00857	0.00251	0.00552	0.00344	0.00600	0.00309	0.00314	0.00345	0.00205
20	0.01797	0.02095	0.01440	0.02142	0.01592	0.02101	0.02206	0.02139	0.03917	0.01349
21	1.09495	0.03752	0.02356	0.02886	0.02315	0.03377	0.03339	0.02100	0.01895	0.01644
22	0.00922	1.12819	0.00541	0.00720	0.00848	0.00752	0.00438	0.00429	0.00405	0.00371
23	0.02153	0.02270	1.34629	0.31895	0.10947	0.11388	0.01323	0.00991	0.00840	0.00939
24	0.02318	0.01902	0.02178	1.09608	0.04015	0.04783	0.01239	0.00964	0.00913	0.00660
25	0.00273	0.00407	0.00344	0.00748	1.03198	0.00806	0.00227	0.00189	0.00211	0.00145
26	0.04325	0.05500	0.05565	0.08372	0.12715	1.20933	0.05128	0.06115	0.05400	0.03174
27	0.07052	0.11315	0.08221	0.06513	0.04858	0.05464	1.13593	0.04487	0.04041	0.05460
28	0.02343	0.03141	0.02252	0.02726	0.02466	0.02968	0.03542	1.03366	0.07339	0.01965
29	0.00400	0.00453	0.00307	0.00381	0.00340	0.00425	0.00463	0.00458	1.01659	0.00297
30	0.06645	0.10154	0.07274	0.06205	0.05114	0.05795	0.05886	0.06599	0.06605	1.26482
31	0.01505	0.02011	0.01380	0.01678	0.01494	0.01805	0.02028	0.02140	0.01940	0.01260
32	0.19626	0.24784	0.18805	0.22107	0.20040	0.23801	0.24368	0.24007	0.22264	0.14628
33	0.19555	0.23067	0.15246	0.18751	0.16588	0.19731	0.23620	0.23459	0.23506	0.15283
34	0.00144	0.00193	0.00133	0.00160	0.00143	0.00173	0.00191	0.00206	0.00181	0.00121
35	0.17759	0.20107	0.13636	0.16908	0.15072	0.18873	0.20526	0.20324	0.48748	0.13165
36	0.00232	0.00352	0.00234	0.00224	0.00189	0.00220	0.00455	0.00255	0.00255	0.02400
37	0.00871	0.01056	0.00737	0.00914	0.00859	0.01045	0.01178	0.01417	0.01337	0.00925
38	0.81390	1.09075	0.75383	0.90796	0.80749	0.97863	1.07765	1.16912	1.01934	0.68424

See footnote at end of table.

Continued

Table 7--Direct and indirect requirements per dollar of delivery to final demand, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971--Continued

Sector 1/	Sector 1/ 31	32	33	34	35	36	37	38
				Coefficient				
1	0.00214	0.00207	0.00387	0.00179	0.00183	0.00129	0.00116	0.00243
2	0.00137	0.00133	0.00192	0.00111	0.00117	0.00084	0.00075	0.00160
3	0.00121	0.00118	0.00146	0.00097	0.00104	0.00074	0.00066	0.00145
4	0.00077	0.00075	0.00082	0.00061	0.00068	0.00047	0.00042	0.00092
5	0.00027	0.00026	0.00032	0.00021	0.00024	0.00016	0.00015	0.00032
6	0.01052	0.01017	0.01098	0.00832	0.00901	0.00639	0.00569	0.01268
7	0.00573	0.00565	0.00620	0.00455	0.00499	0.00350	0.00311	0.00688
8	0.01653	0.01598	0.01817	0.01313	0.01430	0.01005	0.00894	0.01984
9	0.00004	0.00003	0.00005	0.00003	0.00003	0.00003	0.00002	0.00004
10	0.00021	0.00021	0.00019	0.00017	0.00018	0.00013	0.00012	0.00026
11	0.00169	0.00314	0.00200	0.00138	0.00149	0.00115	0.00092	0.00199
12	0.00326	0.00315	0.00286	0.00257	0.00279	0.00208	0.00177	0.00396
13	0.01148	0.01102	0.01042	0.01048	0.01073	0.02301	0.00636	0.01034
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.01994	0.01812	0.05072	0.03171	0.02011	0.14632	0.01271	0.01643
16	0.17507	0.16988	0.15286	0.13714	0.14992	0.10674	0.09505	0.21382
17	0.01151	0.01078	0.00996	0.00939	0.00980	0.00705	0.00653	0.01407
18	0.00011	0.00014	0.00016	0.00011	0.00011	0.00030	0.00006	0.00011
19	0.00631	0.00575	0.00374	0.00345	0.00574	0.00319	0.00260	0.00417
20	0.02812	0.02811	0.02675	0.02737	0.09059	0.01810	0.01750	0.02832
21	0.02589	0.02682	0.02315	0.02443	0.02736	0.02539	0.01574	0.02583
22	0.00524	0.00600	0.00523	0.00437	0.00596	0.00979	0.00294	0.00559
23	0.01015	0.01119	0.01032	0.00881	0.01188	0.01169	0.00615	0.01102
24	0.01184	0.01321	0.01149	0.00958	0.01351	0.01215	0.00666	0.01234
25	0.00227	0.00268	0.00236	0.00195	0.00367	0.00207	0.00127	0.00244
26	0.06136	0.06125	0.05414	0.05109	0.07460	0.04483	0.03360	0.07104
27	0.05643	0.05877	0.05063	0.05629	0.05099	0.04331	0.15057	0.06137
28	0.04054	0.04128	0.03753	0.04399	0.04467	0.02536	0.02037	0.03740
29	0.00603	0.00594	0.00538	0.00635	0.02843	0.00414	0.00327	0.00572
30	0.09221	0.08153	0.06491	0.08052	0.07768	0.11087	0.04665	0.07568
31	1.02580	0.02407	0.02290	0.02108	0.02233	0.01623	0.01422	0.03123
32	0.28991	1.27837	0.25865	0.24297	0.26815	0.18924	0.16112	0.33820
33	0.32838	0.30155	1.32531	0.30415	0.28190	0.18893	0.16856	0.30572
34	0.00251	0.00232	0.00236	1.00197	0.00210	0.00153	0.00136	0.00306
35	0.26743	0.26340	0.23386	0.28171	1.26668	0.18360	0.14526	0.25366
36	0.00469	0.00389	0.00422	0.00311	0.00332	1.00313	0.00204	0.00306
37	0.02556	0.02097	0.01911	0.01531	0.02138	0.00840	1.00703	0.01269
38	1.41843	1.30990	1.22019	1.10761	1.17976	0.86323	0.76670	1.74143

1/ Sector numbers correspond to those listed in table 4. Sector coefficients include induced effects of household spending.

Table 8--Economic multipliers, households endogenous, Twin Valley and Trailblazer-4 RC&D areas, 1971 1/

Sector 2/	(1) Sector output multiplier 3/	(2) Direct employment effect 4/	(3) Total employment effect 5/	(4) Sector employment multiplier 6/	(5) Direct income effect 7/	(6) Total income effect 8/	(7) Sector income multiplier 9/
			Coefficients				
1	3.4198	.000095	.000170	1.7823	.33355	.96082	2.8806
2	3.3342	.000024	.000088	3.6636	.38348	.98248	2.5620
3	3.3118	.000054	.000141	2.6228	.38483	.96622	2.5108
4	3.4245	.000120	.000185	1.5417	.52758	1.11131	2.1064
5	3.2397	.000127	.000187	1.4752	.46458	1.00967	2.1733
6	2.6206	.000063	.000105	1.6770	.18988	.60500	3.1862
7	3.5459	.000045	.000115	2.5595	.12315	.73608	5.9771
8	2.3958	.000031	.000070	2.2742	.11465	.44956	3.9212
9	3.5696	.000063	.000131	2.0813	.60174	1.21865	2.0252
10	2.5131	.000066	.000108	1.6369	.18111	.54776	3.0245
11	3.0043	.000043	.000103	2.3948	.23800	.73215	3.0763
12	2.3783	.000008	.000047	5.7234	.14070	.47741	3.3931
13	3.2888	.000024	.000083	3.4612	.39871	.99987	2.5078
14	3.7127	.000040	.000118	2.9478	.33845	1.06325	3.1415
15	3.7300	.000038	.000113	3.0021	.50993	1.20378	2.3607
16	3.3640	.000016	.000085	5.2566	.17186	.74195	4.3172
17	2.6739	.000057	.000111	1.9325	.22883	.65497	2.8623
18	2.9394	.000048	.000088	1.8178	.24001	.68578	2.8573
19	2.5679	.000023	.000066	2.8387	.26139	.65790	2.5169
20	2.7914	.000051	.000095	1.8627	.24067	.70704	2.9378
21	3.1431	.000014	.000071	5.4615	.23816	.81390	3.4174
22	3.6556	.000031	.000103	3.3660	.39591	1.09075	2.7550
23	3.0588	.000018	.000072	3.9560	.23614	.75383	3.1923
24	3.4157	.000029	.000092	3.2213	.30107	.90796	3.0158
25	2.9910	.000039	.000094	2.4066	.30015	.80749	2.6903
26	3.4144	.000041	.000108	2.6137	.36161	.97863	2.7063
27	3.4014	.000063	.000130	2.0581	.46408	1.07765	2.3221
28	3.3952	.000032	.000093	2.9108	.60078	1.16912	1.9460
29	3.5274	.000061	.000139	2.2787	.31172	1.01934	3.2700
30	2.8222	.000023	.000070	2.9876	.21963	.68424	3.1154
31	3.9710	.000091	.000193	2.1324	.69956	1.41843	2.0276
32	3.8009	.000075	.000152	2.0215	.62165	1.30990	2.1071
33	3.6552	.000021	.000090	4.3353	.54931	1.22019	2.2213
34	3.5198	.000090	.000159	1.7622	.44695	1.10761	2.4782
35	3.7091	.000060	.000136	2.2502	.48951	1.17976	2.4101
36	3.0754	.000078	.000135	1.7268	.31306	.86323	2.7574
37	2.7180	.000058	.000107	1.8499	.32561	.76670	2.3547

1/ See Appendix D for more information on economic multipliers in table 8. 2/ Sector numbers correspond to those listed in table 4. 3/ Sum of column entries, table 7. 4/ Total sector employment divided by total sector output. 5/ Sum of products of each column entry in table 7 times the corresponding sector's direct employment coefficient in column 2, table 8. 6/ Table 8, column 3 ÷ column 2. 7/ The household row of table 6. 8/ The household row of table 7. 9/ Table 8, column 6 ÷ column 5.

APPLICATION OF I-O TO RC&D AND SMALL WATERSHED PLANNING

RC&D goals generally focus on community improvement and stress such things as more jobs, providing more income-earning opportunities for residents, raising the per capita income of the RC&D area, curbing the emigration of people from the area, improving public facilities and services, and upgrading the environment. Projects under the Small Watershed Program are similarly people oriented.

This section uses the study area model to illustrate how I-O techniques could be employed in estimating impacts of alternative projects by analyzing project costs and effects in an I-O framework. Before project costs and beneficial and adverse effects of projects can be cast in an I-O analytical framework, certain decisions must be made, such as:

(1) Will project installation expenditures be made inside or outside the project area? If made both inside and outside the area (the area which the I-O model encompasses), the percent or amount of project expenditures made inside the area must be estimated for each element of cost.

(2) Once local expenditures are determined, in which sectors will the expenditures be made? If expenditures of a project cost item are made in more than one sector of the model, then the proportion of the total local expenditures going to each sector must be estimated.

(3) Over what period of time are the expenditures to be made? A time element should be associated with each expenditure (for both project installation and operation and maintenance) to properly use the model and to express impacts in a meaningful way.

(4) What annual primary 14/ benefits and losses are expected as a result of the project (or what are the direct effects of projects on the local economy once they have been installed)? This question relates to returns on the investment after project installation is completed. What are the annual effects on the private sector (what private business is generated and/or lost as a direct result of the project)?

(5) Once direct or primary effects are determined, in which sectors do they originate and in which sectors do they cause final demand to change? Once project effects on the final demands of individual sectors are estimated, a time element must be attached to the effects. That is, how soon after project installation are these effects felt in the local economy, and what is their duration?

14/ In this report, "primary" is used to define the initial effects related directly to project installation such as initial impacts of project expenditures, change in land use attributable to the project, increased local taxes or assessments to pay for all or part of project costs, flood reduction, better drainage, and so on.

(6) Project-related changes in output of sectors must be in terms of final demand changes in order to use I-O model multipliers to estimate total (direct and indirect) changes in the economy. However, some projects not only affect the output and final demand of the local economic sectors, but may also change a sector's production function by providing more of a given resource, a different resource, or by changing the cost structure of current resource inputs.

For example, when a project is likely to cause technological changes (changes in production functions of sectors) such as might occur with project-induced irrigation in a formerly dryland farming area, effects on the input requirements of the agriculture sectors should be re-evaluated. Also, local changes in production of goods and services that are used as inputs by other economic sectors in the area may change the import/export patterns of the modeled economy, thereby changing input coefficients of sectors in the model (i.e., import substitution may occur as a result of output changes). These types of changes, which may affect the validity of the I-O model, should be assessed when evaluating project developments in the modeled economy. Such changes, if significant, could reduce or increase the magnitude of I-O multipliers. In this study, it was assumed that no structural changes occurred in the modeled economy due to project activities, and implications of possible import substitutions as endogenous sectors expand or decrease output were not examined. It was assumed that project-induced changes in output would affect only the final demand of those sectors directly affected by project activity.

Once the above questions are answered and initial project impact decisions are made, the effects of projects can be analyzed using the results and the analytical techniques available in an I-O model. The two projects selected to illustrate the usefulness of I-O in RC&D and small watershed planning were the Cypress-Black Bayou watershed project in Bossier Parish, located in the Trailblazer-4 RC&D project area, and the Third Forest project in a portion of the Twin Valley RC&D project area.

The Cypress-Black Bayou watershed project is one of SCS' projects administered and developed under the authority of the Watershed Protection and Flood Prevention Act (P.L. 566). Objectives of this project were to provide watershed protection, flood prevention, agricultural water management, recreation, and municipal and industrial water to residents of the area. The work plan proposes an installation period of 4 years for structural measures and 10 years for land treatment measures. The total installation cost of the project, including land treatment and structural measures, was estimated to be $11,257,304, with the Federal Government (under P.L. 566) sharing part of the cost with local interests. Local interests bear the entire cost of operation and maintenance once projects are installed.

The Third Forest project, administered under the U.S. Department of Agriculture's Forest Incentives Program, is a pilot forest development project located in the Upper Sabine Soil and Water Conservation District, covering a large portion of the Twin Valley RC&D project area. The goal of the current project work plan is to plant 10,000 acres of land in pine seedlings during a

1-year period. Planting consists of underplanting 6,000 acres in wooded areas and open-field planting 4,000 acres. Site preparation activities include control burning, cull tree removal, and light-land clearing where needed. The project is estimated to cost $516,300, with the Federal Government sharing approximately 75 percent of the total cost of tree planting and forest improvement.

To illustrate I-O's capability in project analysis, three kinds of project effects are analyzed: (1) those due to project installation activities, (2) annual operation and maintenance on installed projects, and (3) annual effects on selected agriculture crops resulting from land use changes due to the project. Expected returns (increased pulpwood and sawlog production) due to timber investments of the Third Forest project were not evaluated. Also, since the Third Forest project's annual operation and maintenance expenditures are negligible, only installation activities are analyzed using the results of the I-O model.

The table of economic multipliers (table 8) and the inverse matrix (table 7) are used in estimating impacts of the two selected projects. I-O multipliers and coefficients used in the analyses are listed in the respective impact tables to better illustrate which ones to use and to show the differences in sectoral interaction to direct project effects.

The economic multipliers in table 8 are Type II I-O multipliers. That is, they include not only the direct and indirect effects of changes in final demand of local economic sectors, but also the induced effects of local household expenditures. This makes them larger than Type I multipliers which do not account for increased economic activity due to induced changes in income and increased consumer spending. 15/

Normally, the larger and more self-sufficient a region, the larger the economic multipliers will be, whether they are Type I or II. A more self-sufficient economy will import fewer goods and services than the less self-sufficient one, and thereby have fewer leakages of income from the area. The northwest Louisiana area includes the diverse and active economy of the Shreveport metropolitan area. Therefore, an I-O model of this area will most likely have larger multipliers than many of the other more rural RC&D areas which are less self-sufficient and complex.

The analyst must be very careful to multiply the appropriate multiplier by the appropriate economic or project effects variable. I-O multipliers should not be used in isolation of the models from which they were derived because they carry with them the same restrictions and qualifications inherent in the

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15/ However, the Type II multipliers in table 8 may slightly overstate the induced effects because, in computing these multipliers, it was assumed that changes in consumer spending were proportional to changes in income. This may or may not be true in the region under study.

model. Results must be interpreted and qualified with the model's limitations in mind. The subsequent sections on application of I-0 model to planning situations illustrate how I-0 multipliers might be used.

Analysis of the Third Forest Project

As previously noted, only project installation costs (expenditures) and their impact on the area economy are analyzed for the Third Forest project. Installation costs are examined and local project expenditures are estimated in table 9. The total costs of $516,300 are separated by items of expenditure to make it easier to determine whether the expenditures are local or nonlocal, and to also help in deciding in which local economic sectors the expenditures will be made. As indicated in the table, expenditures for pine seedlings and machinery and equipment were made outside the project area and, therefore, had no effect on the local economy.

Sources of funds are shown to help local planners and involved residents see how their share of installation funds are spent, and to enable them to better assess the benefit-cost relationships of this and other alternative projects that are of interest to them. Also, in thoroughly analyzing the effects of a project, it may be desirable to estimate the net regional effects of local funds spent on a project compared to how they would normally be spent (i.e., the net effects of a change in expenditure patterns of a portion of local income). The portion in this case is the area residents' local assessment required to finance their share of the project.

Project effects on the final demand of individual sectors must be estimated before the I-0 model can be used to estimate project impacts on the local economy. Table 10 shows in which sectors final demand changed, estimated changes in final demand, which I-0 multipliers to use, and the estimated impact of project activity. All of the project expenditures in this example were assumed to be spent in the agricultural services sector (sector 11) because the work was contracted to be done by a private vendor in the project area. Impacts are expressed in terms of increased output, employment, and personal income in the project area. They are estimated by multiplying the output multiplier, the total employment coefficient, and the total income coefficient for the agricultural services sector by the estimated changes in final demand for the agricultural services sector. These multipliers are found in columns 1, 3, and 6, respectively, on line 11 of table 8. Estimated impacts are for the total economy, not just sector 11. The project is estimated to increase the area's output by $1,108,888, income by $270,236, and employment by 38 man-years during project installation.

The income and employment estimates in table 10 could have been computed by using the employment and income multipliers in columns 4 and 7 of table 8. However, use of these multipliers would first have required estimating the direct income and employment changes expected in sector 11 due to its changes in final demand. Then the direct income and employment changes multiplied by the income and employment multipliers would yield an estimate of income and employment changes for the local economy identical to those in table 10. This is illustrated in table 11.

Table 9--Project installation costs, Third Forest project, Twin Valley and Trailblazer-4 RC&D areas

Cost item	Total cost	Source of funds 1/: Federal funds	Source of funds 1/: Local funds	Local expenditures 2/: Proportion of total cost	Local expenditures 2/: Amount
	Dollars	Dollars	Dollars	Percent	Dollars
Pine seedlings	61,200	45,900	15,300	0	0
Control burn	5,000	0	5,000	100	5,000
Cull tree removal	150,000	112,500	37,500	100	150,000
Machinery and equipment	86,000	64,500	21,500	0	0
Tree planting	214,100	160,575	53,525	100	214,100
Total	516,300	383,475	132,825	71.5	369,100

1/ Source of funds has no bearing on where funds will be spent. Source is shown only so local residents can compare their costs with their returns (local project impacts). Source of the Federal funds cited here is the Forest Incentive Program administered by the U.S. Department of Agriculture.

2/ Project funds spent in study area.

Source: Basic cost information and estimates of local expenditures based on consultations with SCS personnel on type and nature of expenditures.

Table 10--Estimated local economic impact of the Third Forest project during installation, Twin Valley and Trailblazer-4 RC&D areas 1/

Project activity	Local expenditures	Final demand		Sector output multiplier 2/	Total income coefficient 2/	Total employment coefficient 2/	Impact on local economy		
		Sector changed	Amount of change				Output 3/	Income 4/	Employment 5/
	Dollars	Number	Dollars	Number	Number	Number	Dollars	Dollars	Man-years
Control burn	5,000	11	5,000	3.0043	.73215	.000103	15,022	3,661	.5
Cull tree removal	150,000	11	150,000	3.0043	.73215	.000103	450,645	109,822	15.4
Tree planting	214,100	11	214,100	3.0043	.73215	.000103	643,221	156,753	22.1
Total	369,100	--	369,100	--	--	--	1,108,888	270,236	38.0

1/ Project installation period is 1 year. Therefore, effects of project expenditures would be realized, presumably, over a 1- to 2-year period, allowing some delay for sectoral interaction and money flows, and then would cease.

2/ Source: Table 8. All multipliers of a given type are the same since sector 11 is the only sector in which final demand changed.

3/ Output multiplier (col. 4) multiplied by change in final demand (col. 3).

4/ Total income coefficient (col. 5) multiplied by change in final demand (col. 3).

5/ Total employment coefficient (col. 6) multiplied by change in final demand (col. 3).

Table 11--Estimated changes in income and employment using I-O income and employment multipliers, Third Forest project, Twin Valley and Trailblazer-4 RC&D areas

Project activity 1/	(1) Change in final demand: sector 11 1/	(2) Direct income coefficient 2/	(3) Direct employment coefficient 3/	(4) Direct income change 4/	(5) Direct employment change 5/	(6) Income multiplier 6/	(7) Employment multiplier 7/	(8) Change in income 8/	(9) Change in employment 9/
	Dollars	--------- Number	-------	Dollars	Man-years	---- Number	-----	Dollars	Man-years
Control burn	5,000	.23800	.000043	1,190	.215	3.0763	2.3948	3,661	.515
Cull tree removal	150,000	.23800	.000043	35,700	6.450	3.0763	2.3948	109,824	15.446
Tree planting	214,100	.23800	.000043	50,956	9.206	3.0763	2.3948	156,756	22.047
Total	369,100 10/	--	--	87,846	15.871	--	--	270,241	38.008

1/ From table 10.
2/ From table 8, column 5, line 11. This is the ratio of total income to total dollars of output, sector 11.
3/ From table 8, column 2, line 11. This is the ratio of employment, in man-years, to total dollars of output, sector 11.
4/ Column (1) X column (2).
5/ Column (1) X column (3).
6/ From table 8, column 7, line 11.
7/ From table 8, column 4, line 11.
8/ Column (4) X column (6).
9/ Column (5) X column (7).
10/ Since project expenditures all occurred in sector 11, the total change in final demand, $369,100, could have been used in computing income and employment effects above. However, so that results could be clearly compared to results in table 10, the computations were made for each item of expenditure, rather than a lump sum. Results in columns (8) and (9) above are identical to results in the last two columns of table 10, except for rounding errors.

Still another way to estimate project impacts on employment and income in the project area, using results of the I-O model, is to estimate the project effects on total gross output of each sector, and then multiply estimated changes in sector outputs by their respective direct income and employment coefficients. This method also has the advantage of showing project impacts on each sector in the economy, which may be desirable in some instances. This alternative use of I-O in estimating impacts requires the use of I-O coefficients in tables 6, 7, and 8. This application of an I-O model is shown in table 12. To simplify the illustration in table 12, all changes in final demand were lumped together (i.e., the three expenditure items, treated separately in tables 10 and 11, were combined and the total of $369,100 was used in table 12). This is permissible, since all project expenditures were spent in sector 11, and therefore affect final demand in only this sector of the economy.

To estimate economic effects on each sector of the economy, the total change in final demand of sector 11, $369,100, is multiplied by the column of inverse coefficients for sector 11 found in table 7. Results of this multiplication, as shown in column 2 of table 12, indicate the output requirements necessary from each sector in the economy to support sector 11's final demand change of $369,100.

This display of effects could be useful to project planners in formulating and selecting alternative proposals for development. The display not only shows expected project benefits, but from another viewpoint, it also shows project requirements. Should there be a sector in the economy which, due to a resource shortage or some other insufficient input, could not meet the output requirements expected from it to support the sector selling to final demand, then the proposed development program could be seriously hampered. Such insufficiencies could create bottlenecks critical to project success and economic growth. This detailed inter-sector analysis of project effects made possible by I-O techniques could be very useful in identifying such potential problems in the economy. Results of this type of analysis could be used during the project formulation process to help identify critical needs of the area economy and to aid in designing projects to help meet these needs. For example, critical needs might be local water supply requirements, local resource development needed to expand production of goods critical to an area's continued growth, local supplies of skilled labor, or capital requirements. These kinds of inputs could be related to sector outputs to help assess the potential of the area for growth and development, and to identify problem sectors.

The display in table 12 also shows in which sectors the greatest and least income and employment benefits occur as a result of a given project. This could be useful in assessing the effects of a project, if a project goal was to increase income and employment in particular income groups of the area. Each sector has its array of employment skills and wage and salary levels associated with given levels of output. Therefore, changes in income and employment occurring in the various economic sectors could be allocated among employment and income classes for each sector to assess the distributional effects of income and employment on residents of a project area.

Table 12--Estimated changes in output, income, and employment, by sectors, using inverse and direct coefficients, Third Forest project, Twin Valley and Trailblazer-4 RC&D areas

Sector	(1) Inverse coefficients 1/	(2) Change in output 2/	(3) Direct income coefficients 3/	(4) Direct employment coefficients 4/	(5) Change in income 5/	(6) Change in employment 6/
	Number	Dollars	Number	Number	Dollars	Man-years
(1) Cotton	.04169	15,388	.33355	.000095	5,133	1.46
(2) Grains	.01377	5,083	.38348	.000024	1,949	.12
(3) Other field crops	.01003	3,702	.38483	.000054	1,425	.20
(4) Fruits and tree nuts	.01206	4,451	.52758	.000120	2,348	.53
(5) Vegetables	.00320	1,181	.46458	.000127	549	.15
(6) Dairy	.01099	4,056	.18988	.000063	770	.26
(7) Poultry	.11539	42,583	.12315	.000045	5,244	1.92
(8) Meat animals	.01847	6,817	.11465	.000031	781	.21
(9) Horticulture	.00020	74	.60174	.000063	44	.01
(10) Fisheries	.00021	78	.18111	.000066	14	.01
(11) Agricultural services	1.01897	376,102	.23800	.000043	89,512	16.17
(12) Forestry	.00303	1,118	.14070	.000008	157	.01
(13) Mining	.00653	2,410	.39871	.000024	960	.06
(14) New construction	0.	0	.33845	.000040	0	0.
(15) Maintenance and repair construction	.01053	3,887	.50993	.000038	1,982	.15
(16) Food and kindred products	.17682	65,264	.17186	.000016	11,216	1.04
(17) Apparel	.01189	4,389	.22883	.000057	1,004	.25
(18) Lumber	.00010	37	.24001	.000048	8	0.
(19) Paper and allied products	.01224	4,518	.26139	.000023	1,181	.10
(20) Printing and publishing	.01402	5,175	.24067	.000051	1,245	.26

See footnotes at end of table

Continued

Table 12--Estimated changes in output, income, and employment, by sectors, using inverse and direct coefficients, Third Forest project, Twin Valley and Trailblazer-4 RC&D areas--Continued

Sector	(1) Inverse coefficients 1/	(2) Change in: output 2/	(3) Direct income coefficients 3/	(4) Direct employment coefficients 4/	(5) Change in income 5/	(6) Change in employment 6/
	Number	Dollars	------- Number	---------	Dollars	Man-years
(21) Chemicals and allied products	.01760	6,496	.23816	.000014	1,547	.09
(22) Stone, clay, glass, concrete, and metal	.00387	1,428	.39591	.000031	565	.04
(23) Primary metals industries	.02975	10,981	.23614	.000018	2,593	.20
(24) Fabricated metal products	.09118	33,655	.30107	.000029	10,133	1.00
(25) Machinery (except electric)	.00174	642	.30015	.000039	192	.03
(26) Other manufacturing	.03463	12,782	.36161	.000041	4,622	.52
(27) Transportation and warehousing	.05281	19,492	.46408	.000063	9,046	1.23
(28) Communications (except broadcasting)	.01835	6,773	.60078	.000032	4,069	.22
(29) Radio and television	.00277	1,022	.31172	.000061	318	.06
(30) Utilities (electricity, gas, water, and sewage)	.03873	14,295	.21963	.000023	3,139	.33
(31) Eating and drinking places	.01384	5,108	.69956	.000091	3,573	.46
(32) Wholesale and retail trade (except eating and drinking places)	.18409	67,948	.62165	.000075	42,240	5.10
(33) Finance, insurance, and real estate	.17015	62,802	.54931	.000021	34,498	1.32
(34) Lodging places	.00130	480	.44695	.000090	214	.04
(35) Services (except lodging places)	.12285	45,344	.48951	.000060	22,196	2.72
(36) State and local government enterprises	.00160	591	.31306	.000078	185	.05
(37) Federal Government enterprises	.00679	2,506	.32561	.000058	816	.14
(38) Local households	.73215	270,237	.01761	.000006	4,759	1.62
Total 7/	--	1,108,895	--	--	270,227	38.08

1/ From table 7, column sector 11.
2/ Column (1) X ($369,100), change in final demand, sector 11.
3/ From table 6, row 38; or table 8, column (5).
4/ From table 8, column (2).
5/ Column (3) X column (2).
6/ Column (4) X column (2).
7/ Totals in tables 10, 11, and 12 will not agree exactly because of rounding errors.

Table 12 yields the same total impact results computed in tables 10 and 11 using other I-O methods. It just provides a more detailed breakdown of effects that might be more desirable in project analysis for the reasons just cited.

Analysis of the Cypress-Black Bayou Watershed Project

The Cypress-Black Bayou watershed project offered a wider range of project effects for I-O analysis than the Third Forest project. However, to keep the report from being too bulky, illustration of the capability of I-O in analyzing these effects was limited to project installation expenditures for structural measures, expenditures associated with project operation and maintenance, and direct effects of project-related land use changes on agricultural land.

Installation expenditures for the Cypress-Black Bayou watershed project, excluding land treatment measures, are analyzed in table 13. Of the total project installation costs of $11,257,304, an estimated $9,212,100 were to be spent on structural measures over a 4-year period. It was assumed that funds would be expended in equal amounts over the 4-year installation period, or at the rate of $2,303,025 annually. Table 13 shows these annual project expenditures by items of cost and source of funds, and indicates the amount of annual expenditures expected to be spent in the local area. It was estimated that $1,908,094, or nearly 83 percent of project installation expenditures, would be spent in the project area. Local expenditures for annual operation and maintenance of project facilities are displayed in table 14. These were estimated to amount to $84,934 annually for the life of the project, and represent a change in final demand for the output of the local maintenance and repair construction sector.

It was assumed that all expenditures for structural measures, except those for land rights, would be made in the new construction sector of the local economy. Therefore, the local expenditures for construction, engineering services, and administration in table 13, totaling $1,670,319, would represent a change in final demand for the construction sector's goods and services. The $1,670,319 change in final demand for new construction and $84,934 change in final demand for maintenance and repair construction represents government expenditures made in these sectors for project installation, operation, and maintenance. The estimated local economic impact of these expenditures is shown in table 15. The impacts are estimated using the economic multipliers found in table 8 for each of the two construction sectors. The use of I-O in estimating project impacts of structural measures in table 15 is similar to procedures used in table 10 for the Third Forest project. The I-O impact-estimating techniques illustrated in table 11 and 12 were not used in this example. However, these techniques could be used. Which technique to use is a matter of choice and needs. Methods employed in table 15 represent the most direct application of I-O multipliers and are the simplest to use, since all multipliers are applied directly to one single figure--final demand changes.

Project expenditures for land rights were not analyzed because land sales and easements represent a change in the liquidity position of local landowners

Table 13--Project installation costs, structural measures, Cypress-Black Bayou watershed, Twin Valley and Trailblazer-4 RC&D areas

Cost item	Average annual costs 1/	Source of funds: Federal (PL-566) funds	Source of funds: Other funds 2/	Local expenditures 3/: Proportion of annual costs	Local expenditures 3/: Amount
	---------- Dollars	----------		Percent	Dollars
Construction	1,574,487	732,136	842,351	88.7	1,396,773
Engineering service	173,388	140,444	32,944	51.6	89,468
Administration	317,375	298,333	19,042	58.0	184,078
Land rights 4/	237,775	26,155	211,620	100.0	237,775
Total	2,303,025	1,197,068	1,105,957	82.9	1,908,094

1/ Average annual expenditures expected over the 4-year project installation period.

2/ Other funds consist of contributions by local landowners and taxes collected from the watershed population to help finance project installation.

3/ Project funds spent in the study area as opposed to project expenditures for goods and services purchased outside the study area.

4/ The expenditures for land rights were omitted from the I-O analysis of impacts. See text for explanation.

Source: Basic data source was SCS, USDA, Cypress-Black Bayou Watershed Work Plan, Feb. 1966, and Cypress-Black Bayou Watershed Supplement, June 30, 1972. Estimates of local expenditures based on consultations with SCS personnel on nature of expenditures.

Table 14--Annual operation and maintenance costs, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas

Cost item	Total cost 1/	Local expenditures	
		Proportion of total cost	Amount 2/
	Dollars	Percent	Dollars
Stream channel improvement	7,460	100	7,460
Multiple-purpose reservoirs	770	100	770
Irrigation system	21,630	100	21,630
Minimum basic facilities	60,581	91	55,074
Total	90,441	94	84,934

1/ Operation and maintenance costs paid by the Cypress-Black Bayou Recreation and Water Conservation District. A district-wide tax assessment was made for this purpose.

2/ Local expenditures for project operation and maintenance are estimated changes in final demand for the output of the maintenance and repair construction sector in the local economy.

Source: SCS, USDA, Cypress-Black Bayou Watershed Work Plan, Feb. 1966, and Cypress-Black Bayou Watershed Supplement, June 30, 1972.

Table 15--Estimated local economic impact of project installation, operation, and maintenance expenditures, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas 1/

Project activity	Local expendi-tures	Final demand		Sector output multi-plier 2/	Total income coeffi-cient 2/	Total employ-ment coeffi-cient 2/	Impact on local economy		
		Sector changed	Amount of change				Output 3/	Income 4/	Employ-ment 5/
	Dollars	Number	Dollars	--------- Number	--------		---- Dollars	----	Man-years
Installation 6/	1,670,319	14	1,670,319	3.7127	1.06325	.000118	6,201,393	1,775,967	197.1
Operation and maintenance	84,934	15	84,934	3.7300	1.20378	.000113	316,804	102,242	9.6

1/ Impacts are on an annual basis. Project installation impacts will cease after 4 years, when project installation is completed. Local impacts of project operation and maintenance are expected to start at the time project installation is complete and continue for the life of the project.
2/ Table 8, lines 14 and 15, columns 1, 6, and 3, respectively.
3/ Column 4 X column 3.
4/ Column 5 X column 3.
5/ Column 6 X column 3.
6/ Expenditures for land rights are not included.

relative to their capital assets, and is atypical income. Therefore, it was assumed that it would either be reinvested, saved, or otherwise treated differently by local households (landowners) than income from normal sources.

In an I-O concept, income received from land sales or easements for structural measures should most likely be viewed as purchases by governemnt from other value added in the I-O model. Therefore, land rights payments by government to other value added, an exogenous variable in the model, would be reflected under the gross capital formation column in final demand. However, if not treated in this manner and treated as increases in household income, then the household expenditure of the sum of these household receipts would need to be allocated among the sectors of the model based on knowledge and methodology independent of the I-O model. Each sector allocation of these receipts would represent a change in final demand for that sector in the household (personal consumption) column of the model.

The decision whether to treat the money received from the sale of land rights in the same manner as other increases in personal income should be based on factors such as: size of the project expenditure for land rights, the average amount received per person, income levels of recipients, and the kind of land involved (productive or unproductive). However, if the amount received by each person is large, it is unlikely that it will be spent in the normal fashion of local consumers.

The direct effects of the Cypress-Black Bayou watershed project on the area's agriculture are shown in table 16. The changes in land use and output in table 16 reflect actions local farmers are projected to take with the drainage and irrigation provided by this project, and also land use adjustments caused by loss of productive land to the project.

Table 17 shows in which sectors final demand would be affected by changes in agricultural land use and production (table 16). Also, estimated changes in sales to final demand are indicated for those sectors whose final demand is projected to change. In estimating changes in final demand, it is assumed that a demand exists for the additional outputs of agricultural commodities and that increases in output will either be exported directly by the producing sectors to final demand sources or sold to other endogenous sectors for processing and then exported as a single processed product or as part of a new product of which it is an ingredient.

Furthermore, it is assumed that there are no maximum or minimum limits on increases or decreases in output of sectors in the local economy, and that additional output sold to intermediate and final demand is not of sufficient quantity to cause a change in market prices. Also, the local economy's estimated import relationships established in the I-O model do not change during project analysis.

In developing the final demand estimates in table 17, it was assumed that project activity represented logical action in regard to expanding that output of sectors in the local economy which could be sold through existing or known marketing channels. Based on local marketing patterns, all changes in output due to project development were assumed to directly affect the exports of the

Table 16--Project effects on agriculture, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas

Land use	Without project	With project	Change in land use	Change in value of production 1/
	Acres			Dollars
Soybeans	4,500	1,550	-2,950	-243,957
Cotton	5,100	4,900	-200	179,647 4/
Coastal Bermuda hay	8,550	11,550	3,000	1,458,809 5/
Truck crops	790	1,060	270	191,503
Alfalfa hay	650	500	-150	-5,168
Improved pasture	6,550	7,880	1,330	203,515
Native pasture	1,569	269	-1,300	-73,988
Winter supplemental pasture	1,200	2,800	1,600	53,609
Woodland 2/	1,091	1,091	0	--
Miscellaneous 2/	6,550	6,550	0	--
Federal land 2/	1,900	1,900	0	--
Total	38,450 3/	40,050 3/	1,600	1,763,970

1/ Estimated changes in output (in 1971 dollars).
2/ Land use not affected.
3/ Difference in totals is due to increase in winter pasture, which represents dual land use. Actual total land area remains the same.
4/ Total includes value of lint cotton or ginned cotton and cottonseed, $155,467 and $24,180 respectively. Project improved drainage and water management conditions on bottomlands resulted in higher cotton yields (and increased value of production) offsetting reduction in cotton acreage due to project.
5/ Coastal Bermuda hay output increased as a result of improved drainage and flood prevention on existing hay acreage and additional land being diverted to hay production due to project. It was assumed that an export market existed for the additional hay. The export assumption is critical in the evaluation of project impacts. Should conditions develop so there would be no market for the project induced output, then the impacts would not be forthcoming.

Source: SCS, USDA, Cypress-Black Bayou Watershed Work Plan, Feb. 1966, and Cypress-Black Bayou Watershed Supplement, June 30, 1972.

Table 17--Estimated changes in output and final demand of I-O model sectors, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas

I-O model sector affected by land use changes	Estimated change in sector output 1/		Estimated final demand changes		
			Sector in which final demand is estimated to change	Amount of final demand change 4/	Inverse coefficient used 5/
	Commodity	Dollars	Number	Dollars	Number
(1) Cotton	Ginned cotton and cottonseed	179,647	(1)	177,387	1.01274
(2) Grains	Soybeans	-243,957	(2)	-242,748	1.00498
(3) Other field crops	Hay	1,453,641	(3)	1,426,159	1.01927
(5) Vegetables	Truck crops 2/	191,503	(5)	128,034	1.00281
(8) Meat animals	Beef 3/	183,136	(8)	152,460	1.20121

1/ From table 16, last column. Project-induced changes in sector output or primary effects.
2/ Only two-thirds of additional output exported. Balance consumed locally; effects not evaluated.
3/ Increased output of pasture was converted to pounds of beef and evaluated accordingly.
4/ Changes in output of exporting sectors divided by inverse coefficients to get estimates of changes in final demand.
5/ From table 7.

producing sectors. That is, where increases in output occurred, the additional output would be exported directly out of the area without further processing.

The inverse matrix (direct and indirect requirements) (table 7) was used in estimating changes in final demand. This table shows the amount of output required by the economy from each row sector per dollar of output delivered to final demand by the column sectors. Because of the previously assumed I-O production and consumption relationships for the output of agricultural sectors in which output changed, coefficients in the inverse matrix are needed to adjust the estimated changes in output (entries in last column of table 16) to reflect appropriate final demand changes for the exporting sectors. Adjustments to sector output changes follow.

The producing or exporting sector's estimated change in sector output is divided by that sector's diagonal coefficient in the inverse matrix (that is, the inverse coefficient at the intersection of the row and column where the row and column sector are the same). This coefficient will always have a value equal to or greater than one. The amount by which the coefficient exceeds one is the quantity required of the column sector as intermediate inputs to support a dollar sale to final demand by the column sector.

This adjustment is made in the output of the exporting sector because sectors often consume some of their own output in the production process, and also must produce output for the use of other sectors that supply productive inputs (intermediate inputs) to the exporting sector as it expands production. That is, the exporting sector, in addition to producing output for final demand, must also produce output for endogenous consumption, since it must support its own change in final demand. Therefore, the quantity exported by a sector will always be less than the quantity actually produced by the exporting sector. The amount exported will equal the amount produced only where there is no endogenous consumption of that sector's output. The more aggregated the I-O model's sectors, the less likely of this occurring and the more detailed and disaggregated the sectors of the model, the greater the chance of this occurrence. However, in most small area models, there will be endogenous consumption of a sector's output; and the above adjustment is needed in estimating final demand sales based on output changes.

These adjustments would not be needed if final demand changes were given. However, in most resource development projects in small areas, only output changes resulting from development projects are provided and the I-O analyst must convert output to final demand.

The final demand changes in table 17 are used to estimate the impacts of the Cypress-Black Bayou watershed project on the area's total economy as a result of its direct effect on the area's agriculture. The total impact of the final demand change in each sector is shown in table 18. Estimated impacts are expressed as changes in output, income, and employment in the last three columns of the table. Each set of impact estimates (one for each sector whose final demand changed) represents the sum of all the economic repercussions occurring throughout the economy as a result of the given change in final demand.

Table 18--Local economic impact of project-induced changes in agriculture sectors, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas 1/

Sector	Change in final demand 2/	Sector output multiplier 3/	Total income coefficient 3/	Total employment coefficient 3/	Impact on local economy 4/		
					Gross output	Income	Employment
	Dollars	----	Number	----	------ Dollars	------	Man-years
(1)	177,387	3.4198	.96082	.000170	606,628	170,437	30.16
(2)	-242,748	3.3342	.98248	.000088	-809,370	-238,495	-21.36
(3)	1,426,159	3.3118	.96622	.000141	4,723,153	1,377,983	201.09
(5)	128,034	3.2397	1.00966	.000187	414,792	129,271	23.94
(8)	152,460	2.3958	.44956	.000070	365,264	68,540	10.67
Total	1,641,292	--	--	--	5,300,467	1,507,736	244.50

1/ Estimated impacts represent changes in annual level of total output, income, and employment of area.
2/ From table 17.
3/ From table 8, columns 1, 6, and 3, respectively.
4/ Changes in final demand multiplied by the respective I-O multipliers in columns 2, 3, and 4.

If the I-O analyst wanted a display of project impacts on individual sectors within the economy, then I-O techniques as used in table 12 should be used in developing similar tables for each change in final demand shown in table 17. The estimated changes in final demand for each sector, multiplied by each sector's respective column of inverse coefficients (table 7) will yield estimates of total output changes for each sector in the economy. Table 19 shows the results of this multiplication. 16/ Column totals of table 19 show the total changes in output of the economy, which are the same as those in table 18, except for rounding errors. The row totals of table 19 show the change in each sector's output due to the given changes in final demand. Individual figures within each column show the change in output, by sector, due to the column sector's change in final demand. Zero entries are shown where there were no changes in the column sector's final demand; since only five sectors had final demand changes, most of the table's columns have zero entries.

In table 19, the row totals for each sector affected by project development (those with final demand changes) are greater than the project-induced outputs estimated in table 17. This is because there were final demand changes in more than one sector of the economy, and all sectors with changes in final demand were required to provide inputs in support of the resulting output changes in the local economy. A review of each column of figures where there was a final demand change will show that these sectors (row sectors 1, 2, 3, 5, and 8) sold output to the local economy when the column sector's final demand changed. When sector 2 reduced sales to final demand, sales of these other sectors also declined. Therefore, when final demand in more than one sector changes, and there is a production limit (bottleneck) for a particular sector of the economy, adjustments must be made in estimates of impacts to compensate for this shortage. This particular problem, if it exists in an area, could be identified and examined using I-O techniques as indicated. Results could be used in formulating project measures to alleviate the situation especially if it is critical to the area's continued growth and development. Since unlimited production was assumed in our example, no adjustments were made in the impact analysis of the Cypress-Black Bayou watershed project.

The sums of the detailed display of project impacts on output and personal income shown in table 19 are the same as those in table 18, except for rounding errors. Column totals of table 19 showing changes in output in the economy are the same as those in table 18, column 5. The effect of the specified changes in final demand on income of the study area economy is shown in row 38, table 19, in each column where final demand changed. The total impact on income of the study area ($1,507,735) is shown in row 38 of table 19 in the last column (under Row totals); the total change in output ($5,300,405) is shown in the last row, last column.

The detailed display in table 19 is an example of the difference in using I-O multipliers and techniques as opposed to using a single aggregative multi-

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16/ Table 19 does not show employment and income effects by sector as was done in table 12. However, these effects could be estimated by multiplying output changes in each sector by that sector's direct employment and income coefficients from table 8.

Table 19--Individual sector output changes due to changes in final demand of sectors 1, 2, 3, 5, and 8, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas

Sector 1/	Sector 1/									
	1	2	3	4	5	6	7	8	9	10
					Dollars					
1	179646	-672	4007	0	370	0	0	176	0	0
2	620	-243956	4963	0	308	0	0	4099	0	0
3	358	-291	1453641	0	158	0	0	301	0	0
4	340	-213	1297	0	121	0	0	83	0	0
5	99	-70	427	0	128393	0	0	48	0	0
6	2902	-5311	32331	0	2728	0	0	2360	0	0
7	3691	-2701	19153	0	1535	0	0	704	0	0
8	7751	-11722	120553	0	4748	0	0	183136	0	0
9	8	-7	42	0	3	0	0	3	0	0
10	30	-38	242	0	21	0	0	30	0	0
11	21336	-7114	45394	0	4483	0	0	292	0	0
12	447	-602	3565	0	321	0	0	425	0	0
13	2834	-4600	18853	0	1848	0	0	718	0	0
14	0	0	0	0	0	0	0	0	0	0
15	4161	-5510	29878	0	2220	0	0	1683	0	0
16	24009	-32011	191732	0	17287	0	0	25697	0	0
17	1523	-2111	11566	0	1083	0	0	571	0	0
18	17	-24	128	0	11	0	0	7	0	0
19	706	-769	4435	0	396	0	0	292	0	0
20	3499	-5071	29022	0	2417	0	0	1559	0	0
21	8213	-12552	59798	0	4732	0	0	2067	0	0
22	755	-1068	5918	0	519	0	0	478	0	0
23	1958	-2332	12835	0	1108	0	0	740	0	0
24	3506	-3354	18155	0	1577	0	0	1250	0	0
25	512	-961	5433	0	289	0	0	144	0	0
26	7641	-10807	61966	0	5588	0	0	3116	0	0
27	9234	-13419	69396	0	6417	0	0	7010	0	0
28	4723	-6627	37108	0	3330	0	0	2076	0	0
29	750	-1133	6503	0	512	0	0	327	0	0
30	10478	-14125	72662	0	7240	0	0	4096	0	0
31	3315	-4614	26284	0	2418	0	0	1366	0	0
32	40178	-56526	317306	0	29838	0	0	19979	0	0
33	55300	-67039	373782	0	29155	0	0	16314	0	0
34	305	-424	2452	0	229	0	0	121	0	0
35	33247	-50217	288240	0	22708	0	0	14561	0	0
36	416	-558	3023	0	279	0	0	167	0	0
37	1672	-2313	13092	0	1116	0	0	701	0	0
38	170436	-238495	1377983	0	129270	0	0	68539	0	0
Total	606635	-809372	4723181	0	414793	0	0	365256	0	0

See footnote at end of table.

Continued

Table 19--Individual sector output changes due to changes in final demand of sectors 1, 2, 3, 5, and 8, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas--Continued

Sector 1/	Sector 1/ 11	12	13	14	15	16	17	18	19	20
	Dollars									
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

See footnote at end of table

Continued

Table 19--Individual sector output changes due to changes in final demand of sectors 1, 2, 3, 5, and 8, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas--Continued

Sector 1/	Sector 1/									
	21	22	23	24	25	26	27	28	29	30
	Dollars									
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0

See footnote at end of table.

Continued

Table 19--Individual sector output changes due to changes in final demand of sectors 1, 2, 3, 5, and 8, Cypress-Black Bayou watershed project, Twin Valley and Trailblazer-4 RC&D areas--Continued

Sector 1/	Sector 1/								
	31	32	33	34	35	36	37	38	Row totals
					Dollars				
1	0	0	0	0	0	0	0	0	183528
2	0	0	0	0	0	0	0	0	-233964
3	0	0	0	0	0	0	0	0	1454168
4	0	0	0	0	0	0	0	0	1630
5	0	0	0	0	0	0	0	0	128899
6	0	0	0	0	0	0	0	0	35010
7	0	0	0	0	0	0	0	0	22382
8	0	0	0	0	0	0	0	0	304467
9	0	0	0	0	0	0	0	0	51
10	0	0	0	0	0	0	0	0	286
11	0	0	0	0	0	0	0	0	64392
12	0	0	0	0	0	0	0	0	4157
13	0	0	0	0	0	0	0	0	19655
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	32432
16	0	0	0	0	0	0	0	0	226715
17	0	0	0	0	0	0	0	0	12632
18	0	0	0	0	0	0	0	0	140
19	0	0	0	0	0	0	0	0	5061
20	0	0	0	0	0	0	0	0	31428
21	0	0	0	0	0	0	0	0	62258
22	0	0	0	0	0	0	0	0	6604
23	0	0	0	0	0	0	0	0	14310
24	0	0	0	0	0	0	0	0	21134
25	0	0	0	0	0	0	0	0	5419
26	0	0	0	0	0	0	0	0	67506
27	0	0	0	0	0	0	0	0	78639
28	0	0	0	0	0	0	0	0	40612
29	0	0	0	0	0	0	0	0	6959
30	0	0	0	0	0	0	0	0	80352
31	0	0	0	0	0	0	0	0	28769
32	0	0	0	0	0	0	0	0	350776
33	0	0	0	0	0	0	0	0	407513
34	0	0	0	0	0	0	0	0	2684
35	0	0	0	0	0	0	0	0	308540
36	0	0	0	0	0	0	0	0	3328
37	0	0	0	0	0	0	0	0	14269
38	0	0	0	0	0	0	0	0	1507735
Total	0	0	0	0	0	0	0	0	5300405

1/ Sector numbers correspond to those listed in table 4.

plier, such as the Bureau of Economic Analysis' "Regional Industry-Specific Gross Output Multipliers" (27). BEA's regional multipliers are useful in estimating the total gross output changes expected to occur in an economy due to final demand changes, but do not provide the information necessary to display the details of the estimated impacts via changes in output by sectors.

Table 20 summarizes the estimated economic impacts developed with the I-O model. Impacts in the table are on an annual basis. The annual effects of project installation expenditures, of course, would only occur during the installation period--4 years for the Cypress-Black Bayou watershed project and 1 year for the Third Forest project. Annual impacts of operation and maintenance and other project-associated activities are expected to occur for the life of the project.

Other project effects are expected to occur in the project area in addition to those analyzed with the I-O method. Some of these could be analyzed using I-O, and others could not. For example, environmental consequences of projects and certain social well-being impacts could not be appropriately evaluated using the I-O method alone. However, I-O techniques could be used to some extent to provide inputs for analyzing the consequences of project action on environmental and social well-being conditions in project planning areas if the model used was adequately modified. An article on the use of I-O in analyzing environmental repercussions was written by Leontief several years ago (8). Some publications are now available demonstrating the use of I-O in examining the distributional effects of employment by industries and by earnings categories which indirectly relate to certain aspects of social well-being.

Table 20--Summary of estimated economic impacts on local economy due to selected project activities, Cypress-Black Bayou watershed and Third Forest projects, Twin Valley and Trailblazer-4 RC&D areas 1/

Project activity	Cypress-Black Bayou watershed project			Third Forest project 4/		
	Output	Income	Employment	Output	Income	Employment
	Dollars	Dollars	Man-years	Dollars	Dollars	Man-years
Project installation 2/	6,201,393	1,775,967	197.1	1,108,888	270,236	38.0
Operation and maintenance	316,804	102,242	9.6	--	--	--
Project associated activity 3/	5,300,467	1,507,736	244.5	--	--	--

1/ A complete assessment of the effects of the 2 projects was not made. Only the effects of selected items related to project activities were assessed to illustrate I-O's use in small area planning. All impacts are on an annual basis.

2/ Project installation impacts are for the installation period only and are nonrecurring.

3/ Net effects of economic activity and changes in output occurring in the project area as a result of the project, or project operation, after installation is completed. Expected to occur annually, i.e., raising the level of output, income, and employment by the estimated amounts and maintaining this level for the life of the project.

4/ Except for installation, no annual impacts are estimated for the Third Forest project. There were no expected returns on the investment in the forest project for 15 years from date of project completion, and maximum effects were not expected until 40 to 50 years in the future. Operation and maintenance expenditures were negligible for the Third Forest project.

Source: Tables 10, 15, and 18.

APPRAISAL OF I-O AS A PRACTICAL PLANNING TOOL IN SMALL AREAS

The I-O model attempts to capture or reflect the workings of an economic system as it actually exists at a given point in time. Once developed, the model does not change; but, of course, the economy does change. Consequently, the models eventually deteriorate and models for dynamic economies obviously deteriorate more rapidly than those for more slow-growing, more static economies.

Since the I-O model is imperfect, results based on the model will also be imperfect. The degree of imperfection will vary depending upon the kind of model, the data used in building it, and the time and care exercised in reducing the magnitude of noted weaknesses.

Appraisal of Applied Uses Illustrated in Study Area

A practical evaluation of I-O results should precede all economic decisions based on them. One should ask questions such as: "How do results appear in light of what is practical to expect? Are the implications of the I-O analysis realistic in view of prevailing circumstances in the economy? Are the estimated changes in final demand realistic? Will the market absorb more of the given commodity? What are the current and expected future magnitudes of the market for a given commodity relative to the I-O model's estimated change in output? Will current and expected economic trends support the implications of the model?" Results of the I-O analysis, including the model itself, should be carefully examined before they are used in planning and formulating projects and in impact evaluations of projects.

The quality of a model depends upon how well it depicts the economy modeled. A problem in developing small area I-O models from secondary data lies in proper adjustments for imports and exports. The computer model-generating program used in developing the northwest Louisiana I-O model adjusts small area models for imports and exports by deleting from the parent model 17/ those industries not in the study area (using secondary data sources) and then balancing the model using the "Supply-Demand Pool Technique" of Schaffer and Chu (18). The techniques for this adjustment and balancing activity are discussed in Appendix C. Some additional import-export adjustments, independent of the computer programs, were made in the northwest Louisiana model's transactions table before computing the direct and total (direct and indirect) requirements matrices.

The adjustments involved three of the area's important resource-oriented sectors engaged in timber production and processing of timber and timber products: (1) forestry, (2) lumber and wood products, and (3) paper and allied products. These sectors were adjusted for import-export relationships based

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17/ Parent model refers to the model used as the basic data source. In this study, it is the 1963 U.S. I-O transactions table at the 478-industry level, but it could be a regional, State, or any larger area model which includes the study area.

on primary data collected from a small sample of firms in each sector. This activity was done to determine how sensitive a local model structured from secondary data is to import-export adjustments and to assess the difficulty of making sectoral import-export adjustments in the event they are needed for the model to be useful at the local level. Also, it provided a rough appraisal of the effectiveness of the techniques used in reducing the national model to the local level, or how well such a model depicted import-export relationships in the local economy.

The import-export adjustments made in each of the three timber-based sectors based on primary data were as follows:

(1) <u>Forestry (sector 12)</u>

a. Exports were reduced.

b. Imports unchanged.

(2) <u>Lumber and wood products (sector 18)</u>

a. Exports were increased.

b. Imports were increased.

(3) <u>Paper and allied products (sector 19)</u>

a. Exports were reduced.

b. Imports unchanged.

Table 21 shows the effects of adjusting the three timber-oriented sectors of the model for changes in imports and exports. Sector output multipliers, with households exogenous, are used to show the effects of the adjustment. As expected, the multipliers of the three sectors whose imports or exports were changed were affected most. Other sectors showing strong trade linkages with these sectors were also affected, as indicated by the change in their multipliers. Sector 12 (forestry) showed an increase in the size of its output multiplier of nearly 7 percent. Sectors 18 (lumber and wood products), 19 (paper and allied products), and 20 (printing and publishing) showed significant reductions in the size of their multipliers. Decreases ranged from 14 to 31 percent for these three sectors. The construction sectors also showed declines in size of output multipliers, averaging about 6 percent.

Another I-O application problem relates to aggregation or product mix in I-O sectors. This is illustrated by table 12. The display of project impacts in terms of output, income, and employment in columns 2, 5, and 6 of the table shows that some sectors unrelated to forestry services or the reforestation program are affected by project installation expenditures. The impact of forestry projects on the cotton and poultry sectors, for example, results because the agricultural services sector (in which the forestry project expenditures were made) includes not only firms and individuals engaged in providing forestry contract services, but also those in other categories such as cotton

Table 21--Comparison of output multipliers, households exogenous, adjusted versus unadjusted models, Twin Valley and Trailblazer-4 RC&D areas, 1971 1/

Sector	Output multipliers: Unadjusted model 2/	Output multipliers: Adjusted model 2/	Change	Sector	Output multipliers: Unadjusted model 2/	Output multipliers: Adjusted model 2/	Change
	Multiplier	Multiplier	Percent		Multiplier	Multiplier	Percent
(1)	1.59	1.58	-.6	(21)	1.62	1.58	-2.5
(2)	1.46	1.45	-.7	(22)	1.62	1.57	-3.1
(3)	1.47	1.46	-.7	(23)	1.62	1.61	-.6
(4)	1.30	1.29	-.8	(24)	1.72	1.68	-2.3
(5)	1.31	1.30	-.8	(25)	1.46	1.44	-1.4
(6)	1.47	1.46	-.7	(26)	1.58	1.54	-2.5
(7)	2.17	2.14	-1.4	(27)	1.34	1.34	--
(8)	1.54	1.53	-.6	(28)	1.16	1.15	-.8
(9)	1.24	1.23	-.8	(29)	1.58	1.57	-.6
(10)	1.37	1.46	+6.6	(30)	1.52	1.51	-.7
(11)	1.69	1.60	-5.3	(31)	1.28	1.25	-2.3
(12)	1.37	1.46	+6.6	(32)	1.32	1.29	-2.3
(13)	1.37	1.37	--	(33)	1.33	1.32	-.8
(14)	1.79	1.68	-6.1	(34)	1.41	1.40	-.7
(15)	1.51	1.42	-6.0	(35)	1.47	1.45	-1.4
(16)	1.98	1.94	-2.0	(36)	1.44	1.42	-1.4
(17)	1.44	1.42	-1.4	(37)	1.26	1.25	-.8
(18)	1.89	1.63	-13.8				
(19)	1.90	1.31	-31.1				
(20)	1.74	1.44	-17.2				

1/ Adjustments relate to imports and exports for three sectors only: (12) forestry, (18) lumber and wood products (except furniture), and (19) paper and allied products.

2/ Both models have been adjusted for imports and exports using secondary data techniques. The above adjustments are based on primary data collected for the three timber and timber-related sectors.

ginning, crop dusting, poultry hatcheries, and others. Also, the agricultural services sector purchases inputs from several agriculture sectors when it increases output as indicated in a recent BEA publication (29). Therefore, when the final demand of the agricultural services sector changes, it affects all categories of subindustries and sectors with which they are interrelated. Displaying the effects of sectors, as is done in table 12, allows the analyst to adjust the indicated impacts by sorting out and deleting those impacts that have no apparent relationship to the project or initial I-O sector affected by the project. However, care must be exercised when doing this so that legitimate indirect impacts of projects are not deleted.

Leontief, in discussing basic problems of empirical I-O analysis, noted that the less aggregative and less index-number-like the objects we are trying to measure, the firmer will be our terminological foothold. For this reason, the meaning of the label attached to the individual entry in a reasonably detailed I-O table can be expected to be more precise than the meanings of broadly defined sectors. More importantly, meanings in I-O tables are bound to gain in definiteness as the number of rows and columns of tables increase, or as the model of the economy becomes more refined. Although the index-number problem cannot vanish entirely, with progressive subdivision, the scale of aggregative indeterminacy is radically reduced. Instead of adding together automobiles and shoes, for example, one has to combine only different kinds of shoes on one hand and trucks and passenger cars on the other (9).

Leontief also noted that problems arise from product mix, such as inappropriate statistical classification resulting in the mixing of several heterogeneous products (9). Both the problems of aggregation and product mix appear to be interrelated and, alone or together, can lead to an overstatement of impacts as illustrated in table 12 where individual impacts of a change in final demand of the agricultural services sector are displayed. However, an I-O model can be used to adjust questionable impacts, as it enables one to break down the total impact into its individual effects on each sector, as in tables 12 and 19. This is not possible where impacts are based on a single, broad, aggregative multiplier. In the latter case, the analyst cannot determine the degree to which each sector of the economy contributes to the size of the multipliers, as can be done with I-O analysis.

A question often raised in I-O model development and application in small areas concerns whether households should be treated exogenously or endogenously. This decision can greatly affect impact estimates. When households are treated endogenously in the northwest Louisiana model, the size of the multipliers increases significantly (table 22). Treatment of households as an endogenous sector in the I-O model can lead to estimating errors when the model is applied to local planning problems if the households sector is not carefully developed before including it in the model.

In developing the households sector, two items are very important. First, the earnings of households or payments to households by each sector in the I-O model must be accurately assessed. This information is used in developing the household row of the model. In small areas, sectors are likely to pay both local and nonlocal households for their services. Payments to nonlocal households represent income leakages. The importance of this depends upon the size

Table 22--Comparison of output multipliers, households exogenous versus households endogenous models, Twin Valley and Trailblazer-4 RC&D areas, 1971

Sector	Output multipliers: Households exogenous	Output multipliers: Households endogenous
	Multiplier	
(1) Cotton	1.58	3.42
(2) Grains	1.45	3.33
(3) Other field crops	1.46	3.31
(4) Fruits and tree nuts	1.29	3.42
(5) Vegetables	1.30	3.24
(6) Dairy products	1.46	2.62
(7) Poultry and eggs	2.14	3.55
(8) Meat animals and miscellaneous livestock	1.53	2.40
(9) Horticultural specialties	1.23	3.57
(10) Fisheries	1.46	2.51
(11) Agricultural services	1.60	3.00
(12) Forestry	1.46	2.38
(13) Mining	1.37	3.29
(14) New construction	1.68	3.71
(15) Maintenance and repair construction	1.42	3.73
(16) Food and kindred products	1.94	3.36
(17) Apparel and other textile products	1.42	2.67
(18) Lumber and wood products (except furniture)	1.63	2.94
(19) Paper and allied products	1.31	2.57
(20) Printing and publishing	1.44	2.79
(21) Chemicals and allied products	1.58	3.14
(22) Stone, clay, glass, concrete, and metal	1.56	3.66
(23) Primary metal industries	1.61	3.06
(24) Fabricated metal products	1.68	3.42
(25) Machinery (except electric)	1.44	2.99
(26) Other manufacturing	1.54	3.41
(27) Transportation and warehousing	1.34	3.40
(28) Communication (except broadcasting)	1.15	3.40
(29) Radio and television	1.57	3.53
(30) Utilities (electricity, gas, water, and sewage)	1.51	2.82
(31) Eating and drinking places	1.25	3.97
(32) Wholesale and retail trade (except eating and drinking places)	1.29	3.80
(33) Finance, insurance, and real estate	1.32	3.66
(34) Lodging places	1.40	3.52
(35) Services (except lodging places)	1.45	3.71
(36) State and local government enterprises	1.42	3.08
(37) Federal Government enterprises	1.25	2.72

of the project area, resource ownership within the area, and the kinds of goals and project measures being considered. Examples of nonlocal payments (leakages) are corporate dividends, rent, interest, and wages and salaries paid to nonresidents. On the other hand, exports of local labor and other receipts of local households from outside the area will increase the personal income of local households and, consequently, increase household expenditures. This income should be accounted for in developing the household row. Examples are wage and salary income of residents who work outside the area, government transfer payments, interest, rent, dividends, and other nonlocal earnings of residents.

Second, the expenditure patterns of local households must be estimated and incorporated in the I-O model. This information is used in developing the household column of the model. In small areas, this is a place for significant leakages of income to occur. Households will buy local goods and services and will also import goods and services from outside the area being modeled. Imports represent leakages, and like nonresidential earnings, will affect the impacts of local projects. Also, the array or patterns of estimated local expenditures by sectors can affect the distribution of project impacts among the individual sectors and consequently the total impacts on the whole economy.

A question that may arise regarding the use of the model in this report concerns the fact that it is based on technical coefficients of the 1963 U.S. I-O model (28). The possibility of outdated technical coefficients is a potential problem in most models developed from secondary data. This, however, may not be critical. The possibility of outdated coefficients is just another reason for the I-O analyst to be cautious when using I-O to analyze current economic problems. Technical coefficients remain more stable in some sectors for longer periods of time than in other sectors.

Regarding stability of technical coefficients, BEA analysts compared the 1967 and 1963 U.S. I-O models. Results showed stability in technical relationships. There was little evidence of change in technology during the intervening years. Their comparison suggests that the problem of technological change in I-O tables may not be as serious a problem as one might think. Thus, the rather common criticism that I-O tables are not very good because they are too old to include the effects of recent changes in technology is perhaps too broad a generalization. Though technology does change, the amount is relatively minimal for most industries over the short- to medium-term. For those industries where changes are clear over the time span of the analytical model, new coefficients can be introduced without inordinate difficulty (16).

The stability of technical coefficients is mentioned as a precaution in using the northwest Louisiana I-O model which, although developed with 1971 employment and sector output data, is based on 1963 basic production function data. In-depth investigations into practical aspects of I-O concepts, as they relate to a model's weaknesses, could provide valuable information toward improving the value of I-O as a practical planning tool.

Appraisal of Extended Uses of I-O Not Illustrated in Study Area

The economic feasibility of a proposed development or RC&D project measure cannot be determined by use of I-O analysis. But, given a project proposal, I-O can be used to estimate economic effects within a stated framework of interrelationships existing in the economy at the present time.

As noted by Isard in discussing an I-O model developed for Puerto Rico and the use of the import/export relationships indicated by the model, I-O will not indicate which industries should be developed. For basic industrial development purposes, one must fall back upon comparative cost studies, location theory, and market and regional analysis. In deciding which basic industries should be encouraged to develop in an area, I-O tables are of no help except as a source of statistical data (7).

However, given resource-use coefficients for sectors within an I-O model, it would appear that I-O could be used to identify, in a general manner, which sectors might experience bottleneck problems because of some limiting resource or other economic factor. This information would be valuable in screening project measures and in focusing economic feasibility analyses on problem areas. It might also be useful in formulating development projects, although this was not illustrated in this report. In appraising I-O as a planning tool, several extended uses of I-O techniques should be mentioned.

For example, analyses of the economic development potential in RC&D areas require a close look at the basic resources available for development. No structural analysis of the economy would be complete without this. It should include an appraisal of the primary resources--land, labor, and capital--in connection with their use in the area's economic structure. Economic growth and improvement in RC&D areas will most likely involve: (1) bringing new natural resources into use, (2) more intensive use of current resources, (3) removal of obstacles or barriers to increased natural resource use, and (4) an expansion of exports and processing activities associated with locally produced products and imported raw material and intermediate goods (i.e., export more of "local value added").

An RC&D area's supply of land, labor, and capital available for economic expansion is fixed (both in quantity and quality) in the short run, and as such, is critical to the area's development. These primary resources are critical in the sense that they may be limiting factors or bottlenecks to expanding economic output in the RC&D area. Therefore, when formulating economic goals and measures for RC&D area development, these factors should be examined. I-O techniques might be useful in this analysis by relating expected changes in final demand and total output to fixed resource or primary input requirements.

The inverse matrix of an I-O model can be used to estimate the total requirements of fixed resources (and imports) necessary for production of a given unit of final demand. This capability requires computation of a coefficients matrix, identified by one I-O analyst as a "factor input-intensity coefficients" matrix (1), or simply a total requirements matrix for all inputs included in the payments sector (quadrant III) of the I-O model. An input-intensity coefficient will express the amount of a production factor (in dollars or physical units) directly and indirectly required to allow the column sector in which it appears to meet a one-dollar increase in final demand for the sector's output. Therefore, input-intensity coefficients can be used to directly translate changes in final demand into requirements for primary and exogenous input factors (1).

Input-intensity coefficients may be computed for an RC&D area I-O model by: (1) developing a matrix of direct primary and exogenous input requirements from data in the payments sector for each processing sector in the I-O model of the local RC&D area, (2) computing direct primary and exogenous input requirements coefficients per dollar of gross output for each processing sector in the I-O model, and (3) multiplying the direct primary and exogenous coefficients matrix (step 2 above) by the inverse matrix, with households exogenous, to get an input-intensity coefficients matrix.

Properly developed and if in adequate detail, the input-intensity matrix (in step 3 above) will show the total primary and exogenous input requirements necessary, by kind of input and by sectors, for the RC&D or small area economy to deliver a dollar of output to final demand.

The simple mathematical formulation underlying computation of factor intensity coefficients, in matrix form, is as follows:

$$S\ (I-A)^{-1} = F$$

where,

$(I-A)^{-1}$ = inverse matrix,
S = matrix of direct factor requirements for fixed resources and imports, and
F = matrix of total requirements of fixed resources and imports per unit of final goods.

Yan, in Introduction to Input-Output Economics, gives a simple, direct discussion on I-O's use in allocation of fixed resources (30).

There is another way to manipulate an I-O model to estimate the impacts of sectoral changes in final demand on an area's fixed resources and imports. That is to first estimate changes in output for each sector in the economy resulting from a given change in final demand (as was done in tables 12 and 19), and then multiply each sector's change in output by its resource use and import coefficients. In other words, multiply the column of sectoral output changes by a matrix of factor input coefficients (factor inputs required per unit of output) as defined in matrix S above.

This extension of I-O's capability in estimating impacts of project measures on individual sectors of the economy to identification of resource requirements appears to be valuable in plan formulation and execution. It provides the decisionmaker a closer look at local impacts of projects and the wide range of their repercussions in the local economy in terms of resource requirements. Results of this kind of analysis could be used in detecting resource shortages (critical factors or bottlenecks) associated with changes in output of the area economy by keying in on individual sectors and examining their production functions or input requirements. However, as noted earlier, a table of resource use coefficients for the area's economic sectors would need to be developed to be used in conjunction with the I-O model.

Another extension of I-O in providing planners with more decisionmaking information is its use in developing distributional effects of project impacts on employment and income in project areas. I-O can be used to estimate the effects of changes in final demand on employment and income by sectors in the local economy, as illustrated in table 12. Estimated employment and income could be allocated by occupation and skill group within each sector. This array of effects, aggregated across sectors by employment or income classes, would indicate distributional effects of project measures.

Of course, prerequisite to allocation of project-generated employment among occupation groups and earnings (or income) groups is knowledge about each sector's labor, and its payments for different types of labor. Secondary data on employment and earnings, such as that published by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics, can be used in developing this employment and earnings knowledge.

Implicit in this use of I-O is the assumption that new employment created by expansion in a given sector's output will assume the same skills structure as that already existing in the sector (i.e., there will be a proportionate increase in labor requirements by skill groups). Further, it assumes that the wage and salary scales of the new employment will be the same as that prevailing in the sector before a change in output occurred. This assumption is consistent with I-O theory since the I-O model is built on the assumption of fixed production coefficients and constant prices.

As employment opportunities increase in small areas, there will be a corresponding increase in population unless local unemployment is severe and/or jobs created by development projects are filled by commuters from outside the project area. Population increases will mean increased demands on public facilities and services. Such data as in table 23 can be used in conjunction with I-O impact estimates to help planners evaluate and foresee such needs and plan their development and tax structure programs accordingly.

Table 23--Per capita expenditures for public facilities and services, selected items, by size of population, 1969-70

Item	Municipalities having a 1970 population of: 200,000 to 299,999	100,000 to 199,999	50,000 to 99,999	Less than 50,000
	Dollars			
General expenditure, all functions	236.61	203.21	169.54	112.25
Capital outlay	65.95	47.09	38.45	27.67
Other	170.66	156.12	131.09	84.58
Education	40.31	41.99	31.79	10.75
Other than capital outlay	35.03	36.17	27.21	9.59
Highways	23.17	18.80	19.78	17.41
Other than capital outlay	10.26	10.28	10.51	11.10
Hospitals	4.28	6.07	5.15	4.75
Other than capital outlay	3.92	5.73	4.61	4.26
Police protection	21.74	20.89	18.11	13.45
Fire protection	16.95	16.80	15.12	7.73
Sewerage	20.60	11.27	9.73	10.44
Other than capital outlay	5.24	4.37	3.93	4.25
Sanitation other than sewerage	12.05	8.10	6.81	5.20
Parks and recreation	13.00	11.92	10.29	5.61
Libraries	4.57	3.17	3.06	1.77
Water supply	18.18	16.94	16.50	17.66
Current operation	9.62	9.12	9.33	9.80
Capital outlay	6.29	6.25	5.55	5.78
Interest on debt	2.27	1.57	1.62	2.07
Other utilities	14.35	22.10	12.55	16.16
Current operation	7.63	15.32	7.60	12.69
Capital outlay	5.63	5.82	4.10	2.86
Interest on debt	1.09	0.96	0.84	0.60

Source: Bureau of the Census, U.S. Department of Commerce, City Government Finances in 1969-70, G F70, No. 4, Washington, D.C., Sept. 1971.

CONCLUSIONS

The expected impacts of development measures, estimated via I-O, can be displayed in a table showing the kinds of economic impacts that can be expected for each project measure alternative. Costs of each alternative added to this impact display would provide the project planners and decisionmakers valuable information on local returns per dollar spent for each development alternative.

To take full advantage of an I-O model as a planning aid, the I-O inverse matrix should be used to examine the detailed effects of project impacts. The I-O sector multiplier, like the broad, aggregative multipliers of other similar analytical techniques, provides only an aggregated estimate of project impacts on the whole economy, not on its individual sectors. It is the project impacts on individual sectors (or the incidence of impacts) that is useful in plan evaluation, especially in small areas and where public involvement is of concern. Also, the detailed analysis of project impacts afforded by the I-O inverse matrix makes it possible to appraise the practical aspects of the estimated impacts and their implications.

Use of I-O analysis in project planning in RC&D and small watershed areas where implementation is intended hinges on meeting two requirements. First, if I-O models are expected to yield analytical results of practical value to planners and decisionmakers, they must define the given economy in sufficient detail to relate to accounting components in project plans. That is, I-O model sectors must be disaggregated sufficiently to be analytically compatible with the economic effects of project measures. Second, models must be relatively inexpensive and capable of development over a fairly short time period.

Several important or key sectors of the study area model could have been improved or made more useful by further disaggregation. This would require more data which probably could only be obtained from primary sources within the study area. However, the model at its current level of disaggregation was useful in analyzing project impacts. It was adequate in developing information for comparing the relative value of alternative project measures.

I-O models for small planning areas can be developed from parent models (State, regional, or national models) and other secondary data at relatively low cost. Such models should be adjusted for import-export relationships at the local level to increase the reliability of model results and their use in planning areas.

Time requirements for model generation will vary depending upon the model. However, a model similar to the one in this study could probably be developed in 3 months or less, using the national I-O model as the main data source. This time could be reduced with further refinements in the computer program. This would not, however, include collecting primary data from local project areas and adjusting the model for import-export relationships.

For application to local economic areas, the I-O model results could be improved if supplemented by detailed information on local industry trade patterns. This problem relates to the import-export relationships mentioned above and local capacities and prospects for further expansion in output. Such information as which sectors process locally produced goods and what percent of raw material such as mineral products and raw farm products is processed in the area and the percent exported in raw form (unprocessed) is needed to improve the estimates made with the models. Local primary data is needed because secondary data used in model development may be inadequate for appraising the implications of output changes. Also, as noted, the use of the model could be broadened if resource use coefficients were developed for its sectors.

The computer program (used in this study) for developing small area models via the national I-O model is now operative. All that is required is that the small area model be defined according to the industry classification codes of the national I-O model, and external inputs as identified in Appendix C be provided. The program creates models of variable size, given the data inputs, with households treated either endogenously or exogenously. The payments sector of the model consists of imports, other value added, and households (if households are not treated endogenously). Final demand includes six categories: (1) personal consumption, (2) gross private capital formation, (3) net inventory change, (4) Federal Government purchases, (5) State and local government purchases, and (6) exports. The program computes, in addition to the inverse matrix, I-O output, income, and employment multipliers by sector. With slight modification, and given the necessary data, the program could compute pollution, energy, water use, and other resource requirement multipliers. However, data requirements for this extension of I-O would need to be assessed before determining its feasibility.

In view of data requirements and more refinements needed in I-O model analytical techniques, it would be advisable to have future I-O application to planning activities be a team effort involving two or more individuals, including members of the planning parties and sponsoring agencies such as SCS. Also, since use of I-O results in small planning areas will require skill and knowledge of I-O techniques on the part of the local planning analyst, users should be trained or briefed on I-O techniques and their application.

APPENDIX A

SECTOR CLASSIFICATION OF NORTHWEST LOUISIANA I-O MODEL

Sector Number and Title	Related SIC Codes	Types of Establishments and Activities Included in Sectors 1/
	PROCESSING SECTORS	
AGRICULTURE	DIVISION A	
(1) Cotton	0112	Cotton farms or that portion of the farm operation engaged in cotton production.
(2) Grains	0113	Production of corn, rice, soybeans, and wheat.
(3) Other Field Crops	0110	Production of crops such as hay, alfalfa, and sugarcane.
(4) Fruits and Tree Nuts	0122	Production of fruits and nuts.
(5) Vegetables	0123	Truck farms, melons, onions, beans, lettuce, and other vegetables.
(6) Dairy Products	0132	Production of milk and other dairy products on the farm.
(7) Poultry and Eggs	0133, 0134	Production of broiler chickens, chicken egg farms, turkey, duck, geese, and quail farms.
(8) Meat Animals and Miscellaneous Livestock	0135, 0136, 0139, 0193	Production of beef cattle, hogs, and horses.
(9) Horticultural Specialities	0192	Production of flowers and shrubs. Nurseries and greenhouses.
(10) Fisheries	091	Catching of finfish, shellfish, and other marine activities. Includes fresh water commercial fisheries.

Continued

1/ See footnote at end of table.

Sector Number and Title	Related SIC Codes	Types of Establishments and Activities Included in Sectors 1/
	PROCESSING SECTORS	
AGRICULTURE	DIVISION A	
(11) Agricultural Services	071, 072, 073 085, 098	Cotton ginning, grain harvest and other contract work, animal breeding, poultry hatcheries, fish farms and hatcheries, forestry services, animal husbandry services, landscape gardening, and tree planting.
(12) Forestry	074, 081, 082 084, 086	Operation of timber tracts, forest nurseries, gum extraction, and other forest products.
MINERALS	DIVISION B	
(13) Mining	10, 11, 12, 13, 14	Extraction of coal, ores, crude petroleum, natural gas, quarrying and chemical, and fertilizer mineral mining.
CONTRACT CONSTRUCTION	DIVISION C	
(14) New Construction (construction related to new or original structures, additions, alterations, and remodeling of building and nonbuilding facilities)	15, 16, 17	Construction (including new work, additions, alterations, and repair) of buildings such as houses, apartment buildings, farm buildings, commercial and public buildings, power plants, and pumping stations.
(15) Maintenance and Repair Construction (construction related to upkeep and maintenance of existing building and nonbuilding facilities)		Highway and street construction, construction of railroads, elevated highways, viaducts, dams, reservoirs, docks, and drainage projects. Plumbing, heating, air conditioning, electrical work, paper hanging, painting, carpentering, masonry, metal, and concrete work.
MANUFACTURING	DIVISION D	
(16) Food and Kindred Products	20	Meat, vegetable and dairy products processing, flour mills, and cottonseed oil and soybean oil mills.

Continued

1/ See footnote at end of table.

SECTOR CLASSIFICATION OF NORTHWEST LOUISIANA I-O MODEL--Continued

Sector Number and Title	Related SIC Codes	Types of Establishments and Activities Included in Sectors 1/
	PROCESSING SECTORS	
MANUFACTURING	DIVISION D	
(17) Apparel and Other Textile Products	23	Production of clothing, sheets and other bed covering, curtains, and draperies.
(18) Lumber and Wood Products (except furniture)	24	Logging camps and contractors, sawmills, planing mills, millwork, and veneer and plywood production.
(19) Paper and Allied Products	26	Pulp, paper and paper board mills, paper coating and glazing, envelopes, bags and wallpaper production, and manufacture of sanitary paper and food containers.
(20) Printing and Publishing	27	Publishing and printing newspapers, periodicals, books, greeting cards, and business forms and commercial printing and bookbinding.
(21) Chemicals and Allied Products	28	Industrial inorganic and organic chemicals, plastics, synthetic resins and rubber, drugs, soap, perfume, cosmetics, paints, gum and wood chemicals, fertilizers, and pesticides.
(22) Stone, Clay, Glass, and Concrete Products	32	Flat glass, glass containers, glass products, tile, cement, pottery, concrete, gypsum, asbestos, lime, brick, and cut stone.
(23) Primary Metal Industries	33	Blast furnaces, steel works, rolling and finishing mills, and iron and steel foundries.
(24) Fabricated Metal Products	34	Manufacture of metal cans, cutlery, hand tools, hardware, plumbing fixtures, fabricated structural metal products, bolts, nuts, screws, and metal stampings.

Continued

1/ See footnote at end of table.

Sector Number and Title	Related SIC Codes	Types of Establishments and Activities Included in Sectors 1/
	PROCESSING SECTORS	
MANUFACTURING	DIVISION D	
(25) Machinery, (except electrical)	35	Manufacturing of steam engines, hydraulic turbines, internal combustion engines, machinery and equipment, such as grain combines, cotton pickers, bulldozers, concrete mixers, cranes, conveyors, industrial trucks, tractors, metalworking machines, and office, computing and accounting machines.
(26) Other Manufacturing		Electrical machinery, equipment and supplies, such as motors, generators, and household appliances, transportation equipment, clocks, watches, jewelry, and petroleum and coal products.
TRANSPORTATION, COMMUNICATION, AND PUBLIC UTILITIES	DIVISION E	
(27) Transportation and Warehousing	40, 41, 42, 45, 47	Railroad transportation, local and suburban transit passenger transportation, taxi cabs, trucking, warehousing, air transportation, and transportation services.
(28) Communication (except broadcasting)	481, 482, 489	Telephone and telegraph communication.
(29) Radio and Television	483	Radio and television broadcasting stations.
(30) Utilities (electricity gas, water, and sewage)	49	Electric, gas, water, and sanitary service companies.
WHOLESALE AND RETAIL TRADE	DIVISION F	
(31) Eating and Drinking Places	58	Cafeterias, restaurants, oyster bars, beaneries, soda fountains, dairy bars, night clubs, bars, saloons, and taverns.

Continued--

1/ See footnote at end of table.

Sector Number and Title	Related SIC Codes	Types of Establishments and Activities Included in Sectors 1/
	PROCESSING SECTORS	
WHOLESALE AND RETAIL TRADE	DIVISION F	
(32) Wholesale and Retail Trade (except eating and drinking places)	50, 52, 53, 54, 55, 56 57, 59	Wholesale distribution of merchandise to retail outlets and retail stores, selling merchandise for personal, household, or farm use and consumption, such as department and grocery stores, meat, fish, and fruit markets, automotive dealers, gasoline service stations, furniture, hardware, shoe, and drug stores, liquor stores, antique shops, and other retail outlets.
FINANCE, INSURANCE, AND REAL ESTATE	DIVISION G	
(33) Finance, Insurance, and Real Estate	60, 61, 62, 63, 64, 65, 66, 67	Federal Reserve Banks, commercial banks, savings and loan associations, agricultural credit institutions, personal credit unions, security and commodity brokers, life, health, and accident insurance companies, insurance agents, brokers and adjusters, real estate operators, agents, brokers, and lessors, title, abstract, and investment companies.
SERVICES	DIVISION H	
(34) Hotels, Motels, and Other Lodging Places	70	Hotels, inns, motels, cabins, resort hotels, YMCA, YWCA, boarding houses, trailer parks, and camps.
(35) Services (except lodging places)	72, 73, 75, 76, 78, 79 80, 81, 82, 0722	Personal services, such as laundries, barber shops, beauty shops, diaper service, funeral service, advertising agencies, automobile repair shops, motion picture production and movie houses, amusement and recreational services, medical and health services, such as physicians and dentists, veterinarians and animal hospitals, legal services, educational services, and nonprofit organizations.

1/ See footnote at end of table.

Continued

SECTOR CLASSIFICATION OF NORTHWEST LOUISIANA I-O MODEL--Continued

Sector Number and Title	Related SIC Codes	Types of Establishments and Activities Included in Sectors 1/
PROCESSING SECTORS		
GOVERNMENT ENTERPRISES		
(36) State and Local Government Enterprises		Government-operated facilities, such as electric, gas, and water utilities, passenger transit service, highway toll facilities, air transportation facilities, and State-owned liquor stores.
(37) Federal Government Enterprises		Federal Government-operated facilities such as post offices, military post exchanges, TVA, Commodity Credit Corporation, and Rural Electrification Administration.
HOUSEHOLDS		
(38) Local Households		Income and expenditures of local households. Payments to households by sectors in model for labor, rent, interest, profits, dividends, etc. Personal consumption expenditures made by households to sectors in the model.
PAYMENTS SECTORS		
IMPORTS		Purchases of goods and services by sectors in the modeled economy from sources outside the study area. Payments in the form of wages, salaries, rent, interest, and dividends to nonlocal labor and nonresidents for capital and other primary inputs. Payments for imported goods including raw material, semi-finished goods, and finished goods.
OTHER VALUE ADDED		Indirect business taxes, capital consumption allowances, corporate income (or profits), taxes, and retained earnings.

1/ See footnote at end of table.

Continued

Sector Number and Title	Related SIC Codes	Types of Establishments and Activities Included in Sectors 1/
PROCESSING SECTORS		
FINAL DEMAND SECTORS		
Local Households (in processing sector)		Local household personal consumption expenditures included in processing sector. Nonlocal personal consumption expenditures included in exports.
Net Inventory Change		The value of the change in the physical volume of inventories held by business.
Gross Private Capital Formation (capital accumulation)		Purchases of plant, machinery, and equipment to be used in the production of goods and services. New construction, including both residential and nonresidential.
Federal Government Purchases		Federal Government expenditures for goods and services.
State and Local Government Purchases		State and local government purchases of goods and services.
Exports		Receipts of local businesses and households for goods and services sold to nonlocal households and business firms.

1/ The listing of establishments and activities in each industry group is incomplete. The listing indicates generally what is included in each industry group but is not exhaustive. Also, if a particular activity did not exist in the study area, it was deleted from the model during the industry aggregation process. The study area is comprised of the following parishes in northwest Louisiana: Bienville, Bossier, Caddo, Claiborne, DeSoto, Natchitoches, Red River, Sabine, and Webster.

APPENDIX B

MODEL GENERATION FLOW CHART

(1) Define subarea model.

(2) Adjust 1963 U.S. I-O flow table, 478-industry level, by deleting sectors not in subarea economy.

(3) Aggregate sectors of adjusted U.S. I-O flow table to level of subarea model.

(4) Compute direct requirements matrix for adjusted and aggregated U.S. I-O model flow table.

(5) Estimate sector total gross outputs (TGOs) for subarea model.

(6) Multiply adjusted U.S. direct requirements matrix times subarea TGOs (column by column) to get partial subarea flow table. → A

Continued

A →

(7) Estimate final demand vectors including local personal consumption expenditures for the subarea model, except exports, and read into flow table in Step 6. This gives first approximation of subarea model.

(8) Estimate total personal income of subarea and payments of government to households. Read into flow table. During balancing of flow table, the sum of all entries in household row is forced to equal total personal income of area. This is a way of adjusting model for sector payments to nonresidents of subarea and for labor exports.

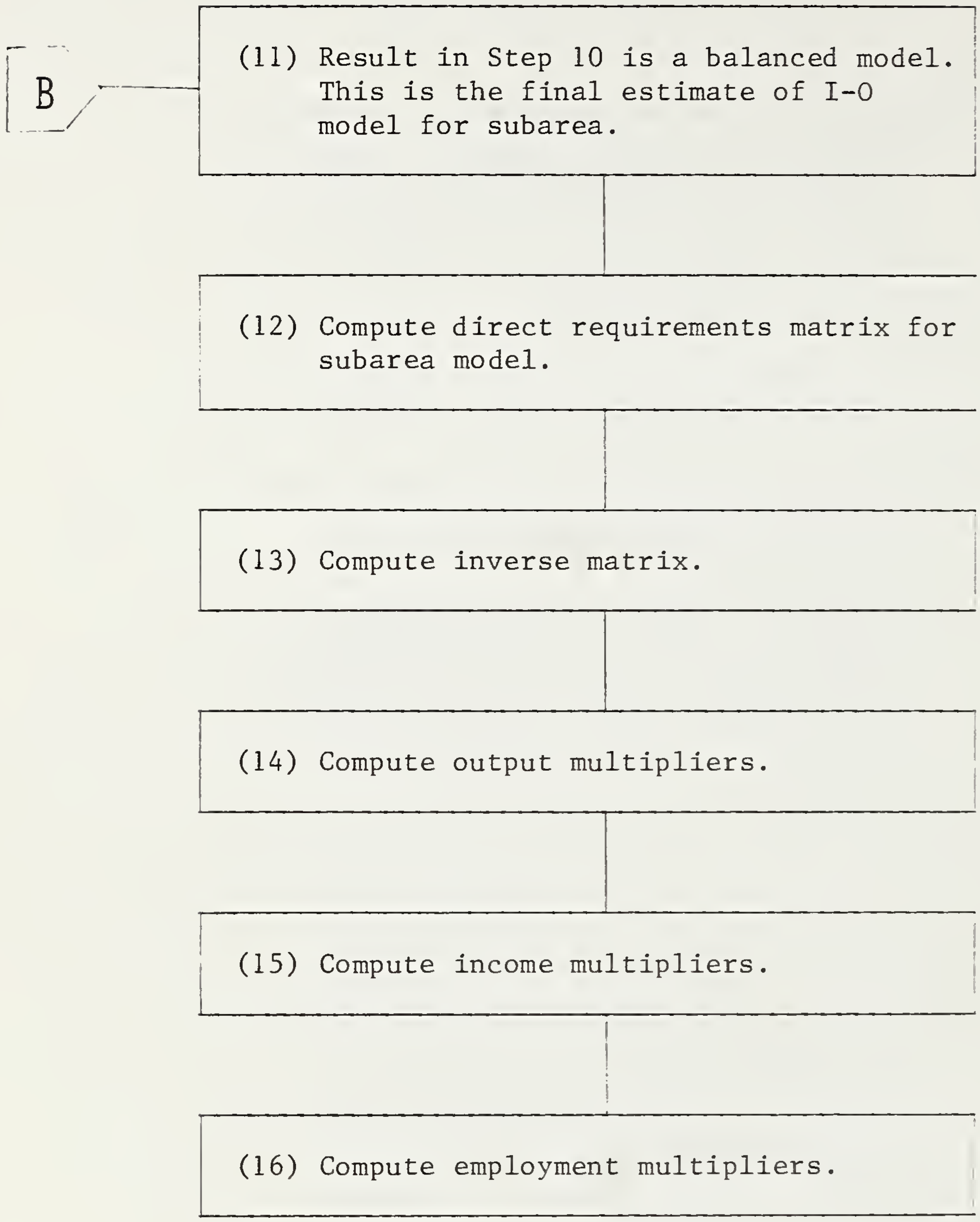
(9) Balance subarea model for exports and imports, using TGOs as control totals. Use supply-demand pool technique discussed in Schaffer and Chu's "Non-Survey Techniques for Constructing Regional Interindustry Models" (18).

(10) Force household column total to equal household row total. If column total is less than row total, increase household column imports by difference; if greater than row, reduce imports by difference.

→ B

Continued

MODEL GENERATION FLOW CHART--Continued



APPENDIX C

METHODOLOGY

It would be too great a task in this report to list all the data sources and estimating techniques used in developing the northwest Louisiana I-O model. Throughout the development of the model, there were numerous excursions in search of data and techniques to estimate inputs, outputs, employment, and income for various sectors for which data were either incomplete or not readily available. However, in the following sections, the major data sources and methodology are identified and discussed.

The I-O model generation system used in developing the northwest Louisiana I-O model was based entirely on secondary data. The transactions table was constructed using an aggregation and matrix balancing program developed at the University of Florida. Computer facilities there were used in running most of the matrix generation programs connected with the model. An aggregation program was developed to aggregate the 478-industry level 1963 national I-O table to the sector classification level of the study area model. The aggregated study area model was adjusted and balanced using a program that employed the supply-demand pool technique developed by Schaffer and Chu. The computer programming and data processing were under the direction of Robert McElroy of the Food and Resource Economics Department of the University. Professor Edna Loehman of the same department provided technical consultation in developing the computer program and the I-O final demand vectors.

The computer program for the system used the following inputs:

(1) Computer tape of National 478-Industry Level Input-Output Transactions Matrix for 1963.

(2) Industry description of study area model.

(3) Total gross outputs of industries in study area model and for Louisiana.

(4) Estimates of final demand for each industry in the model, except for exports. Exports were estimated as a residual during a flow-table balancing routine via the computer program.

(5) Employment by industry for the study area and for Louisiana.

(6) Household income and personal consumption expenditures by industry.

(7) Constant dollar deflators or ratios for adjusting input data for different years.

(8) Study area to State personal income and population ratios.

The preceding inputs were used in the computer program to develop the I-O model and I-O multipliers.

The first step was to define the study area model. County Business Patterns (CBP); USDA's Agricultural Statistics; U.S. censuses of population, governments, minerals, manufactures, wholesale and retail trade, and services; and State directories of manufactures were used in defining the small area I-O model (along with the analyst's knowledge of the area economy). Industries in the study area model were assigned industry codes corresponding to industry codes on the U.S. I-O model tape.

Next, the U.S. I-O model tape was edited by deleting from the national flow table those industries not present in the study area. After editing, the remaining industries in the U.S. flow table were aggregated according to sector definitions of the study area model.

The aggregated tape was then used to compute a direct requirements matrix, which was multiplied by gross outputs estimated for each of the industries in the study area model (a column-by-column operation). The result was a partial I-O flow table of the study area. Households and final demand inputs were added to the flow table at this point in the program.

The household row for the study area model was estimated using the value added component of the 1963 national I-O model. The national value added figures were used to estimate value added for corresponding sectors in the study area model based on sector employment and payroll data and total gross output of each sector. The value-added estimates for the study area model were then adjusted to remove payments for indirect business taxes, corporate profits taxes, retained earnings, and capital consumption allowances; this left wages, salaries, and property income as payments to the household row or household income. Statistics of Income was used in making these adjustments (5, 6). Household row entries were then adjusted for payments by local businesses to nonresidents, and for income received by local residents from nonlocal sources by using total personal income estimates of the study area population acquired from the 1970 U.S. Census of Population (24).

The household column (expenditures) was developed using data in Scheppach's State Projections of GNP (20) for Louisiana and the total personal income ratio of the study area to Louisiana.

Industry estimates of final demand (except for exports) were developed using Scheppach's data (20). These along with the household row and column data were fed into the program and included in the flow table to make it complete, except for imports and exports. Next, the study area model was balanced by estimating imports and exports for the various industries in the model. This was a row-by-row operation. Industry sales along each row were summed, including sales to final demand. Row totals of each industry were compared to total gross outputs which were used as control totals. Total gross outputs were held constant and were not changed during the balancing process. Exports were estimated as a residual during this activity. Also, additional imports were estimated and added to the import row if local requirements were not met by local production. This process employed the Schaffer and Chu supply-demand pool technique (18).

Import and export changes were estimated as follows:

(1) If a row total (regional requirements) exceeded industry total gross output, that industry's exports were set equal to zero, and all cell entries along the row were reduced proportionately, moving all reductions to the import row under appropriate columns. The reduction process simply required multiplying each row entry by the ratio of industry total gross output to industry row total.

(2) If a row total was less than industry total gross output, the surplus output (total gross output minus row total) was moved to the export cell in the industry row and other entries in the row were left unchanged.

(3) If a row total equaled total gross output, no changes were required.

When this activity was completed, column totals equaled row totals, and the resulting flow table was the final estimate of the study area I-O model transactions matrix.

Total gross outputs used as inputs to the model generation program were estimated in several ways. Output/employment ratios were used for nonagricultural sectors. These were computed from existing State data available in the Harvard MRIO model (17) which provides estimates of industry output and employment for specified years at the State level. Estimates of final demand were computed using data from the same source (20). Local employment, population, and personal income were used in adjusting State (Louisiana) gross output and final demand data to the study area level.

USDA's national, State, and county statistics, publications of the U.S. Census of Agriculture, and USDA's Statistical Reporting Service's State publications were used in estimating output, income, and employment for agriculture sectors in the study area model. Louisiana Forestry Commission publications (12) were used to develop data for the forestry sector.

The computer program for developing small area models, such as the northwest Louisiana model, using data in the national I-O model is now operative. All that is required is that the small area model be defined according to the industry classification codes of the national I-O model and external inputs as identified above be provided. The program creates models of variable size, given the data inputs, with households treated either endogenously or exogenously. The computer program has been revised since development of the northwest Louisiana model so that data in the more recent 1967 national I-O model could be used, rather than the 1963 I-O data.

The payments sector of the program model consists of imports, other value added, and households (if households are not treated endogenously). Final demand includes six categories: (1) personal consumption, (2) gross private capital formation, (3) net inventory change, (4) Federal Government purchases, (5) State and local government purchases, and (6) exports.

The program computes, in addition to the inverse matrix, five I-O multipliers by sector: (1) output, (2) Type I income, (3) Type II income, (4) Type I employment, and (5) Type II employment multipliers. With slight modification, and given the necessary data, the program could compute pollution, energy, water use, and other resource requirement multipliers discussed in the main text of this report.

APPENDIX D

ADDENDUM TO TABLE 8

This appendix defines further the economic multipliers in table 8. Column (1), Sector Output Multiplier: Obtained for each sector of the study area I-O model by summing the column entries in table 7, the column sums being the column sector's output multiplier. It shows the total dollars' worth of output the whole economy must produce per dollar of output sold to final demand by the column sector. Therefore, to use this multiplier, one must know the change in final demand of the given sector. The sector's output multiplier times the sector's change in final demand will yield a product which is an estimate of the total output change expected to occur in the modeled economy due to that sector's change in final demand. The change in final demand may be either an increase or reduction in sales; the multiplier is applicable in either case.

Column (2), Direct Employment Effect: A sector's total employment divided by its total output. Employment is in man-years and output in dollars. It is estimated independently of the I-O model. The ratio shows the change in man-years of employment of a sector per dollar change in output of the sector.

Column (3), Total Employment Effect: This column of coefficients shows the total change in employment in the whole economy per dollar change in final demand for each sector. A sector's total employment effects coefficient times that sector's change in final demand will yield a product which is an estimate of the total employment change (in man-years) in the whole economy due to that sector's change in sales to final demand.

The total employment effects coefficients were computed for the study area economy (I-O model) by multiplying entries in table 7 (the inverse matrix of the model) by the direct employment coefficients (shown in column 2 of table 8).

Column (4), Employment Multiplier: An estimate of the total employment change in the whole economy per one-unit change (a one-man-year change) in employment in a given sector of the study area model. A sector's employment multiplier times that sector's change in employment (increase or decrease in man-years of employment) will yield a product which is an estimate of the total change in the whole economy due to employment changes in the given sector.

The employment multiplier for an I-O model sector is computed by dividing that sector's total employment effects coefficient by the sector's direct employment effects coefficient. To use this multiplier in estimating employment changes in the economy due to a sector's change in sales to final demand, one must first estimate the direct employment change occurring in the sector. The direct employment change of a sector is estimated by multiplying the sector's direct employment coefficient (column 2, table 8) times the sector's change in final demand. The resulting product (an increase or decrease in man-years of employment in the sector) times that sector's employment multiplier will yield the estimated change in man-years of employment expected to occur in the whole economy due to the given sector's change in sales to final demand.

Column (5), Direct Income Effect: The direct income effect coefficient is the total income payments of a sector (wages, salaries, interest, rent, profits, etc.) divided by its total output (in dollars). The ratio shows the change in income payments by a sector per dollar change in output of the sector.

Column (6), Total Income Effect: The total income effects coefficient of a sector shows the total change in personal income expected to occur in the whole economy per dollar change in that sector's sales to final demand.

A sector's total income effects coefficient times that sector's change in final demand will yield a product which is an estimate of the total change in personal income expected to occur in the whole economy due to that sector's change in sales to final demand.

Column (7), Income Multiplier: An estimate of personal income changes expected to occur in the whole economy for each dollar change in income payments to a particular sector of the study area model. It is the ratio of the total income effects to the direct income effects of a sector.

To use the income multiplier for estimating total income changes in the economy due to a sector's change in sales to final demand, one must first estimate the direct income change expected in the given sector due to its change in final demand. The direct income change of a sector is estimated by multiplying the sector's direct income coefficient (column 5, table 8) times the sector's change in final demand. The resulting product, the estimated change in that sector's personal income payments, times the sector's income multiplier will yield a product which is the estimated change in dollars of personal income (a gain or loss depending on whether final demand sales of the sector increased or decreased) expected to occur in the whole economy due to the sector's change in final demand.

In summary, the sector output, employment, and income multipliers in table 8 are used to estimate economic changes in the modeled economy as follows:

(1) Sector Output Multiplier. To estimate changes in output in the whole economy, multiply the sector output multiplier times the sector's change in final demand. The result is an estimate of the total output change in the economy.

To estimate the distributional or sectoral effects of a final demand change, rather than using the output multiplier, multiply a sector's change in final demand by the sector's column of inverse coefficients found in table 7. Each respective inverse coefficient in the column times the column sector's change in final demand will yield a product which is the estimated change in output for each row sector in the table. (This procedure is illustrated in columns (1) and (2) of table 12). The sum of the individual (sector) changes in output will equal the product obtained by multiplying the sector output multiplier by the change in final demand.

(2) Sector Employment Multiplier. To estimate changes in employment in the whole economy, multiply the sector employment multiplier by the sector's change in employment.

(3) Sector Income Multiplier. To estimate changes in income in the whole economy, multiply the sector income multiplier by the sector's change in income payments to households.

If there are changes in final demand in more than one sector of the economy, simply estimate the individual impacts of each sector on the economy, as described above, and then sum the impacts of each sector to get the total impacts of project action (as in table 20).

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