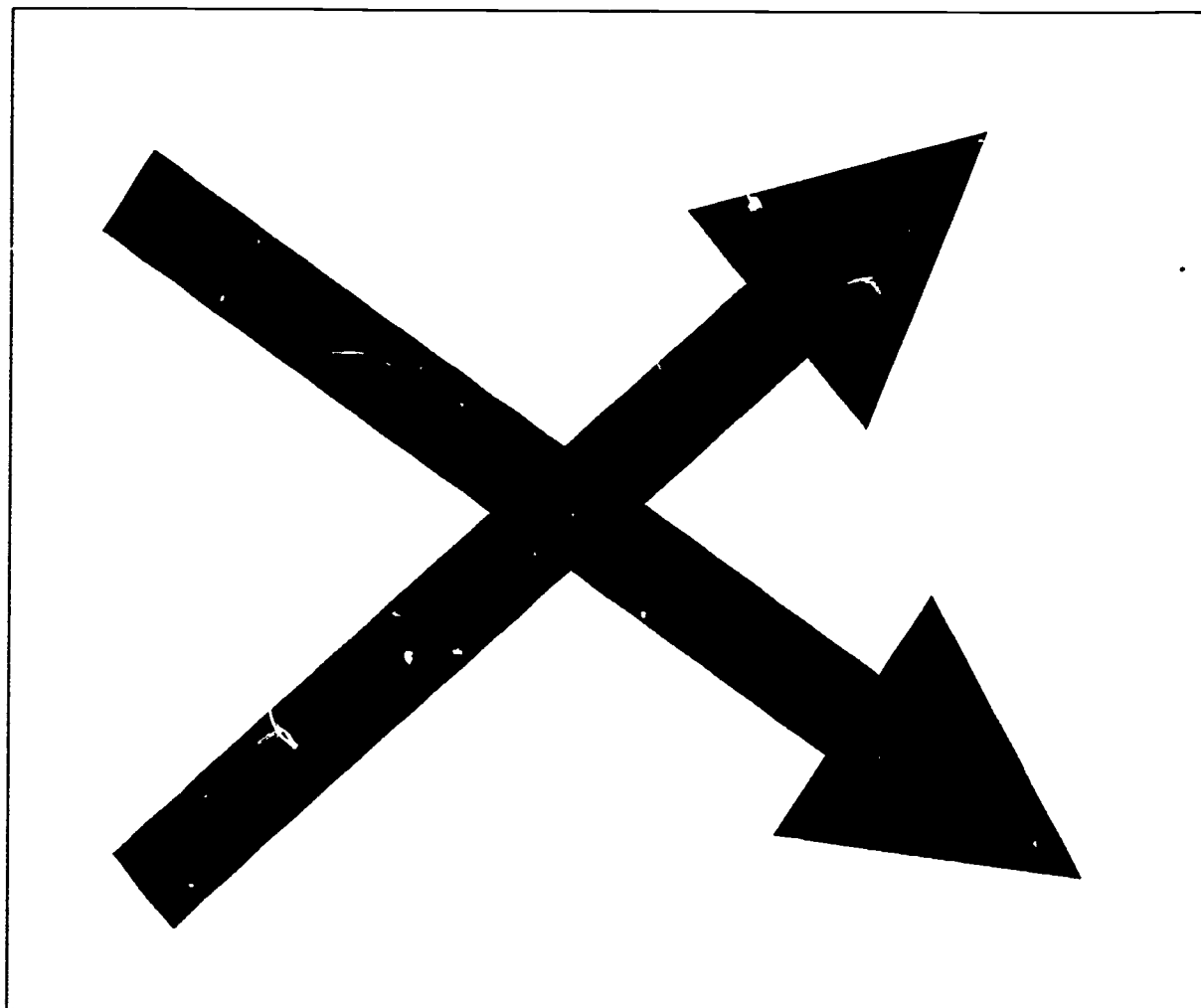ABSTRACT
              This study deals with the structural
interrelationships among agricultural sub-sectors, and between the
agricultural and non-agricultural sectors of the West Virginia
economy. The study is intended to offer information on which to base
sound economic development decisions. An input-output economic model
is used in order to focus on the interaction between agricultural
production and other sectors of the state economy. The major findings
are: (1) a $1 million change in commodities sales at the farm level
translates into an average change of $2.9 million in the state's
total output of goods and services; (2) a $1 million change in gross
farm income yields an average change of $2.2 million in statewide
income; (3) every 100 jobs created in the agricultural production
sector stimulates 295 total jobs in the state economy; (4) the crop
production sub-sectors have larger output and employment multipliers,
on average, than those for livestock production, although the
livestock production sub-sectors have larger average income
multipliers; (5) the agricultural production sub-sectors showing high
impact on the state economy include dairy products, food and feed
grains, and fruit and nut trees; and (6) input-output coefficients
from this study reflect high degrees of interdependence among
agricultural production sub-sectors and between the agricultural
sector and other sectors of the economy. The paper includes three
tables showing cash receipts from farm sales, sectors and their
components, and input-output multipliers for different sectors.
Includes 11 references. (TES)

THE ROLE OF AGRICULTURE IN THE ECONOMIC DEVELOPMENT OF WEST VIRGINIA: AN INPUT-OUTPUT ANALYSIS

Authors

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Highlights

The economic linkages among the agricultural sector, its input supply sources, and the associated manufacturing, processing, marketing, and service sectors, determine the impact that changes in agriculture are likely to have on the West Virginia economy. Sound economic development decisions require knowledge about the effects of these linkages. To provide some of this information, an input-output model was constructed focusing on the interaction of the agricultural production sector with other sectors of the state economy.

The major findings are:

1. A $1 million change in sales of agricultural commodities at the farm level results in an average change of $2.9 million in the state's total output of goods and services;

2. A $1 million change in gross farm income results in an average change of $2.2 million in statewide income;

3. As a result of the above impacts, every 100 jobs created in the agricultural production sector stimulate 295 total jobs in the state economy;

4. The crop production sub-sectors have larger output and employment multipliers, on average, than those for livestock production, although the livestock production sub-sectors have larger average income multipliers;

5. Among the agricultural production sub-sectors ranking high in terms of potential impact on the state economy are the dairy products sub-sector, the food and feed grains sub-sector, and the fruit and tree nuts sub-sector; and

6. The magnitude of input-output coefficients estimated from this study indicates relatively high degrees of interdependence not nly among agricultural production sub-sectors, but between the agricultural production sector and other sectors of the economy.

Table 1: Cash Receipts from Farm Sales in West Virginia, 1983 and 1985

Commodity	Cash Receipts ($1,000s)		Percentage of Total Receipts	
	1983	1985	1983	1985
Livestock and				
Livestock Products:				
Cattle and calves	51,222	70,837	24.3	29.4
Dairy products	49,119	49,038	23.3	20.4
Chickens	34,192	29,786	16.2	12.4
Turkeys	13,091	25,214	6.2	10.5
Hogs	9,230	3,702	4.4	1.5
Eggs	8,783	8,389	4.2	3.5
Sheep and Lambs	3,384	2,639	1.6	1.1
Miscellaneous	1,093	2,001	0.5	0.8
SUB-TOTAL	170,114	191,606	80.7	79.5
Crops:				
Apples	19,043	25,089	9.0	10.4
Tobacco	8,922	6,992	4.2	2.9
Hay	4,154	4,491	2.0	1.9
Corn	3,365	10,306	1.6	4.3
Peaches	2,594	17	1.2	----
Wheat	771	528	0.4	0.2
Miscellaneous	1,803	1,933	0.9	0.8
SUB-TOTAL	40,652	49,356	19.3	20.5
TOTAL	210,766	240,962	100	100

Source: West Virginia Department of Agriculture (11).

Approximately two-thirds of the state's population is classified as rural, non-farm. The symbiotic relationship between the farm and non-farm components of the economy is evident from the fact that in 1982, for example, 62 percent of farmers had an off-farm occupation. The average farm household derives 72 percent of total income from off-farm sources (10). On the other hand, the non-farm sector benefits both directly and indirectly from the output, income and employment generated by farm-related activities.

The importance of agriculture in West Virginia is therefore much greater than that implied by the gross sales revenue from farm products and services (3). There are many interdependent activities and services that are necessary to manufacture, process, market, and service farm products through the production and marketing chain. While decision-makers and planners are often aware that interdependencies exist among various sectors of the state economy, the magnitude and nature of the interdependencies are mostly unknown. This concern prompted the undertaking of a study to determine the nature of the economic interdependencies among various sectors in the state of West Virginia, with special emphasis on the agricultural production sector. The results from this study can provide agricultural and non-agricultural policy- and decision-makers with guidelines for formulating strategies to stimulate economic development in the state.

Methodology

An input-output (I-O) model was used to derive the parameters of interest in this analysis. I-O models are tools, based on accounting and mathematical principles, that can be used to construct a profile of the economic activities in a given region, and in the process, reveal the interdependencies among various industries or sectors in that region.[1]

For purposes of this study, the state economy was divided into 30 sectors -- 21 agricultural (including 8 agricultural production sub-sectors and 13 agribusiness sectors), 2 forestry and 7 non-agricultural sectors (Table 2). The disaggregation of the agricultural sector into specific crop and livestock

1 For details on the input-output technique, see Miernyk (6).

sub-sectors allowed for the determination of which agricultural sub-sectors have a greater impact on the state economy. Researchers also point out that the greater the level of disaggregation of the industry being analyzed -- agriculture in this case -- the greater is the reliability of estimated coefficients (8).

In addition to the 30 sectors mentioned above, four final-demand and three final-payment "sectors" were incorporated into the model. The former include state exports, consumption or household expenditures, state and local government expenditures, and federal government expenditures in the state; while the latter is comprised of state imports, household payments, and all other final payments.

Data sources used for the study include the most recent U.S. Department of Commerce input-output tables which contain aggregate transactions for the U.S. economy. Data for West Virginia were extracted from the national tables and updated to 1983 levels.[2]

Three tables can be generated from an I-O model: the transactions table, the direct requirements table and the interdependencies table. These tables provide a description of the monetary value of goods and services flowing within an economy during a given time period. In addition, they contain the information necessary to derive output, income and employment multipliers for specific sectors within the economy -- in this case, the state of West Virginia. The multipliers provide insights into the structure of the economy, and by virtue of their predictive capability, can be used to formulate economic development strategies.

Results

The following discussion centers around the multipliers derived from this analysis. A multiplier is a number indicating the direct, indirect and induced impacts that an unit change in a given variable -- output, income, or employment -- for a given industry or sector is likely to have on the state economy. The larger the multiplier, the greater is the impact of a change.

There are two types of multipliers forthcoming from an I-O analysis -- Type I and Type II. The Type I multipliers include the direct and indirect impacts of change in a given sector. When the induced effects of a change from more employees having more income to spend are also taken into account, a

Type II multiplier results. Since the magnitude of the induced impacts is difficult to estimate and may sometimes be overstated, it is usually recommended that the two types of multipliers be viewed as the upper and lower bounds of changes in the sector. The actual impact usually falls within this range (2).

Both Type I and Type II multipliers were estimated in this analysis. The Type I and Type II multipliers for different sectors, sorted by specific categories of economic activity -- agricultural production, agribusiness, forestry, and non-agricultural -- are presented in Table 3. These multipliers are discussed in the following sections. However, since Type II multipliers are, in effect, a multiple of Type I multipliers, for discussion purposes, only Type I multipliers are used for illustration and comparison.

Output Multipliers

An output multiplier indicates the total dollar value of output generated in the economy by a $1 change in final demand for the products of a particular sector. These multipliers are computed by adding the column total of interdependency coefficients for a sector, and therefore provide an indication of the degree of structural interdependence between each sector and the rest of the economy. Output multipliers can be used to measure the contributions to total economic activity arising from the sales of each sector. For example, an output multiplier of 1.44 for the dairy products industry (Table 3), indicates that a $1 million increase in final demand for dairy products would increase total state output of all goods and services by $1.44 million (the initial increase in demand times the multiplier).

The vegetables and miscellaneous crops sub-sector[3] has the largest output multiplier in the agricultural production sector. The food and kindred products n.e.c. (not elsewhere considered) sub-sector, on the other hand, has the largest output multiplier of the agribusiness sector. The lumber and wood products sub-sector was found to have the largest output multiplier in the state economy.

The average output multiplier for the agricultural production sector of the economy is 1.47 (Table 3). The crop production sector was found to have a larger average output multiplier than the livestock production sector, indicating perhaps, that statewide output would benefit more from an aggregate increase in crop production than a similar in-

2 A description of the steps involved in the derivation, and the mathematical procedure utilized in the development and inversion of matrices comprising the state model, are provided in Materu (5).
3 See Table 2 on following pages for the products comprising each sub-sector.

Table 2: Input-Output Model Sectors and Sector Components

Sector	Components
Agricultural production	
Dairy Farm Products	dairy farms; milk production; dairy heifer replacement farms
Poultry and Eggs	broilers, fryers and roaster chickens; chicken eggs; turkeys and turkey eggs
Meat Animals and Miscellaneous Livestock	beef cattle farms; stockyard fattening hogs; sheep and goats; fur animals; horses; other animals n.e.c.
Food and Feed Grains	wheat; rice; corn; soybeans; sorghum; alfalfa; clover
Tobacco	establishments engaged primarily in tobacco production
Fruit and Tree Nuts	deciduous tree fruits; citrus fruits; grapes; nuts; berries
Vegetables and Miscellaneous Crops	Irish potatotes; sweet corn; cabbage; melons; tomatoes; celery; beans; peas
Greenhouse and Nursery Products	ornamental floriculture; food crops grown under cover
Agribusiness	
Agricultural, Forestry and Fishery Services	poultry hatcheries; soil preparation services; crop planting and protection services; crop preparation for marketing; livestock services; forestry services; fish preserves; meat and slaughter inspection
Landscape and Horticultural Services	landscape counseling and planning; lawn and garden services
Food and Kindred Products: Meats and Poultry	meat packing plants; sausage and other prepared meats; poultry dressing plants; poultry and egg processing
Food and Kindred Products: Dairies	butter; cheese; ice cream; other milk products
Food and Kindred Products: Prepared Feeds	prepared feeds n.e.c.
Food and Kindred Products: Bakeries	bread; cake and related products; cookies and crackers
Food and Kindred Products: Beverages	malts and malt beverages; wines; liquor; canned soft drinks
Food and Kindred Products: Canned Fruits and Vegetables	canned fruits and vegetables
Food and Kindred Products n.e.c.	frozen fruits, juices and vegetables; flour; soybean oil; cooking oils; macaroni and spaghetti

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Table 2 (Continued)

Sector	Components
Agribusiness (Continued)	
Tobacco Manufacture	cigarettes; cigars; chewing tobacco; other processed tobacco
Nitrogen and Phosphoric Fertilizers	nitrogen and phosphoric fertilizers
Agricultural Chemicals n.e.c.	agricultural chemicals n.e.c.
Farm and Garden Machinery	farm machinery and equipment; lawn and garden equipment
Forestry	
Forest Products	timber farms; forest nurseries; extraction of pine gum; fish catching; miscellaneous marine product activities
Lumber and Wood Products except Containers	logging contractors; sawmills; wood preserving; plywood; etc.
Non-Agricultural	
Mining	iron and ferroalloy mining; nonferrous mining; coal; crude petroleum and natural gas; stone and clay mining; chemical and fertilizer mining
Construction	construction; maintenance and repair
Other Manufacturing n.e.c.	ordnance; textiles; household fixtures; printing and publishing; plastics; paints; drugs; glass; metal works; electronics and electronic products; leather; clay products, etc.
Transportation, Communications and Utilities	transportation; warehousing; radio, TV and other communications; electric, gas, water and sanitary services
Wholesale and Retail Trade	wholesale and retail trade
Finance, Insurance and Real Estate	banking; credit; insurance; real estate and property rental
Services n.e.c.	hotels; business and consulting services; eating and drinking places; auto repair and services; amusements; health, educational and social services; non-profit organizations

crease in aggregate livestock production. The reason for this may be that most of the livestock produced in West Virginia is shipped out-of-state for further processing. Also, an increase in crop production is accompanied by proportionate increases in the production of inputs such as pesticides and herbicides, some of which are produced in-state.

Income Multipliers

The income multiplier measures the total change in statewide household income resulting from a $1 change in the labor expenditure of a given sector in response to a change in demand for the sector. For example, an increase of $1 million in wages and salaries paid to employees in the greenhouse and nursery products sub-sector, would result in a $1.35 million increase in statewide income (Table 3). This indicates that as employees' incomes increase, their increased consumption expenditures result in income increases for individuals or businesses that supply them with goods and services. Income increases also result in larger tax revenues which, in turn, can lead to more public expenditures with their associated multipliers.

The fruit and tree nuts sub-sector was found to have the largest income multiplier in the agricultural production sector. The agribusiness sub-sector with the largest income multiplier is the food and kindred products (prepared feeds) sub-sector. The finance, insurance and real estate sector has the largest income multiplier in the state economy.

The agricultural production sector has an average income multiplier of 1.47 (Table 3). The livestock production sector has a larger average income multiplier than the crop production sector, indicating that statewide income would increase more rapidly from an increase in aggregate livestock production. The reason for this may relate to the fact that some livestock-based enterprises, such as dairy operations, tend to be relatively more capital-intensive, and as a result, are possibly associated with higher net incomes.

Employment Multipliers

These multipliers measure the total employment change in the state resulting from a change in employment of a given sector (due to a change in final demand). As Table 3 shows, an increase of 100 employees in the poultry and eggs sub-sector, for example, would increase statewide employment by approximately 191 persons.

The food and feed grains sub-sector has the largest employment multiplier of the agricultural production sector. This industry also has the largest

employment multiplier of all sectors in the state. The prepared feeds sub-sector was found to have the largest employment multiplier of the agribusiness sector.

The average employment multiplier for the agricultural production sector is 1.69 (Table 3). The crop production sector has a larger average employment multiplier (in addition to, as mentioned earlier, a larger average output multiplier, but a smaller average income multiplier) than the livestock production sector. This finding may be explained in part by the fact that some aspects of crop production, e.g., harvesting fruit, tend to be relatively more labor-intensive. It was also found that the non-agricultural sectors of the economy on average, cannot duplicate the high job creation ratio characterizing either the agricultural production or the agribusiness sectors. As a caveat, it must be pointed out that comparisons based on averages should be viewed with caution since the outcomes are likely to be influenced by the varying degrees of aggregation or disaggregation of specific sectors.

In general, the results indicate relatively high degrees of interaction not only among agricultural production sub-sectors, but between the agricultural production sector and other sectors of the state economy. These other sectors include: food and feed processing; manufacturing; farm machinery; fertilizer and chemicals; transportation; communications and utilities; construction; wholesale and retail trade; finance; and services.

The preceding analysis of the multiplier effects of changes in the farm sector leads to the conclusion that changes in agricultural output, income and employment levels profoundly affect output, income and employment, respectively, in other sectors of the state economy. The magnitude of input-output coefficients estimated from this research indicates that agriculture is not only dependent on other industries, including agribusiness industries, but that growth or decline in agriculture has a relatively high positive or negative impact, respectively, on state economic development.

The coefficients estimated from this analysis were, in many instances, within the range of coefficients estimated for the agricultural sector in previous I-O studies of the West Virginia economy, including those by Bills (1) and Miernyk (7). A detailed comparison of the results from this study with those from Bills and Miernyk can be found in Materu (5). It should be pointed out, however, that across-the-board comparisons are not always appropriate since the investigations involved different assumptions, approaches, levels of aggregation, and time periods.

Table 3: Type I and Type II Multipliers for Different Sectors
Estimated for West Virginia, 1983

Sector	Type I Multipliers			Type II Multipliers		
	Output	Income	Employment	Output	Income	Employment
Agricultural Production						
Dairy	1.44	1.48	1.55	4.55	2.08	2.28
Poultry and Eggs	1.39	1.45	1.91	2.42	2.09	3 15
Meat and Misc. Animals	1.19	1.65	1.44	1.80	2.39	2.15
Food and Feed Grains	1.29	1.24	2.96	2.49	1.78	7.58
Tobacco	1.65	1.35	1.46	3.14	1.93	2.15
Fruit and Tree Nuts	1.57	1.74	1.38	2.52	2.48	1.78
Vegetables and Misc. Crops	1.77	1.49	1.55	3.74	2.18	2.47
Greenhouse and Nursery	1.47	1.35	1.30	2.87	2.41	2.03
Average	1.47	1.47	1.69	2.94	2.17	2.95
Agribusiness						
Ag., For., and Fishery Svcs.	1.51	1.33	1.15	3.10	1.96	1.48
Landscape and Hort. Svcs.	1.41	1.32	2.15	2.68	1.88	4.05
Meat and Poultry Products	1.39	1.31	2.12	2.44	1.90	4.55
Dairy Products	1.41	1.49	2.08	2.39	2.11	3.63
Prepared Feeds	1.29	1.80	2.14	1.71	2.60	3.37
Bakery Products	1.56	1.31	1.90	3.43	1.81	3.52
Beverages	1.10	1.15	1.13	1.64	1.67	1.63
Canned Fruits and Veg.	1.44	1.16	2.10	3.10	1.68	5.79
Food Products n.e.c.	1.66	1.52	2.07	3.21	2.20	3.76
Tobacco Manufacture	1.56	1.62	1.87	2.65	2.36	3.32
N and P Fertilizers	1.08	1.04	1.78	3.15	2.02	8.00
Ag. Chemicals n.e.c.	1.23	1.24	1.64	2.27	1.30	3.55
Farm and Garden Machinery	1.35	1.46	2.00	1.94	2.12	3.54
Average	1.38	1.37	1.86	2.59	2.01	3.86
Forestry						
Forest Products	1.09	1.09	1.34	1.90	1.56	3.22
Lumber and Wood Products	1.96	2.00	1.97	3.68	2.87	3.18
Average	1.53	1.54	1.65	2.79	2.21	3.20
Non-Agricultural						
Mining	1.63	1.37	2.04	3.56	1.95	4.00
Construction	1.49	1.33	1.36	1.82	2.24	1.44
Manufacturing n.e.c.	1.36	1.82	1.65	2.07	2.62	2.45
Transp., Communic., Utilities	1.58	1.56	1.82	3.10	2.21	3.25
Trade	1.70	1.70	1.34	3.07	2.45	1.68
Finance, Insurance	1.53	2.03	2.05	2.18	2.75	2.96
Services n.e.c.	1.55	1.38	1.27	3.03	1.97	1.74
Average	1.55	1.60	1.65	2.69	2.31	2.50
State Average	1.45	1.46	1.75	2.72	2.14	3.26

Conclusions

Results of this study provide insights relative to the structural inter-relationships among agricultural sub-sectors, and between the agricultural and non-agricultural sectors of the West Virginia economy. This analysis provides a basis for evaluating the economic impacts of the growth or decline of some specific economic sectors. An understanding of the forces that impinge on the state economy, coupled with the knowledge of how each sector of the economy contributes to the economic welfare of the region can facilitate the process of formulating public policies and/or private initiatives to stimulate the state and regional economy.

The importance of agriculture to the state economy extends beyond the farm gate, due to the ripple effects in the economy resulting from changes in agricultural production, incomes and employment. In some cases, for example in employment impacts, the agricultural sector has a greater effect on the state economy than the average non-agricultural sector. Agriculture is one of the many sectors important not only to rural incomes, rural people and agribusiness, but to the rest of the state economy. Hence, agriculture plays and will continue to play a crucial role in the revitalization and economic development of the state.

Agriculture has been undergoing a metamorphosis in the last few years stimulated both by farm-level changes and changes in federal fiscal, monetary and trade policies. The result has been, and is likely to continue to be, an increased emphasis on productivity and cost control, as farmers strive to improve their competitive position in the market place. This does not diminish the role of a farmer in society or the importance of agriculture in the economic development of the state or nation. In the final analysis, an economy is only as vibrant as the sectors upon which it is based, and as complex as the symbiotic relationships that weave these diverse sectors together. Agricultural production, processing and marketing are certainly important elements in this set of relationships.

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WEST VIRGINIA AGRICULTURAL AND FORESTRY EXPERIMENT STATION
100 YEARS OF IMPROVING LIFE
1888–1988