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# **The Economic Impact of Agriculture and Ag- Related Industries on the Commonwealth of Virginia**

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## **ACKNOWLEDGMENTS**

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Dr. Albert E. Essel, Extension Specialist and Agricultural Economist, Virginia State University;

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## EXECUTIVE SUMMARY

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During the autumn of 1997, faculty in the Department of Agricultural and Applied Economics at Virginia Tech, in cooperation with the representative from Virginia Department of Agriculture and Consumer Services, (VDACS) analyzed the size and economic contribution of agriculture in Virginia. In this report, agriculture is described and measured as a four-part system: 1) production of agricultural goods and services, including farm crops, livestock, horticulture, landscaping, Christmas trees, aquaculture, vineyards, and private woodlots; 2) processing of food, tobacco, wine, and cotton textiles; 3) distribution-related activities, such as transportation and the wholesale and retail sale of agricultural products; and 4) input sectors, that is, activities that supply goods and services for production, processing, and distribution activities.

With approximately one of every ten jobs in Virginia related to agriculture, agricultural activities are major components of the employment base within both rural and urban areas. Agriculture makes significant contributions to Virginia's employment, Gross State Product (GSP), and overall economic well-being. In addition, agriculture provides many non-market benefits to the Commonwealth.

The major farm commodities produced in Virginia are cattle and calves (in the northern, western, central, and southwestern districts of the state), poultry (in the northern and western districts), dairy (in the northern, central, and southwestern districts), tobacco (in the southern and southwestern districts), and soybeans (in the eastern and southeastern districts). The major agricultural manufacturing activities in the state are poultry processing (in the northern district), tobacco processing (in the central district), and meat processing (in the southeastern district).

A summary of the economic contributions of these agriculturally related activities shows

- \* **\$12.8 billion or 7.4 percent contribution to GSP, up from \$11 billion in 1992;**
- \* **235,800 jobs (6 percent of state total) directly related to agricultural production, inputs, processing, and distribution;**
- \* **An additional \$6.7 billion in GSP (3.9 percent) and 152,000 jobs (4 percent) from effects of agriculture-related income on other sectors;**
- \* **A total of approximately 11.2 percent of GSP and 10 percent of jobs in Virginia related in some way to the agricultural economic system.**



## **INTRODUCTION**

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According to the Virginia Agricultural Statistics Service (VASS), as of June 1, 1997 Virginia contained approximately 47,000 farms and 8.5 million acres of farmland.<sup>1</sup> Farming is only a portion of the chain of economic activities that stretches from the producer of farm supplies to the processors and distributors that put agricultural products into the hands of consumers. In addition to the state's farms and farmers, the agricultural system includes food, fiber, wine, and tobacco processors that manufacture products for sale across Virginia and around the world; transportation workers, wholesalers, and retailers who distribute both processed and unprocessed products to consumers; and producers and suppliers of inputs to farmers, processors, and distributors. This agricultural system, with its many linkages, touches the lives of every Virginian by contributing to virtually every sector of the state's economy.

Faculty in the Department of Agricultural and Applied Economics at Virginia Tech, in cooperation with the Virginia Department of Agriculture and Consumer Services (VDACS) personnel, first conducted a study in 1993 to determine the size and economic contribution of Virginia's agricultural sector to the Virginia economy (Johnson and Wade, 1994). An advisory committee that included agricultural industry representatives and experts in the analysis of economic impacts guided the 1993 study (see Acknowledgements). The committee helped define the agricultural system and refine the measurement procedures. These definitions and measurement procedures were carried over to this study. State-of-the-art methods were used both to measure the linkages between the system's components and to estimate employment levels.

In 1997, the VDACS personnel requested that the original report be updated to reflect the current status of agriculture in Virginia. That a more complete picture could be obtained if the study were conducted after the publication of the 1997 Census of Agriculture was acknowledged. However, VDACS personnel maintained that a study conducted prior to the publication of the Census of Agriculture would be of benefit to them. This study documents the significant economic impacts of agriculture on Virginia and on particular areas of the state, prior to the release of the 1997 Census of Agriculture.

## **THE CHANGING AGRICULTURAL SYSTEM**

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Since Colonial times, when the economy of Virginia was almost entirely agricultural, the proportion of the labor force engaged in farming has declined as technology has increased the productivity of both farm and non-farm labor. At the same time, the number of jobs in non-farming components of the system has steadily increased as farmers have become less self-sufficient and have transferred many of the responsibilities for producing agricultural inputs, processing its raw inputs, and marketing to other sectors of the economy.

Another change that marks the current agricultural system is agriculture's increased diversification and linkages with the nation and the world. Today, Virginia's agricultural system produces specialized, high-quality products that are marketed in many parts of the world, while other agricultural products are imported and sold through Virginia distribution channels.

To suggest that agriculture is a small sector of the Virginia economy is a mistake. Today, Virginia's agriculture includes not only traditional field crops, vegetables, livestock, and seafood, but aquaculture,

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<sup>1</sup> Virginia Agricultural Statistics Service, <http://www.nass.usda.gov/va/>



landscape and nursery products, ornamentals, and premium farm wines as well. Moreover, it has significant links to the tourism and forestry industries.

## **MEASURING ECONOMIC CONTRIBUTIONS**

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Estimating the significance of an industry is important and useful for many reasons. Chief among them is that it allows decision-makers to better understand the effects of their decisions on an industry as well as on industry linkages. People derive their income and some sense of worth from their employment. They pay taxes and make purchases with a portion of their income. These activities affect still more people whose livelihoods depend upon this spending of income.

Acting collectively is costly for small firms. Because most agricultural enterprises in the state are small and diverse, they can easily be overlooked in the state and local policy-making process. Attracting and nurturing large high-tech industries that promise high wages and increased employment result in high political payoffs. Thus, studies of the overall economic significance of such diffuse and diverse industries as agriculture are very important for informed political decision making.

The agricultural sector is difficult to measure, especially in terms of employment, because of the diversity and dissimilarity of its components. The most diverse is the farm production component, which encompasses individuals working by and for themselves, family laborers, unpaid labor, dual-occupation workers, seasonal labor, contract labor, products consumed at home, and government programs that affect income. Because the farm component is linked to the other components both through producers' purchases of inputs and through the sale of products for processing and distribution, double counting can easily occur, which the author worked painstakingly to avoid (Appendix A).

### **Methodologies Used to Estimate the Significance of Agriculture**

The methodologies used to estimate the economic impact of agriculture generally have followed two approaches: the final demand approach and the sectoral definition approach.<sup>2</sup> The final demand approach begins by estimating the consumption (final demand) of food and fiber and then works back through the sectors using an input/output table to determine the amount of output from other sectors required to produce the final demand. This approach is used in the Davies-Goldberg "Agribusiness" and Economic Research Service (ERS) "Food and Fiber System" methodologies. In contrast, the sectoral definition approach begins with the value of raw farm material produced. Then, the value of the inputs required to produce the raw material as well as the value added in the food and fiber processing and distribution sectors are accounted for.

This study generally follows the sectoral definition methodology adopted by Johnson and Wade in their 1994 study, *The Economic Impact of Agriculture in Virginia*. However, a few alterations have been made to better reflect changes in the structure of Virginia agriculture and to incorporate changes due to the availability of additional data.

The most significant changes in method were

- 1) To mitigate swings in yields and prices due to the vagaries of weather and other similar factors, 1991-96 average levels of value of production were used instead of the most recent year (1996) of available price and production data. However, using multi-year averages tends to downplay the impact of structural changes in crop mix, for example, the addition of cotton in a rotation.

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<sup>2</sup> See Leones, Julie, Gerald Schluter, and George Goldman.

- 2) IMPLAN value-added and employment coefficients for 1994 were used for the agricultural processing sector. The Johnson and Wade study used 1991 IMPLAN coefficients for all sectors. These newer coefficients were thought to capture changes that may have occurred in the substitution of capital for labor and the proportion of value added in the increasingly high-tech processing sectors.
- 3) IMPLAN value added and employment coefficients for agricultural production were changed considerably between 1991 and 1994 because Micro Implan Group (MIG) changed the methodology for making these estimates. Consequently, the author did not have sufficient confidence in the newer estimates to warrant their use in this study.

In addition, the magnitude of the distribution, input, and export sectors was estimated using the same coefficients as in the study by Johnson and Wade. Thus, the impacts grew (declined) proportionally with the size of the agricultural production and agricultural processing sectors. This approach focuses solely on current accounts. Therefore, only the current depreciable component of the long-term effects of capital spending by the industry is captured. In addition, this analysis does not capture the impacts of positive spillover effects (open space, rural character) or negative spillover effects (pesticide and nutrient run-off, odor, dust, noise) of the industry.

## Definition of the Agricultural Sector and Backward Linkages in this Study

The definition of an industry is the most pivotal element in an economic impact study. Groups interested in making a particular industry appear large are interested in attributing as much economic activity to their industry as possible. Some studies only include the direct output of the sectors comprising the industry. However, input-output analysis allows one to capture the effect of backward-linked sectors, those sectors that provide inputs to the industry in question. Economic impact analyses are very sensitive to the inclusion of additional sectors and backward linkages. Therefore, the importance of clearly identifying the sectors included in the definition of the industry and of making the rationale for selection of particular sectors obvious cannot be over-emphasized.

The definition of the agricultural sector (also referred to as the agricultural economic system) used in this study is as follows:

- ***farm production*** which includes all farm crops; livestock, (including horses); agricultural, horticultural, and landscaping services; Christmas trees; aquaculture; vineyards; and private woodlots (but excludes commercial forestry and forest products);
- ***processing*** of both in-state and out-of-state production which includes food and tobacco products, wineries, and textiles (including natural fiber textiles,<sup>3</sup> but excluding all apparel and textile-based consumer products);
- ***distribution*** which includes transportation and wholesale and retail sale of farm and processed products (including the basic value of food sold through restaurants *but excluding all restaurant markup and restaurant activity itself*<sup>4</sup>); and
- ***input activities*** which include all in-state production of goods and services for the farm and for the processing and distribution activities described above.

<sup>3</sup> Natural fiber textiles are referred to as non-cotton later in the text.

<sup>4</sup> The agricultural portion of the restaurant sector was difficult to estimate. Therefore, none of the restaurant sector, neither its sales nor employment, is included in the estimates of the agricultural system. However, its purchases of food from the Virginia processing sector were estimated from the input-output model. Restaurant purchases of out-of-state food were excluded, and none of its other inputs was included.

The definition obviously extends beyond the farm-based definition of agriculture to a systemwide definition. A Virginia farm-based definition would include only those products that flow from raw farm materials produced in the state to their final consumers. The systemwide definition includes all in-state activities that add value to farm products, regardless of origin of the farm production. Therefore, the processing sector includes the value added to processed food, tobacco, and fiber products purchased from out-of-state producers as well as from Virginia producers, and the distribution sector includes value added to food products produced either in Virginia or out-of-state but distributed to Virginia consumers. In neither case is the value of the out-of-state production included.

As with the Johnson and Wade study, the definition of the agricultural economic system used in the current study *excludes* all forestry, forest products, and wood products. Consequently, most previous measures of Virginia's food and fiber sector are not directly comparable to the estimates in this study of the agricultural sector in Virginia. Furthermore, the definition used in both studies excludes all the economic activity associated with the wood products, non-cotton textiles, and restaurant employees, as well as that portion of the of the distribution sector not handling agricultural commodities.

In general, any level of sectoral sales or final demand for agricultural goods is expected to have, besides its *direct* effects, additional *indirect* and *induced* effects on total industrial output, wage income, Gross State Product (GSP), and total employment. The indirect effect is the production by other sectors of goods and services used in the production of food and fiber; the induced effect is the impact of household spending of income earned in direct and indirect production. For example, the income generated by the sale of cattle that a farmer raises is a *direct* economic effect. When the farmer purchases feed for cattle, the feed sale is an *indirect* effect of the cattle production. Finally, if the farmer uses the profit from the cattle sale or feed store employees spend their wages to purchase new televisions, those purchases produce *induced* effects through the economic activities associated with the sales of the televisions.

In this study, the IMPLAN (Impact Modeling for PLANning) system was used to generate estimates of the indirect and induced impacts of Virginia agriculture (farming, processing, and distributing) for the entire state and its agricultural statistic districts. IMPLAN is one of the most widely used input-output models in the nation (Lindall and Olson) and is described in Appendix A.<sup>5</sup>

## Data Sources

The main data sources were *Virginia Agricultural Statistics*, employment reports prepared by the Virginia Employment Commission (VEC), and databases accessible within the IMPLAN model. Because official sources of employment information, such as Virginia's Covered Employment series, seriously underestimate employment in farming, farm employment was estimated indirectly from typical employment/output ratios derived from the IMPLAN model. Inputs were estimated by determining the linkages from each system component to its suppliers.<sup>6</sup>

The data used for estimating the farm-level value of production is provided in tables 1 through 3. This study used the 1991-96 averages in the far right column as the basis for this estimate.<sup>7</sup> A few

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<sup>5</sup> For more information and other definitions of basic economic terms used in this report, see "Definitions," Appendix A.

<sup>6</sup> For more details, see "Data Sources," Appendix A.

<sup>7</sup> As noted before, this decision was made to mitigate some of the fluctuations in agricultural prices and production levels. The Johnson and Wade study used only the 1992 estimates available at the time of their study. The 1992 data provided in tables 1-3 may differ slightly from that used by Johnson and Wade due to subsequent updates made by VASS.

significant ramifications of this decision to use the multi-year average should be noted. Generally, if the value of production has been consistently trending upward over this period, the multi-year average will be lower than the most recent year's level (and vice versa). Cotton production provides the most striking example of this effect with steadily increasing sales from 1991 (\$5,614,000) to 1996 (\$57,787,000), but average sales for the period of \$24,710,000. At the same time, sheep and lambs have been trending downward in production. Thus, the 1991-96 average is higher than the 1996 sales.

Shifts in production between enterprises will cause changes in the amount of employment and value added required. As production shifts from more to less labor-intensive enterprises, the dampening effect on employment levels can be significant. The IMPLAN estimates of full time equivalent jobs (FTEs) per million dollars of sales are found in Appendix Table B1. Of particular note is that high-valued crops, such as tobacco, require much less land to produce \$1 million of sales than do lower value crops like corn or wheat. In addition, shifts from one crop to another imply changes in the amount of value added. Estimates of the amount of value added per dollar of sales for each crop are also found in Appendix Table B1.

## **THE ECONOMIC IMPACT of VIRGINIA'S AGRICULTURE**

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- \* **Over \$26 billion in total sales**
- \* **Almost \$13 billion contribution to Gross State Product (GSP)**
- \* **Over one-quarter million jobs**
- \* **An additional \$6.7 billion in GSP (3.9 percent) and an additional 152,000 jobs (4.0 percent) from induced effects.**
- \* **11.2 percent of GSP and 10.0 percent of jobs in the state are in some way related to the agricultural economic system.**

For the period 1991-96, average annual farm-level sales were \$2.2 billion dollars. Manufactured food, fiber, and tobacco had sales of \$16.4 billion, and the distribution system added another \$2.6 billion. Together these three components purchased inputs from in-state suppliers worth over \$4.9 billion. In total, the system generated over \$26.1 billion in sales, affecting virtually every sector of the state economy. The estimated value of product flows in Virginia's agricultural system is shown in Figure 1.

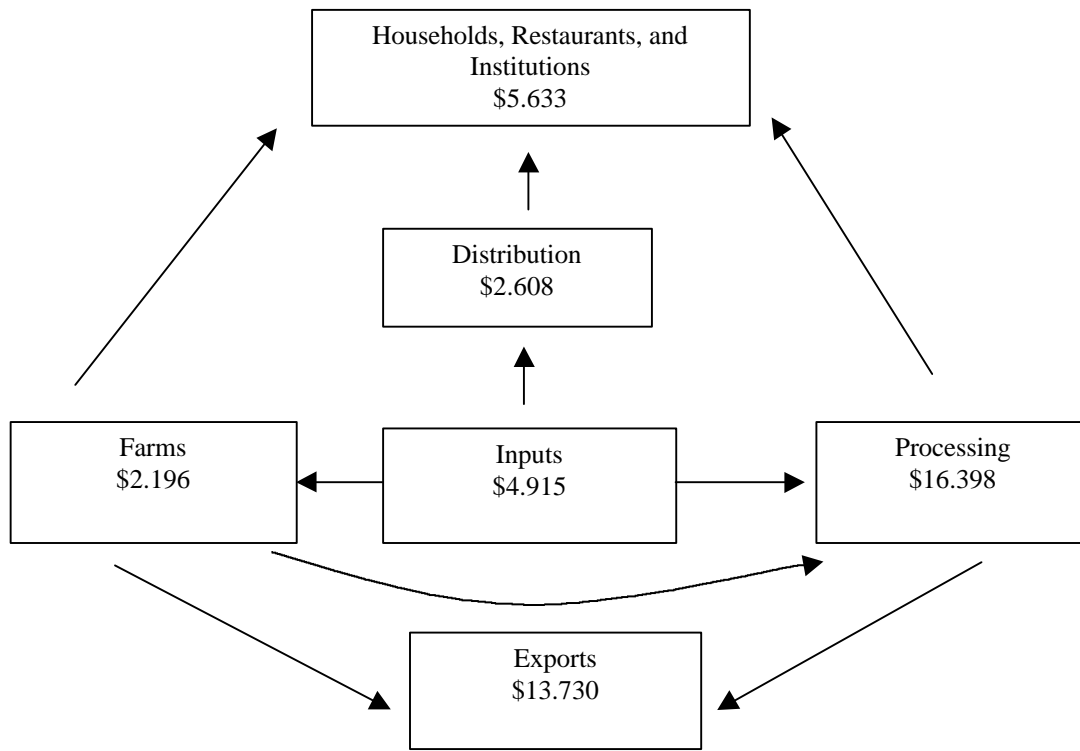
**Table 1 Cash Receipts from Crops, Virginia, 1991-96**

	1991	1992	1993	1994	1995	1996	91-96 Average
	-----\$1,000-----						
Tobacco	197,171	189,667	180,807	168,590	174,906	187,793	183,156
Peanuts	86,938	81,476	53,580	80,075	61,928	58,981	70,496
Soybeans	85,875	79,982	77,506	80,491	79,750	95,600	83,201
Corn, Grain	47,510	66,630	44,920	52,449	66,518	96,338	62,394
Wheat	28,432	45,348	38,863	43,719	65,281	69,253	48,483
Hay	27,898	28,918	29,520	27,205	26,951	30,284	28,463
Rye	390	409	228	342	235	439	341
Barley	7,290	9,561	7,742	6,305	10,525	12,344	8,961
Cotton, Lint & Seed	5,614	7,722	9,365	25,700	42,072	57,787	27,410
Other Field Crops <sup>1</sup>	1,082	1,506	1,646	1,660	1,567	1,630	1,515
Sweet Potatoes	1,365	761	702	830	895	747	883
Potatoes	21,495	16,799	19,504	19,373	21,362	20,187	19,787
Vegetables	77,328	86,670	65,314	93,480	87,862	52,997	77,275
Fruits	53,515	46,881	43,669	45,129	53,045	52,213	49,075
Greenhouse, Nursery & Christmas Trees	117,551	127,163	134,023	139,387	140,787	155,342	135,709
Greenhouse	40,364	44,387	47,820	51,670	52,287	61,067	49,599
Nursery & Christmas Trees	77,187	82,776	86,203	87,717	88,500	94,275	86,110
Cattle & Calves	387,203	336,371	339,302	292,424	252,371	211,294	303,161
Milk, Wholesale	269,325	291,888	276,500	272,272	266,340	289,980	277,718
Hogs	84,965	74,036	78,838	72,220	63,341	81,410	75,802
Total Poultry and Eggs	496,415	533,773	595,776	641,390	669,625	747,720	614,117
Broilers	305,087	330,145	370,986	397,880	400,828	466,388	378,552
Turkeys	122,934	137,879	157,080	171,864	198,810	204,250	165,470
Chickens, Farm	1,539	2,497	2,273	2,321	1,669	1,716	2,003
Eggs	66,855	63,252	65,437	69,325	68,318	75,366	68,092
Total Sheep, Lambs & Wool	5,549	6,662	6,730	5,718	5,672	5,343	5,946
Sheep & Lambs	5,379	6,407	6,556	5,460	5,357	5,177	5,723
Wool	170	255	174	258	315	166	223
Other Livestock <sup>2</sup>	106,590	112,276	117,926	125,407	135,502	142,236	123,323
<b>Total</b>	<b>2,729,016</b>	<b>2,812,097</b>	<b>2,858,990</b>	<b>2,980,661</b>	<b>3,042,619</b>	<b>3,278,323</b>	<b>2,952,988</b>

<sup>1</sup> Other field crops include mushrooms, grain sorghum, canola, sunflower, seed crops, and other field crops.

<sup>2</sup> Other livestock include turkey eggs, ducks, other poultry, horses, mules, honey, beeswax, aquaculture, mink pelts, and all other livestock  
Source: Virginia Agricultural Statistics Service, 1997.

**Figure 1. Average value of product flows (in billion dollars) in Virginia's agricultural system, 1991-96.<sup>8</sup>**



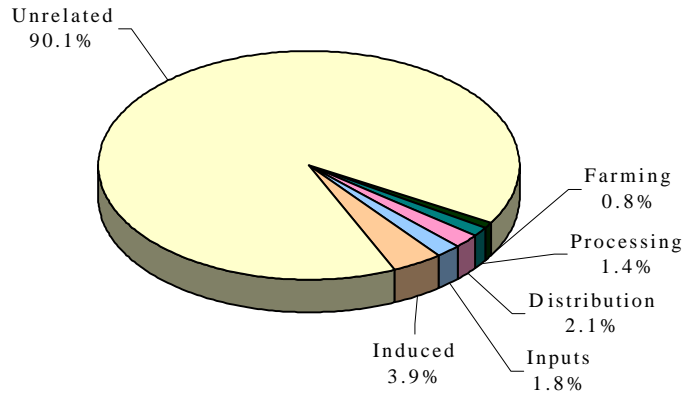
If only the contribution to Gross State Product (GSP), that is value added by in-state activity, is counted, agricultural economic system 1991-96 average sales accounted for almost \$12.8 billion (7.4 percent) of the estimated total GSP generated by *all* industries in Virginia.

The agricultural economic system also supported approximately 236,000 jobs, over 6 percent of the 1991-96 average state total for all industries in the state. That figure includes 30,800 on farms; 54,900 in processing; 80,900 in the distribution sector; and 69,200 in input sectors. Surprisingly, most of these jobs were in urban areas of the state.

As with other industries, when the income generated by the agricultural economic system for its employees, proprietors, and owners is spent, a multiplier effect occurs in other sectors of the economy. On average, for the period 1991-96, these induced effects added an additional \$9.74 billion in sales, \$6.7 billion in GSP (Table 1 and Figure 2), and 152,000 jobs. The percent of total jobs in Virginia (1991-96 average) related to agriculture, including those that are accounted for by the four parts of the agricultural economic system and those supported by the induced effects income earned in the agricultural economic system is shown in Figure 2.

<sup>8</sup> These estimates are based upon 1992 IMPLAN data relationships and 1991-96 average value of production figures from VASS for the farm sector and 1994 IMPLAN data relationships and 1996 quarter 2 employment figures from the VEC.

**Figure 2. Components of farm and farm related employment in Virginia**



The economic impact of agriculture on Virginia’s economy is summarized in Table 2.

**Table 2. The average economic impact of Virginia's agricultural economic system, 1991-96.**

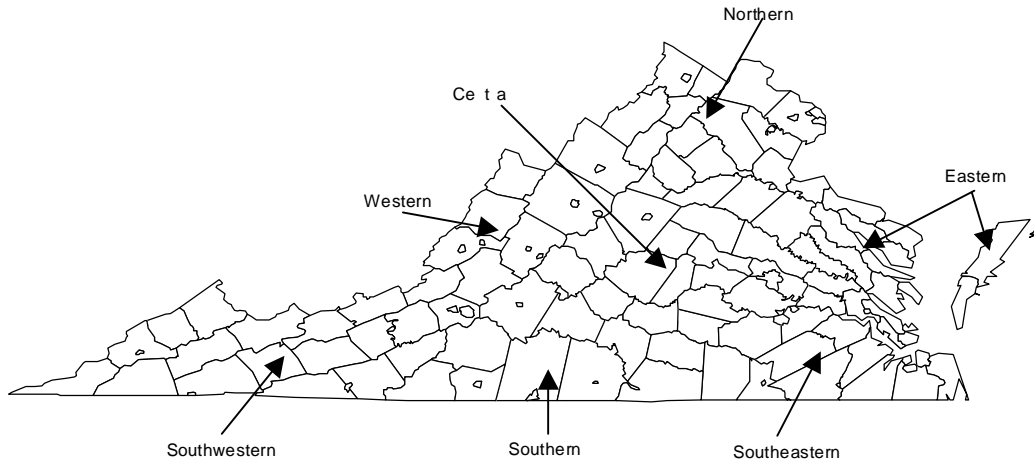
	Sales (\$ billion)	Contribution to GSP or Value Added (\$ billion)	Employment (thousand)
Farm Production	2.196	0.360	30.8
Processing	16.398	7.744	54.9
Distribution	2.608	2.224	80.9
Inputs	4.915	2.452	69.2
<b>Total System</b>	<b>26.117</b>	<b>12.780</b>	<b>235.8</b>
Induced Effects	9.735	6.691	152.0
<b>Total Related to Agriculture</b>	<b>35.852</b>	<b>19.473</b>	<b>387.8</b>
% of State Total	12.32%	11.21%	9.88%

## **REGIONAL COMPOSITION of AGRICULTURE**

For the 1991-96 period, the top ten farm commodities (in terms of cash receipts) in Virginia were (from largest to smallest) broilers, cattle and calves, milk, tobacco, turkeys, greenhouse and nursery products, soybeans, vegetables, hogs, and peanuts. Relatively few changes in Virginia's national rankings occurred in production between 1992 and 1996: tobacco production slipped from 5<sup>th</sup> to 6<sup>th</sup>; peanuts from 5<sup>th</sup> to 6<sup>th</sup>; sweet corn from 18<sup>th</sup> to 22<sup>nd</sup>; sheep from 19<sup>th</sup> to 20<sup>th</sup>; hogs from 20<sup>th</sup> to 21<sup>st</sup>; and wheat from 21<sup>st</sup> to 22<sup>nd</sup>. However, Virginia's national rank in beef production increased from 24<sup>th</sup> to 20<sup>th</sup> while turkey production held a steady rank of 6<sup>th</sup> in the nation. On average, for the 1991-96 period, field crops, fruits and vegetables, and nursery products accounted for 36 percent; and meat, dairy, and animal products accounted for 64 percent of total cash receipts.

Production and processing of most agricultural commodities are concentrated in specific areas of the state. The corresponding agricultural statistic districts are shown in Figure 3. (Appendix C provides a

list of the jurisdictions included in each district.) At the farm level, grains are generally grown in the east grown in the south, while burley tobacco is grown in the southwest; and dairy and livestock production Virginia—meat packing, poultry processing, prepared fish, confectionery products, fluid milk products, districts. Poultry processing is the largest food manufacturing industry in the northern and eastern located predominately in the central district.



Since this study was completed before publication of the 1997 Census of Agriculture, the regional each commodity using 1992 Census of Agriculture regional production levels. Thus, the assumption 1996 at the 1992 levels, which may not be accurate for all commodities because of regional shifts in of production. <sup>9</sup> Regional food processing employment levels were derived from VEC employment showing the relative importance of various agricultural activities to each agricultural statistic district

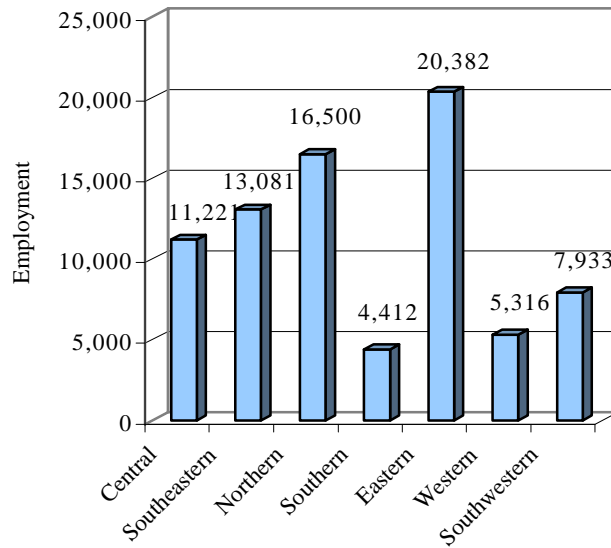
The distribution of total direct farm employment is shown in Figure 4, and direct farm-production Cattle production employs the most people in the northern, western, central, and southwestern districts. considerable amount of production also in the eastern and central districts. In the southeastern district, Growth in the hog sector is thought to have contributed most of this change. Total employment in

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<sup>9</sup> Agricultural processing employment was estimated using VEC quarter 2 employment data for 1996. Officials at disclosed because too few firms were represented, which could result in disclosure of individual operations.)

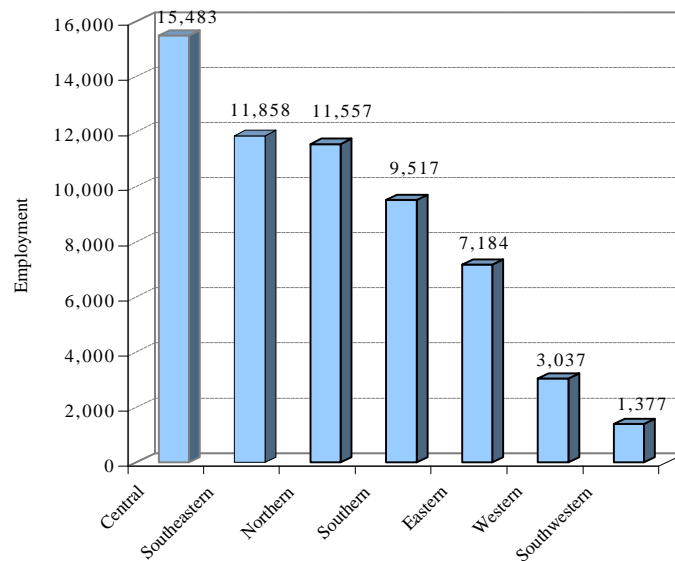


**Figure 4. Farm sector employment numbers by region, 1996.**



Estimates of total employment by district for the processing sector are shown in Figure 5, and estimates of the direct agricultural-processing employment levels by commodity for each district are shown in Appendix D figures 7D through 11D. Poultry processors are major employers in the northern and eastern districts. Tobacco processing tends to dominate agricultural-processing employment in the central and southern districts. Meat processing is the major source of agricultural-processing employment in the southeastern district, and textile manufacturing is important to the southern tier of counties.<sup>10</sup>

**Figure 5. Agricultural processing sector employment numbers by region.**



<sup>10</sup> Data for all individual industries were unavailable due to the disclosure rules imposed by the VEC. Only the largest sectors were chosen for illustrative purposes.

Regional distribution of agricultural processing employment is not necessarily directly related to the regional distribution of agricultural production employment (Figures 4 and 5). Clearly, the agricultural economic system extends itself well beyond the farm into suburban and urban jurisdictions. This gap underscores the importance of the agricultural economic system in providing employment and income in many non-rural areas.

Estimates of agricultural economic system employment totals in each agricultural statistics district and in the state as a whole and the average number of jobs (1991-96) supported by production of major agricultural commodities (cattle, poultry, hogs and sheep, dairy, major crops, tobacco, processed meat, processed milk, processed tobacco, and miscellaneous agricultural manufacturing) are shown in Tables 3 and 4. For instance, the estimated average number of direct jobs supported in Virginia by production of all major crops for the 1991-96 period was 4,574. Similarly, the processed-meats industry in Virginia supported 21,098 direct jobs.

Direct employment percentages by district are also presented for each commodity group in Tables 3 and 4. These employment estimates were obtained by grouping commodities presented in Appendix B into major industries (cattle, dairy, crops, tobacco, etc.) and adding the direct employment numbers within each group.

Poultry and egg production account for a large share of agricultural output in Virginia. Most annual chicken and turkey sales are not included in farm sales because poultry farms are generally owned by vertically integrated poultry processing establishments, thus prohibiting capture of sales data in an open market.<sup>11</sup> For the period 1991-96, the average annual value of production of turkeys, chickens, and eggs combined was about \$614 million, and the direct contribution to gross state product (GSP) and employment was approximately \$74 million with 6,322 FTEs. These sales resulted in a total contribution to GSP of approximately \$102 million and over 9,200 FTEs once indirect and induced effects were included.

Beef cattle, the second largest meat commodity in Virginia, produced over \$303 million average in annual cash receipts, made an average direct contribution of more than \$90 million to GSP for the 1991-96 period. The average level of direct employment in the beef cattle sector was 7,655 FTEs. The beef sector provided a total contribution to GSP of approximately \$126 million and over 8,600 FTEs.

Average annual fluid milk sales for the period 1991-96 were estimated to be almost \$278 million. The sector's direct contribution to GSP and employment were approximately \$48 million with 3,055 FTEs, respectively. Contributions to GSP from indirect and induced effects were approximately \$70 million and to total employment, over 4,300 FTEs.

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<sup>11</sup> A vertically integrated poultry establishment is a food-processing firm that owns, or contracts with, poultry farmers to ensure a supply of live poultry for its processing plants. The processing firm purchases farm inputs and services and sells processed meat. Because live poultry is an intermediate product of these firms, the poultry is not recorded in any sector's sales.

**Table 3. Direct agricultural production annual employment by district and commodity group, 1991-96 average<sup>1</sup>**

Farm production sector	Virginia Agricultural Statistic District							State total
	Northern	Western	Central	Eastern	Southern	South-western	South-eastern	
	Number (Percent)							
Cattle	1,341 (23.6)	697 (12.3)	1,207 (21.1)	80 (1.4)	551 (9.7)	1,558 (27.4)	245 (4.3)	5,679
Poultry	3,258 (40.6)	2,826 (35.2)	881 (11.0)	563 (7.0)	179 (2.2)	5 (0.1)	306 (3.8)	8,019
Hogs and sheep	212 (10.2)	67 (3.2)	108 (5.2)	83 (4.0)	74 (3.6)	107 (5.2)	1,420 (68.5)	2,072
<b>Total major livestock</b>	<b>4,811 (30.5)</b>	<b>3,590 (22.8)</b>	<b>2,196 (13.9)</b>	<b>727 (4.6)</b>	<b>804 (5.1)</b>	<b>1,670 (10.6)</b>	<b>1,971 (12.5)</b>	<b>15,770</b>
Dairy	1,055 (33.1)	347 (10.9)	506 (15.9)	45 (1.4)	426 (13.4)	702 (22.0)	110 (3.4)	3,190
Major crops <sup>2</sup>	615 (13.4)	197 (4.3)	552 (12.1)	943 (20.6)	272 (5.9)	353 (7.7)	1,646 (36.0)	4,574
Tobacco	0 (0)	0 (0)	246 (6.1)	0 (0)	1,681 (41.8)	1,479 (36.7)	619 (15.4)	4,025

<sup>1</sup>These estimates were updated from 1991 estimates to average 1991-96 estimates by assuming that changes in total state-level employment were distributed in the same proportions as in 1991.

<sup>2</sup>“Major Crops” include corn, soybeans, wheat, barley, hay, and peanuts.

**Table 4. Direct agricultural processing sector annual employment by district and commodity group, 1996.**

Processing sector	Northern	Western	Central	Eastern	Southern	South-western	South-eastern	State
	Number (Percent)							
Meat	7,557 (35.8)	322 (1.5)	1,461 (6.9)	5,313 (25.2)	92 (0.4)	15 (0.1)	6,338 (30.0)	21,098
Dairy	398 (20.1)	145 (7.3)	923 (46.7)	168 (8.5)	0 (0)	208 (10.5)	135 (6.8)	1,977
Other food <sup>1</sup>	3,603 (21.0)	2,33 (13.6)	4,664 (27.1)	1,509 (8.8)	524 (3.0)	1,031 (6.0)	3,529 (20.5)	17,197
Tobacco	0 (0)	0 (0)	8,074 (86.0)	194 (2.1)	936 (10.0)	0 (0)	180 (1.9)	9,384
Textiles <sup>1</sup>	0 (0)	232 (9.7)	363 (15.2)	0 (0)	0 (0)	125 (5.2)	1,675 (69.9)	2,395

<sup>1</sup> Other than meat and dairy.

<sup>2</sup> Includes only textiles made predominantly from natural fibers (cotton, wool, etc.).

## CONCLUSIONS

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Many people have the mistaken impression that agriculture is only a small part of Virginia's economy. The truth is that agriculture is a significant industry in the state. Approximately one of every ten jobs in Virginia is related to agriculture. About 10 percent of Virginia's work force is employed in farm production, agricultural processing, distribution of agricultural goods, and supply of inputs to production, processing, and distribution. The four components of the agricultural economic system account directly for over 7 percent of GSP. When multiplier effects are considered, agriculture-related activities account for as much as 11.3 percent of Virginia's economy.

These estimates of agriculture's contribution are significant. Even so, they are conservative for several reasons. 1) Published estimates of employment in farming fail to account for most unpaid family and operator labor. 2) The IMPLAN input-output model generates impact estimates that are generally considered to be conservative. 3) Only the current account portion of agricultural investment expenditures were included. 4) The value and impact of farm products produced and consumed by farm families were not included. 5) The impacts of government subsidies were excluded. And 6) forestry and wood products were excluded.

Surprisingly, a large portion of the jobs in Virginia's agricultural system occur in the state's urban areas. Most agricultural inputs are produced, services are offered, and processing and distribution of products occur in cities and their surrounding counties.

Agriculture in Virginia is a vigorous economic sector, closely tied to Virginia's quality of life by the sector's history, economic contributions, and importance as a predominant land use. This study indicates that Virginians should have a vested interest in a healthy and prosperous agricultural sector.

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## APPENDIX A. NOTES on METHODS

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### Definitions

The **multiplier effect** refers to the following process:

- 1) A sector creates jobs that provide income to otherwise unemployed and underemployed people or to new workers.
- 2) Those people spend much of their income on goods and services bought within the local community.
- 3) This increase in demand for goods and services purchased in the local economy eventually results in the creation of other new jobs in the region such as retail establishments, service industries, suppliers of raw materials to the new company, producers of new products using the new firm's output as input, etc.
- 4) The cycle continues with more income being spent, creating more demand and more new jobs. The effect eventually ends because, at each stage, some of the income of the newly employed will be used to purchase goods and services *outside* the region. This loss is known as **leakage**. Once the new income has leaked out of the county, no more driving force exists behind the multiplier effect, and the cycle ends.

The sum of all activity that has occurred during the cycle is the **output multiplier**.

Input-output models distinguish between output, income, and Gross State Product. **Output**, often called economic activity, includes all sales by all firms. Output is the most commonly used measure of impact, but it is not the best measure because it includes a lot of intermediate products produced in other regions. **Gross State Product** (GSP) is a more meaningful measure of impact because it takes out the part of output not produced locally. **Income** measures the portion of GSP that becomes the gross income of individuals.

### Description of the IMPLAN Model

IMPLAN (Impact Model for PLANning), an input-output modeling system developed by the U. S. Forest Service, was used to generate a series of economic multipliers for the Commonwealth of Virginia. Industries within an economy are interdependent in the sense that goods and services are traded among firms. An increase in the demand for an existing sector's output, or the location of a new firm in the region, will result in increased output in many other sectors of the economy. These resulting effects are quantified by calculating input-output multipliers. The IMPLAN system provides the data necessary to construct an input-output model of any county, or grouping of counties, in the country. IMPLAN provides multipliers for any of 528 economic sectors, some or all of which may exist in the region under study. When a new firm is anticipated in a sector for which no current firms exist, the IMPLAN system can be adjusted to include the new firm.

### Avoiding Double Counting

The monetary flows from farming to processing and distribution (Figure 2 in text) were estimated for this study from coefficients generated by the IMPLAN model. These flows were then used to eliminate double counting in the estimates of inputs. For example, of the estimated \$2,855 million in farm sales, about \$1,106 million was sold to Virginia processors while the rest constituted direct sales to consumers and "exports" to buyers outside the state. The \$1,106 million, plus the inputs used by farmers to produce it, constitute indirect inputs of the processing sector. If the inputs of farms are added to the inputs of processors, (\$1,106 million plus the sum of the processing sector's inputs) the farm inputs are counted

twice. To correct this double counting, \$1,106 million in farm sales and the inputs required to produce them were subtracted from the estimate of system inputs. In addition, processors purchased an estimated \$1,272 million from the distribution sector which, with the associated inputs, were again subtracted from total inputs to avoid double counting. Many studies have failed to make corrections such as these and thus tend to overestimate the level of inputs used by the system and its contribution to the total economy within which it operates.

## **Data Sources**

The main data sources were *Virginia Agricultural Statistics* (published annually by the VASS), employment reports prepared by the VEC, and databases accessible from within the IMPLAN model.

County-level cash receipt data are compiled by the United States Department of Agriculture's Economic Research Service on an annual basis and reproduced in *Virginia Agricultural Statistics*. County-level cash receipts data for all farm-level commodities were obtained from the 1996 *Virginia Agricultural Statistics* publication.

County-level employment data (that is FTEs in 1996) were acquired from the VEC, at the four-digit Standard Industrial Classification (SIC) level. The county-level farm receipts and farm-related manufacturing employment data were used in the input-output model to assess backward linkage impacts of the agricultural economic system on Virginia's economy. IMPLAN data for 1994 were used for the agricultural-processing sectors.

Cash receipts information from *Virginia Agricultural Statistics* was used to estimate value added and total employment for each farm commodity. Direct contributions to Gross State Product (GSP) at the farm level were estimated by multiplying cash receipts by the ratios of value added to sales (these ratios were obtained from the input-output model). Similarly, direct employment by farm commodity was estimated by multiplying cash receipts by ratios of employment to sales. IMPLAN data for 1991 were used for the agricultural production sectors since the 1994 IMPLAN data for the agricultural production sectors had changed substantially from the 1991 IMPLAN data. Sources at MIG, Inc., the producers of IMPLAN data, substantially changed their methodology for distributing the components of value added (employment earnings, proprietor's income, and taxes) since the original study was conducted. MIG, Inc. recommended that the researchers use the 1991 data for the farm production sector to facilitate comparisons between the two periods.

Total sales of processed agricultural commodities were estimated by dividing the VEC employment figures by ratios of employment to sales obtained from the input-output model. Direct contributions to GSP attributable to food manufactures were estimated by multiplying total sales per commodity by direct value-added to sales ratios obtained from IMPLAN.

## APPENDIX B. IMPLAN EMPLOYMENT AND VALUE-ADDED RATIOS

**Table 1B. 1991 IMPLAN employment and value-added ratios**

Sector	Direct jobs per million dollars of sales	Direct value added per dollar of sales
Tobacco	1.141	0.0765
Peanuts	6.913	0.076
Soybeans	6.929	0.078
Corn, grain	10.645	0.539
Wheat	26.520	0.566
Hay	34.210	0.373
Rye	26.520	0.566
Barley	10.161	0.538
Cotton, lint & seed	11.863	0.188
Other field crops <sup>1</sup>	23.192	12.779
Sweet potatoes	8.035	0.052
Potatoes	8.393	0.052
Vegetables	8.373	0.050
Fruits	19.893	0.027
Cattle & calves	25.252	0.297
Milk, wholesale	11.002	0.172
Hogs	23.778	0.353
Broilers	10.294	0.120
Turkeys	10.294	0.120
Chickens, farm	10.294	0.120
Eggs	10.294	0.120
Total sheep, lambs & wool	25.284	0.313
Sheep & lambs	25.284	0.313
Wool	25.284	0.313
Other livestock <sup>2</sup>	10.110	0.035
Greenhouse, nursery & Christmas trees	30.316	0.009
Greenhouse	30.316	0.009
Nursery & Christmas trees	30.316	0.009
Agricultural services	39.733	0.047

<sup>1</sup> Other field crops include mushrooms, grain sorghum, canola, sunflower, seed crops, and other field crops.

<sup>2</sup> Other livestock include turkey eggs, ducks, other poultry, horses, mules, honey, beeswax, aquaculture, mink pelts, and all other livestock



## APPENDIX C. VIRGINIA AGRICULTURAL STATISTIC DISTRICTS

**Table C1. Cities and counties located in the seven Virginia agricultural statistic districts.**

Northern	Eastern	Western	Southern	Southwestern	Central	Southeastern
Alexandria	Accomack	Alleghany	Charlotte	Bland	Albemarle	Brunswick
Arlington	Charles City	Augusta	Danville	Bristol	Amelia	Chesapeake
Clarke	Essex	Bath	Franklin Co.	Buchanan	Amherst	Dinwiddie
Culpeper	Gloucester	Botetourt	Halifax	Carroll	Appomattox	Emporia
Fairfax City	Hampton	Buena Vista	Henry	Dickenson	Bedford City	Franklin City
Fairfax Co.	James City	Clifton Forge	Lunenburg	Floyd	Bedford Co.	Greensville
Falls Church	King & Queen	Covington	Martinsville	Galax	Buckingham	Isle of Wight
Fauquier	King George	Craig	Nottoway	Giles	Campbell	Mecklenburg
Frederick	King William	Highland	Patrick	Grayson	Caroline	Norfolk
Harrisonburg	Lancaster	Lexington	Pittsylvania	Lee	Charlottesville	Portsmouth
Loudoun	Mathews	Roanoke City	South Boston	Montgomery	Chesterfield	Prince George
Madison	Middlesex	Roanoke Co.		Norton	Col. Heights	Southampton
Manassas	New Kent	Rockbridge		Pulaski	Cumberland	Suffolk
Manassas Park	Newport News	Salem		Radford	Fluvanna	Surry
Page	Northampton	Staunton		Russell	Fredericksburg	Sussex
Prince William	Northumberland	Waynesboro		Scott	Goochland	Virginia Beach
Rappahannock	Poquoson			Smyth	Greene	
Rockingham	Richmond Co.			Tazewell	Hanover	
Shenandoah	Westmoreland			Washington	Henrico	
Stafford	Williamsburg			Wise	Hopewell	
Warren	York			Wythe	Louisa	
Winchester					Lynchburg	
					Nelson	
					Orange	
					Petersburg	
					Powhatan	
					Prince Edward	
					Richmond City	
					Spotsylvania	

## APPENDIX D. FARM PRODUCTION and AGRICULTURAL PROCESSING EMPLOYMENT, by COMMODITY

Figure 1D. Regional share of cattle production employment, 1991-96.

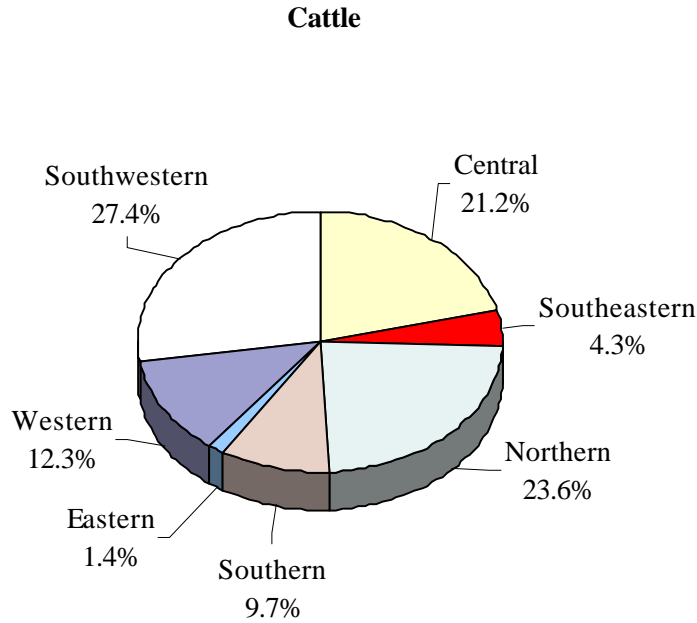


Figure 2D. Regional district share of poultry production employment, 1991-96.

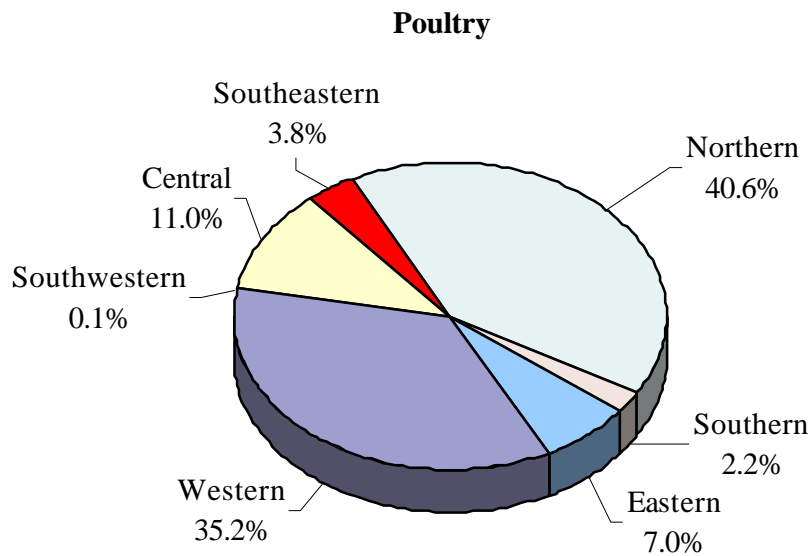


Figure 3D. Regional share of hogs and sheep production employment, 1991-96.

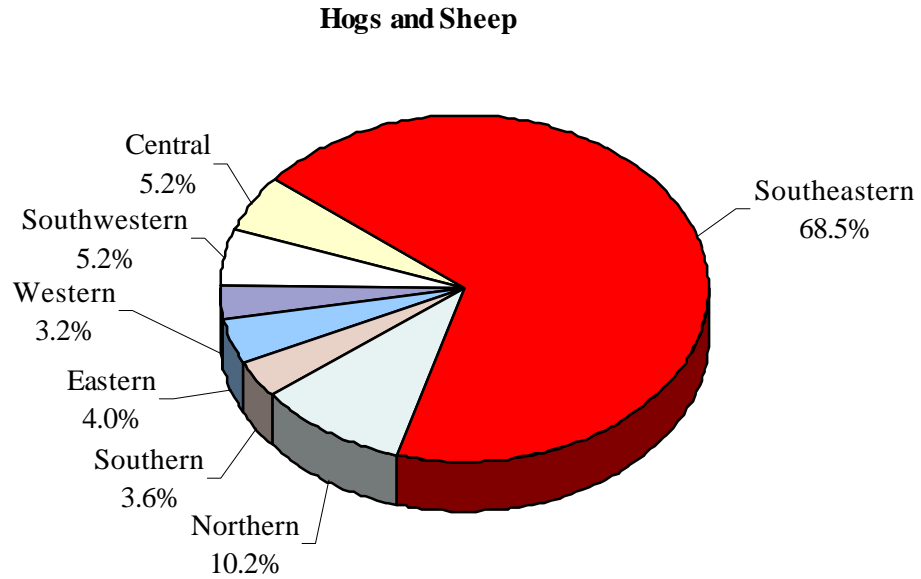
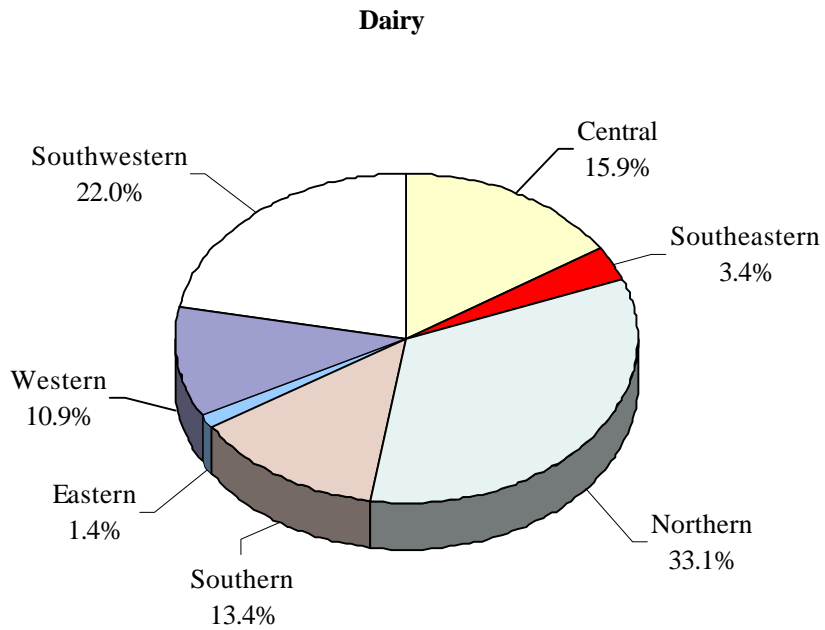
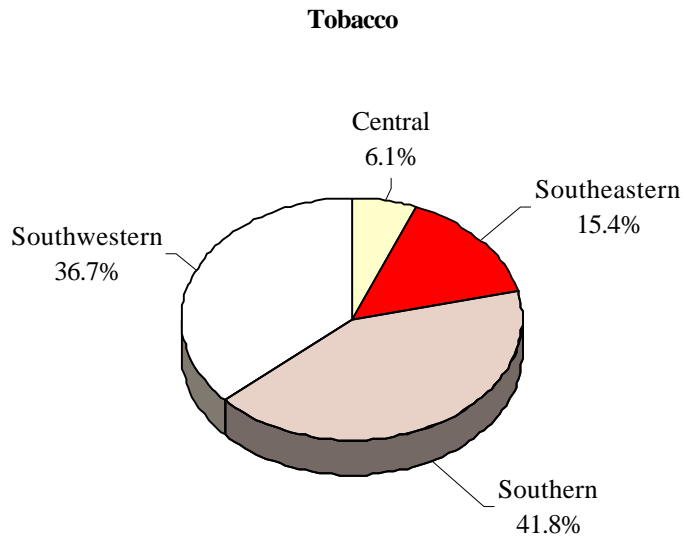


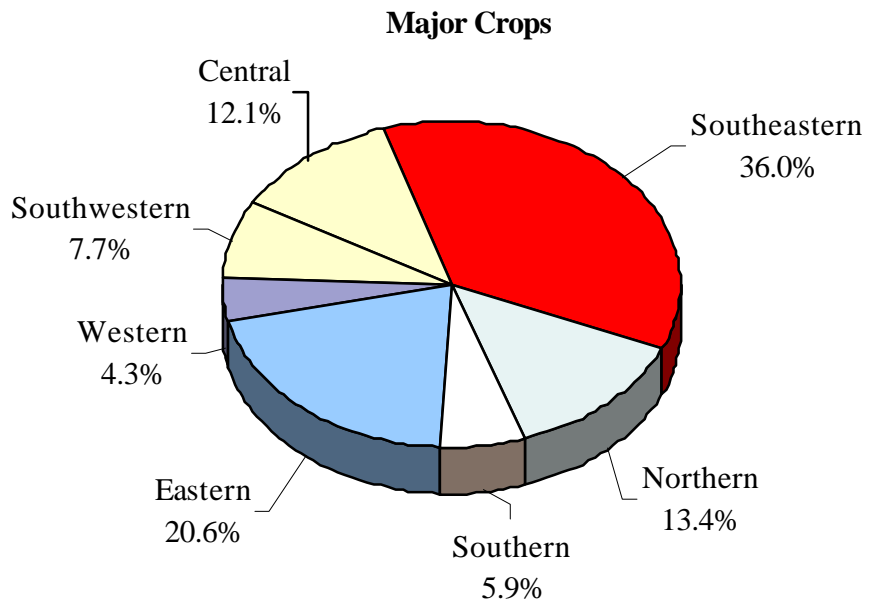
Figure 4D. Regional share of dairy production employment, 1991-96.



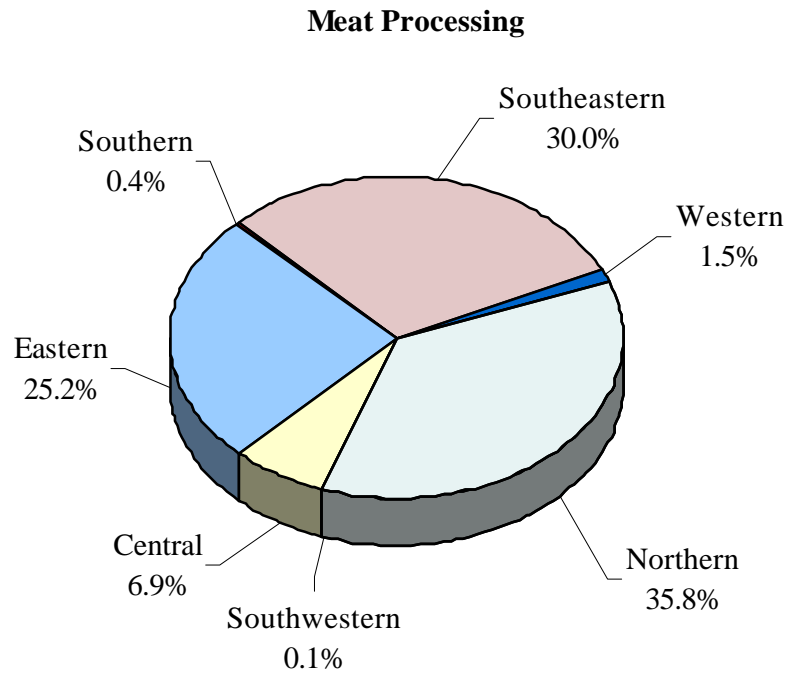
**Figure 5D. Regional share of tobacco production employment, 1991-96.**



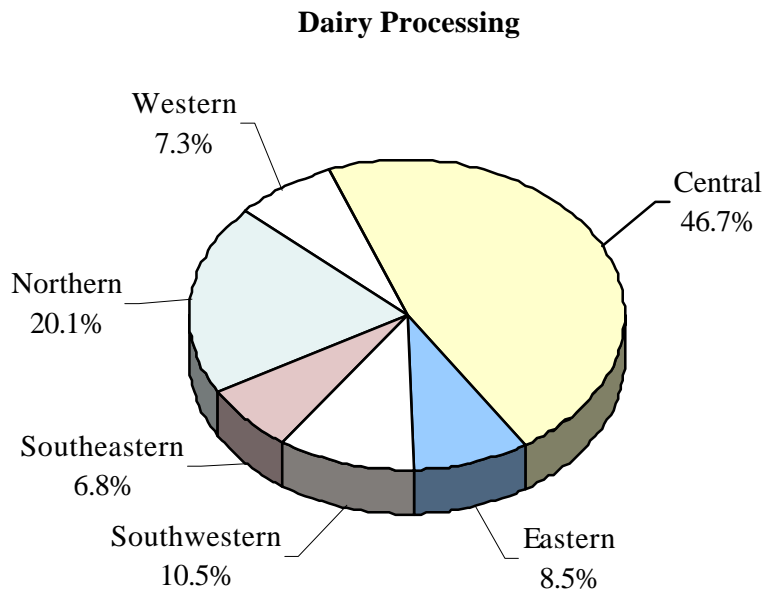
**Figure 6D. Regional share of major crops production employment, 1991-96.**



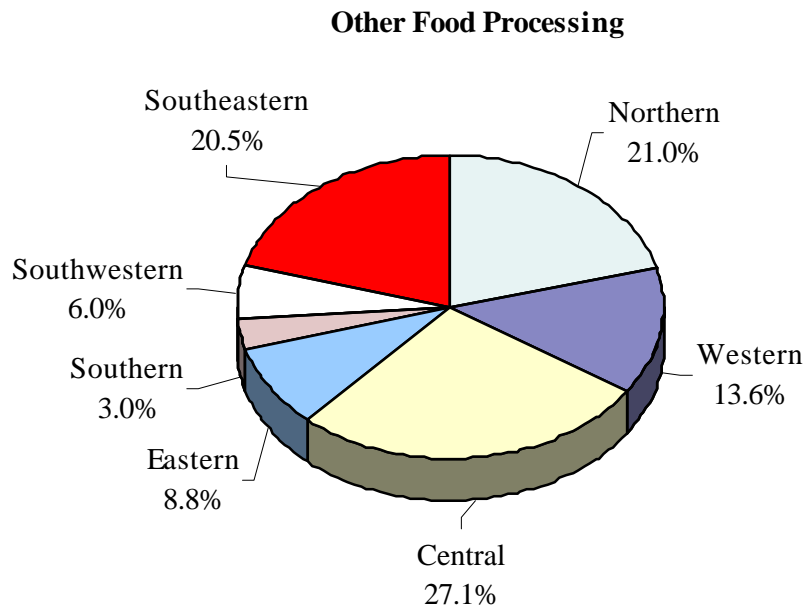
**Figure 7D. Regional share of meat processing employment, 1996**



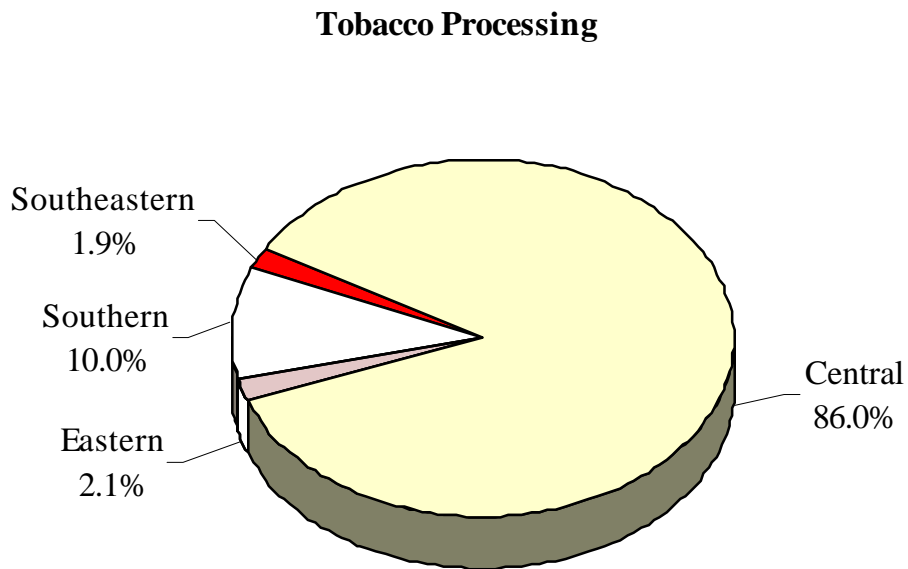
**Figure 8D. Regional share of dairy processing employment, 1996**



**Figure 9D. Regional share of food processing employment other than dairy and meat, 1996**



**Figure 10D. Regional share of tobacco processing employment, 1996**



**Figure 11D. Regional share of natural fiber textile processing employment, 1996**

**Textile Processing**

