

Economic Impacts of Agriculture and Forestry in Tennessee

Introduction

State and national budget shortfalls have spurred renewed debate over the role and purpose of all government agencies. In order to justify expenditures, agricultural economists have been called upon to give insight into the economic size and effect of agriculture¹ on the state economy. Additionally, efforts to attract value-added agricultural industry have been promoted. Questions regarding the type of firms to attract, the sufficiency of resources required, and the environmental impacts that might occur are being asked.

This study examines the economic importance and impacts of agricultural and forestry industrial complexes on Tennessee's economy. Using an input-output model, direct impacts, impacts on related input industries, and impacts through resulting expenditures by households and institutions are estimated at both a state and five-region level. The impacts are provided for three major indicators: total industry output, employment, and value added.

When the land grant colleges were established in 1862, the boundaries of agriculture were fairly simple to define. They were literally the farm fences. Everything that occurred within those fences was agriculture. Sixty percent of the population lived on farms where inputs, food production, processing, storage, and consumption were mostly done on the farm. Today these tasks are woven into the larger pattern of society. Farms by themselves are no longer an adequate boundary to describe agriculture.

The definition of Tennessee's agricultural sector has been evolving through the past ten years. Gaines pointed out that the traditional accounting system includes only total sales within

¹ In this proposal, forestry and the production of forest products are incorporated in agriculture and agribusiness, respectively.

production agriculture, and excludes all agricultural input and output industries. According to this definition, agriculture only accounts for 2 percent of the Tennessee economy (Gaines, 1994). Smith expanded the definition to include all agribusiness, which includes farm input industries and output industries such as food packaging and clothing. Under this expansion, agriculture accounts for 25 percent of the Gross State Product (GSP) (Smith, 1985). Neal addressed this issue by using input-output analysis to find the direct, indirect, and induced effect coefficients (Neal, 1990). He used the expanded definition to compute the coefficients of impact upon the economy. The author laid down a much needed quantifiable procedure, but he did not apply these coefficients to the final demands of the sectors to get a total percentage of the economy attributed to agriculture.

Other states, besides Tennessee, have also been developing a procedure of agricultural impact accounting. Some narrowly define agriculture as only the farm production sector. Others view agriculture with a wider lens and include agricultural production, processing, input industries, transportation, agricultural financial services, real estate services, and wholesale and retail trade of food and fiber goods (Leones *et al.*, 1994). A few also include the forestry, lumber, and fishing sectors.

For the purpose of this analysis, agriculture and forestry includes the production and processing of agricultural and forest products and the input suppliers of these products. The objectives of this analysis are to: 1) provide an overview of Tennessee's agriculture and forestry resource base; and 2) evaluate the economic importance and impacts of the agricultural and forestry industrial complexes for the state and for specific consumption regions within the state. Detailed presentations of certain aspects of the modeling process and economic impacts from subsectors of agriculture and forestry are presented in Appendix Sections 1-3.

Overview of Agriculture and Forestry in Tennessee

Of the 26.4 million total acres in Tennessee, approximately 11.1 million acres, or 42 percent, are in farms. Cropland accounts for 63.6 percent of farmland, followed by woodland and pastureland at 23.5 percent and 8.8 percent, respectively. The predominant crops harvested, including acreage and Tennessee's ranking among states based on production, are summarized in Table 1.

Table 1. Crops Harvested, Acreage, and State Ranking

Crops	Acreage (Thousands of Acres)	State Ranking
Hay (all types)	1,646	--
Soybeans for beans	1,156	18
Corn for grain	576	18
Cotton	472	10
Wheat for grain	305	20
Corn for silage	68	--
Tobacco	59	3
Vegetables	35	--
Sorghum for grain	10	14
Orchards	4	--

Source: 1997 Census of Agriculture, USDA; Tennessee Agriculture 2000, Tennessee Agricultural Statistics Service

Cattle and calves, poultry and poultry products, dairy products, and hogs and pigs are the predominant livestock in the state. According to the *1997 Census of Agriculture*, the value of livestock, poultry, and their products sold totaled over \$1 billion. Of that total value, cattle and calves contributed 41.2 percent, poultry and poultry products 28.3 percent, dairy products 20.2 percent, and hogs and pigs 7.0 percent. Tennessee ranks 14th in the United States for number of cattle and calves and 23rd for hogs and pigs. Beef cows are the predominant cattle raised (Tennessee Agricultural Statistics Service, 2000).

From 1996 to 1999, the number of farms in the state remained relatively stable at 91,000. The average size farm in 1997 was 131 acres compared to 432 acres for the United States.

Figure 1 shows the distribution of average farm sizes by county across the state. Topography, beginning from the eastern part of the state to the west, is mountainous to fairly level. The average farm size is smaller in the eastern and middle part of the state and larger in the western part. Approximately 75.8 percent of the total number of farms had sales in the \$1,000-\$9,999 range, 19.8 percent in the \$10,000-\$99,999 range, and 4.4 percent had sales \$100,000 or more (1997 Census of Agriculture, Tennessee Agricultural Statistics Service, 2000).

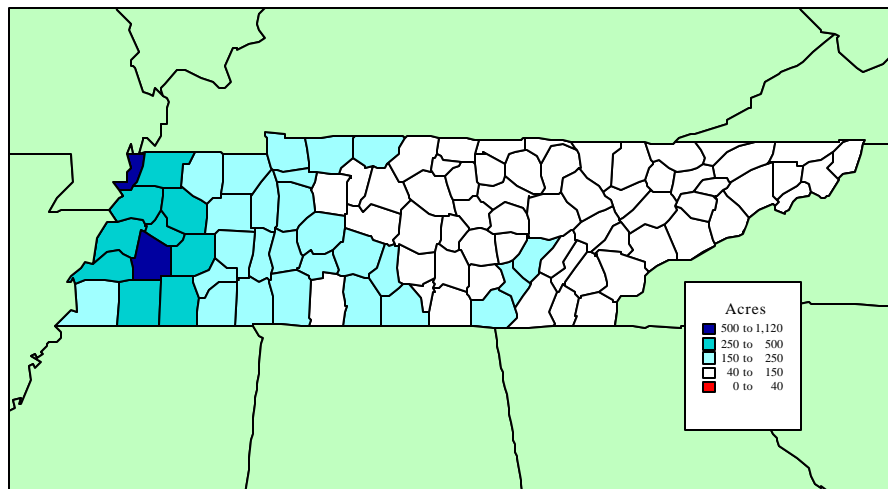


Figure 1. Average Farm Size for Tennessee, 1997.

Tennessee's more significant agricultural commodities in terms of value, along with their corresponding U.S. market share, are shown in Table 2. In descending order they are cattle, poultry and eggs, hay and pasture, oil-bearing crops, greenhouse and nursery products, dairy farm products, cotton, tobacco, and feed grains (barley, corn, oats, and sorghum for grain). Tobacco and cotton have the largest U.S. market share at 6.45 percent and 3.47 percent, respectively (1997 Census of Agriculture). For the commodities listed in Table 2, the maps in Figures 2 through 10 show the predominant areas where they are produced throughout the state.

Table 2. State Value of Agricultural Commodities and U.S. Market Share

Commodity	Value (Million \$)	U.S. Market Share (Percent)
Cattle	426	1.05
Poultry & Eggs	293	1.32
Hay & Pasture	280	1.71
Oil Bearing Crops	245	1.57
Greenhouse & Nursery Products	213	1.95
Dairy Farm Products	209	1.10
Cotton	208	3.47
Tobacco	189	6.45
Feed Grains	148	0.62

Source: 1997 Census of Agriculture, 1997 IMPLAN Data

Tennessee agricultural exports in 1999 totaled a little over \$382 million. The value of the more predominant commodities exported include unmanufactured tobacco at \$85 million, soybeans and soybean products at \$84 million, cotton and cottonseed products at \$51 million, poultry and poultry products at \$31 million, and dairy products at \$9 million (Tennessee Agricultural Statistics Service, 2000).

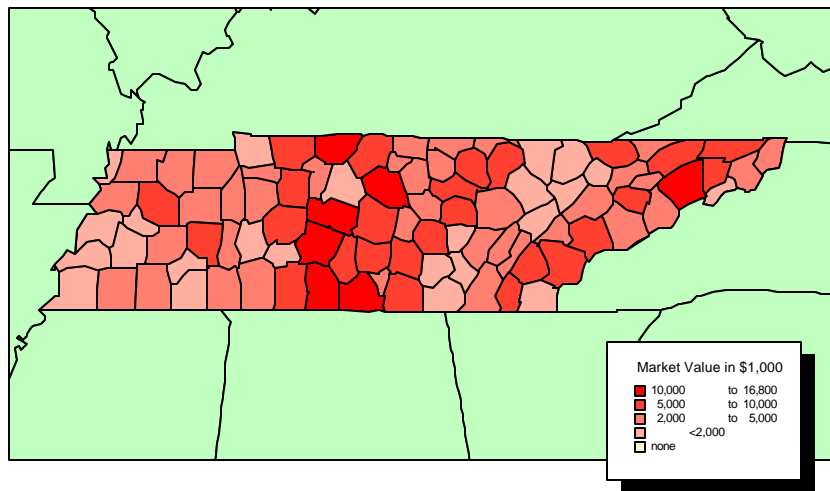


Figure 2. Market Value of Cattle & Calves Sold, 1997.

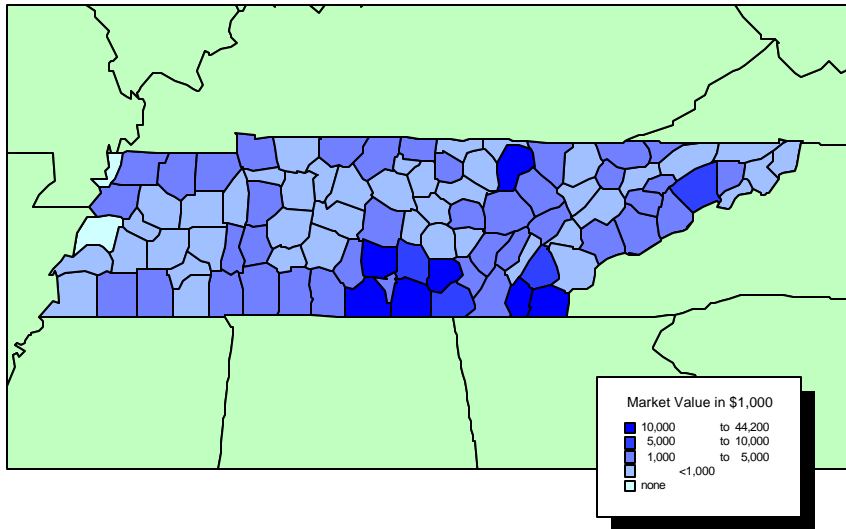


Figure 3. Market Value of Poultry & Poultry Products Sold, 1997.

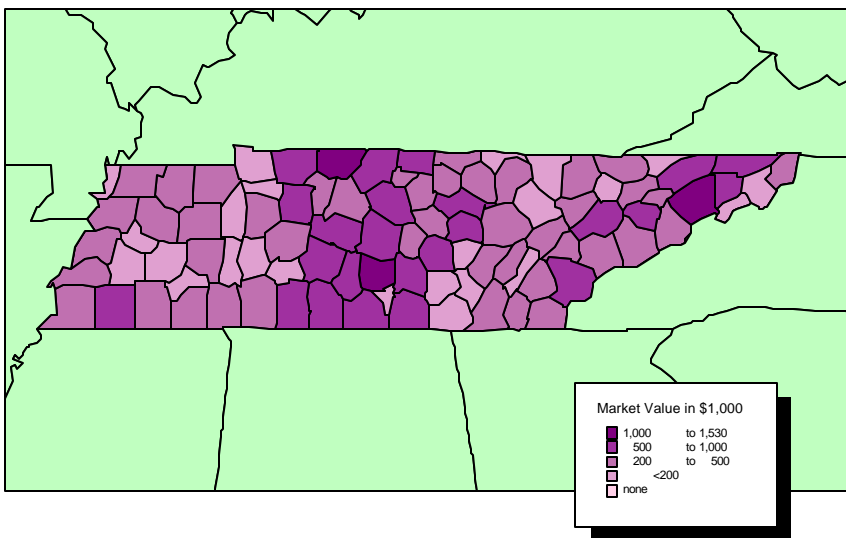


Figure 4. Market Value of Hay, Silage, and Field Seeds Sold, 1997.

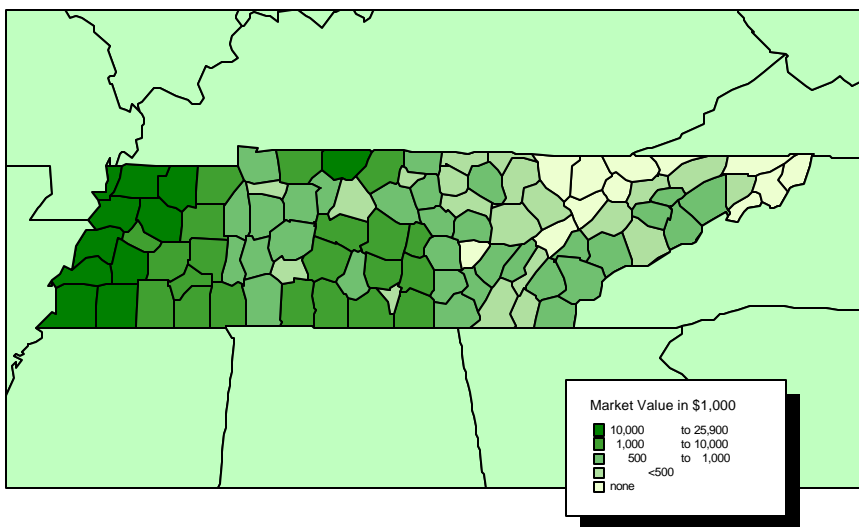


Figure 5. Market Value of Soybeans Sold, 1997.

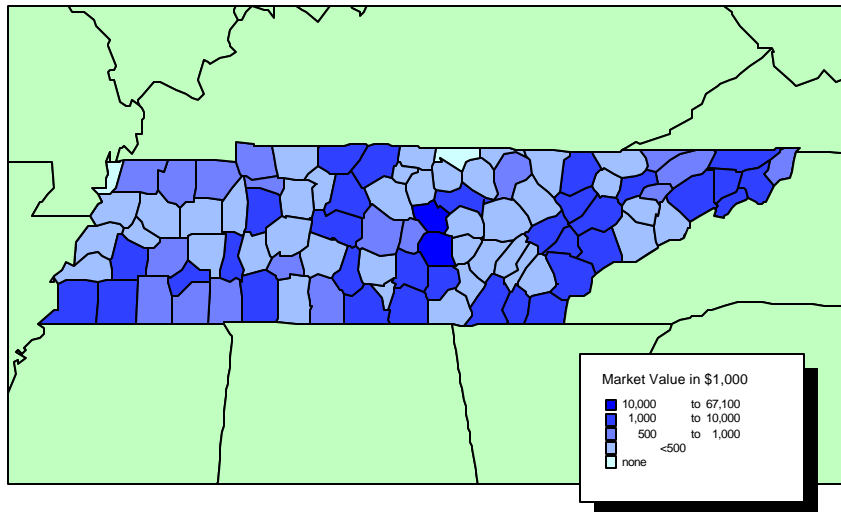


Figure 6. Market Value of Nursery & Greenhouse Crops Sold, 1997.

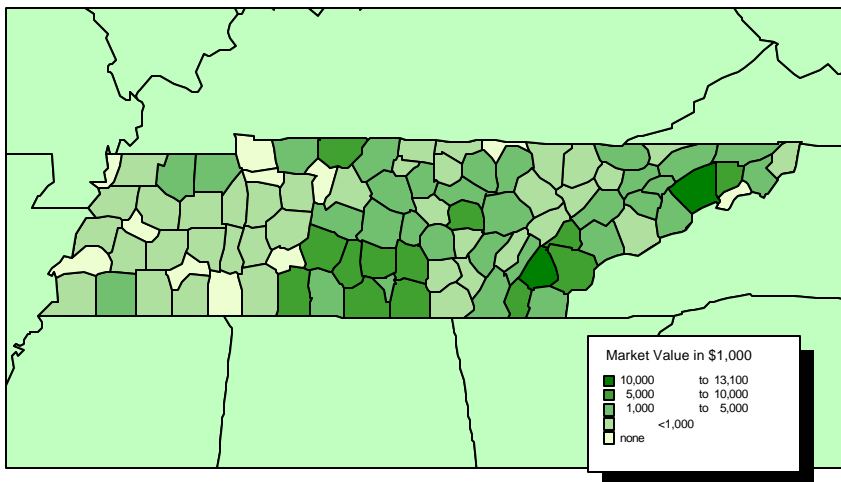


Figure 7. Market Value of Dairy Products Sold, 1997.

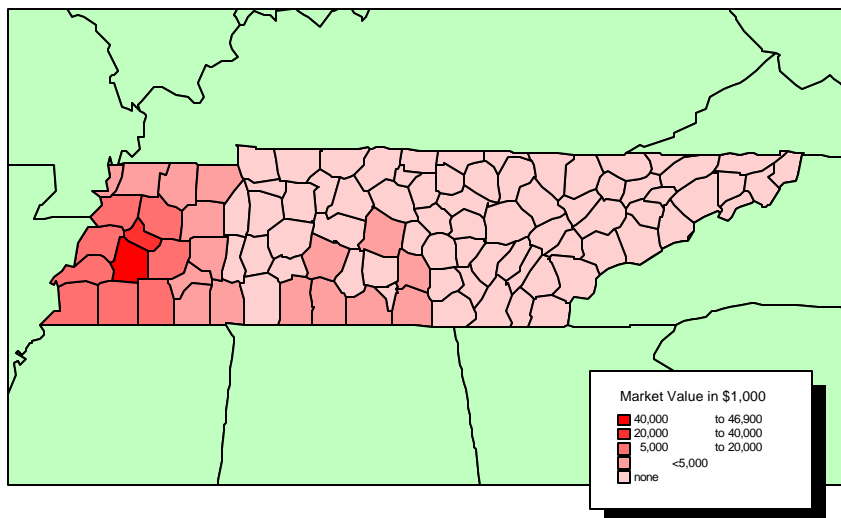


Figure 8. Market Value of Cotton Sold, 1997.

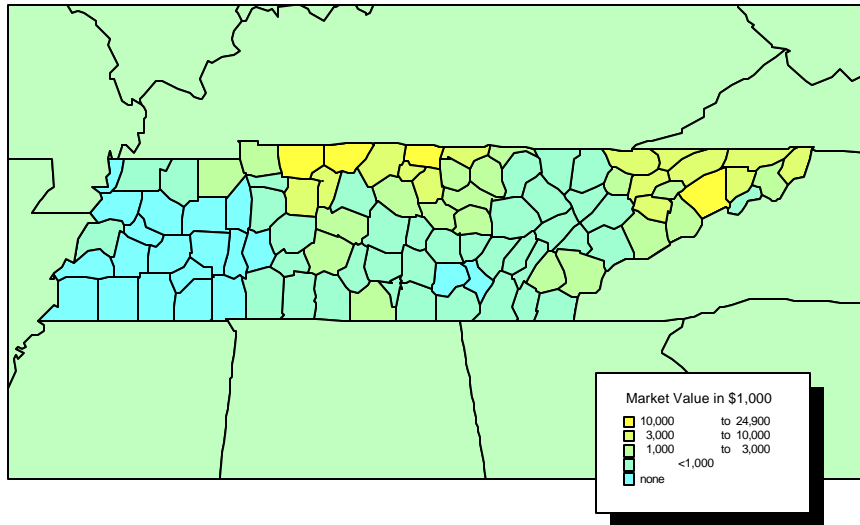


Figure 9. Market Value of Tobacco Sold, 1997.

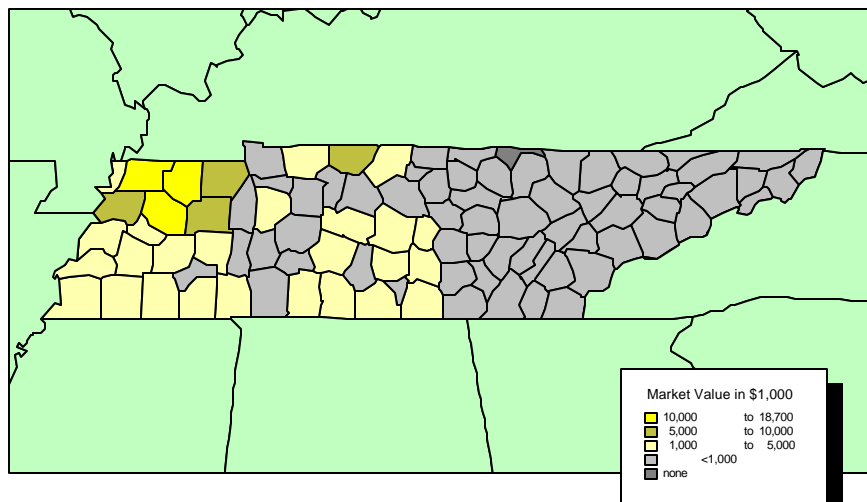


Figure 10. Market Value of Feed Grains Sold, 1997.

Tennessee has witnessed an increase in forest areas over the last couple of decades, primarily due to farmlands reverting back to forest. According to the United States Forest Service in 1999, approximately 55 percent of the state is forested. Hardwoods, at 78 percent, are the predominant species. White oak, red oak, hickory, yellow poplar, and maple are some of the more predominant hardwood species. Major species of softwoods include loblolly pine, virginia pine, redcedar, and shortleaf pine. Approximately 69.4 percent of the total forest area is owned by individuals, 13.9 percent by government, 9.7 percent by forest industry, and 7 percent by other corporations (Tennessee Division of Forestry).

Counties with large volumes of standing timber include Hardeman, Hardin, Wayne, Perry, Humphrey, and Hickman in middle and west Tennessee, and Cumberland, Morgan, Scott, and Campbell in east Tennessee (Figure 11). For timber removals, Hardeman, McNairy, Hardin, Wayne, Perry, and Hickman counties have large acreages (Figure 12). Counties in the outer basin between middle and west Tennessee and counties in the Cumberland Plateau area of east Tennessee are heavily forested (Figure 13).

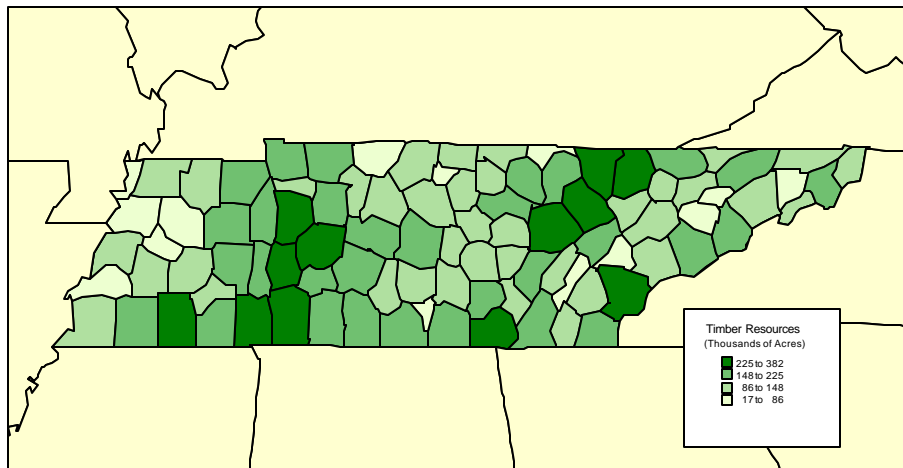


Figure 11. Tennessee's Standing Timber Resources, 1997.

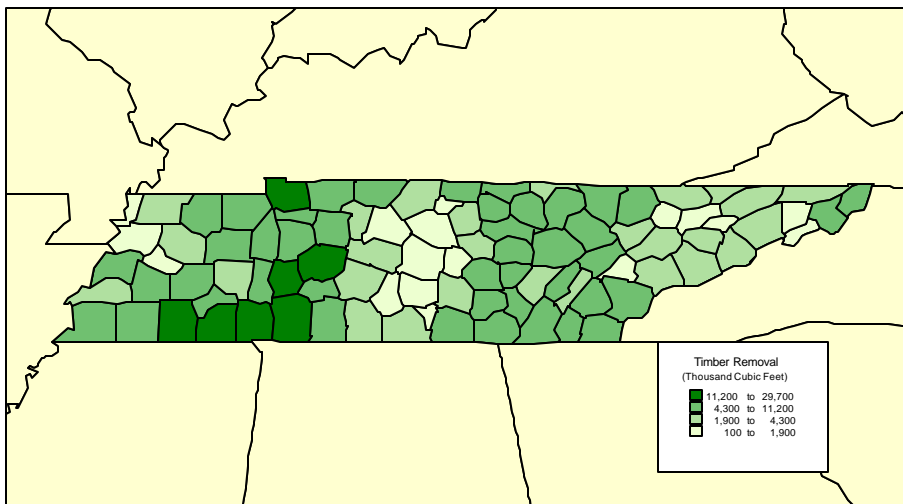


Figure 12. Timber Removal in Tennessee, 1997.

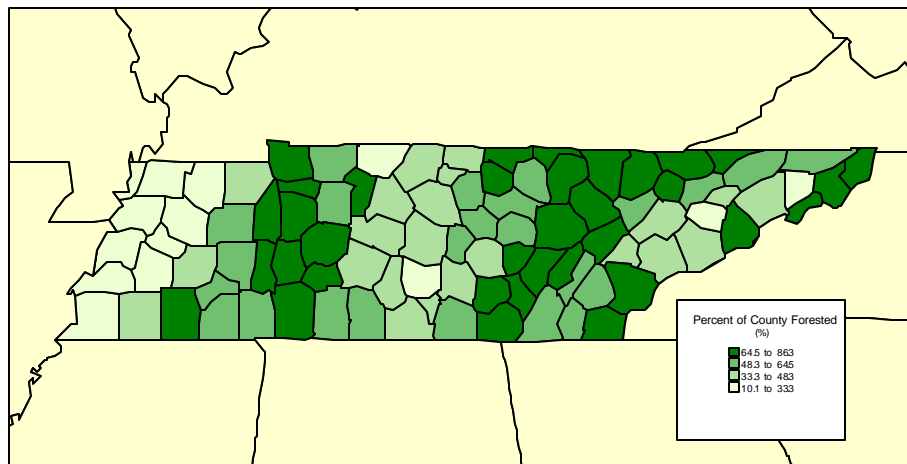


Figure 13. Forest Coverage in Tennessee Counties, 1997.

Manufacturing industries for the state include food and kindred products, tobacco products, textile mill products, apparel and other textile products, lumber and wood products, furniture and fixtures, and paper and allied products. Jobs and wages are created when raw agricultural and forest commodities are processed, handled, and marketed. In 1996, over \$26 billion dollars of goods were shipped, close to 177,000 Tennesseans were employed, with a payroll close to \$4 billion (Table 3). Food and kindred products shipped the largest value, close to \$11 billion, followed by paper and allied products at \$4.2 billion, and apparel and textile products at \$3.4 billion. Forest products as a group, lumber and wood products, furniture and fixtures, and paper and allied products, shipped over \$9 billion of goods. Tennessee's market share of the United States for value of shipments for food and kindred products is 2.3 percent, followed by textile mill products at 3.1 percent, apparel and other textile products at 4.4 percent, lumber and wood products at 2.3 percent, furniture and fixtures at 5.3 percent, and paper and allied products at 2.6 percent.

Although apparel and textile products manufacturers employ the largest number of individuals, recent trends of decrease employment have occurred. However, food and kindred products processors and forest products manufacturers (lumber and wood products, furniture and

fixtures, and paper and allied products) employ a large share compared to apparel and textile products manufacturers. For the industries listed in Table 3, the maps in Figures 14 through 20 show the predominant areas where these manufacturing and processing establishments are located throughout the state.

Table 3. 1996 Manufacturing Statistics for Tennessee

Manufacturing Industry	Employees (Number)	Payroll (Million \$)	Establishments (Number)	Value of Shipments (Million \$)
Food & Kindred Products	37,800	1,060	323	10,835
Tobacco Products	871	27	8	--- ^a
Textile Mill Products	19,700	443	172	2,512
Apparel & Other Textile Products	48,700	750	507	3,432
Lumber & Wood Products	21,500	400	1,087	2,454
Furniture & Fixtures	28,900	634	313	2,935
Paper & Allied Products	19,300	651	181	4,217
Total	176,771	3,965	2,591	26,385

^a Data not disclosed.

Source: U.S. Census Bureau

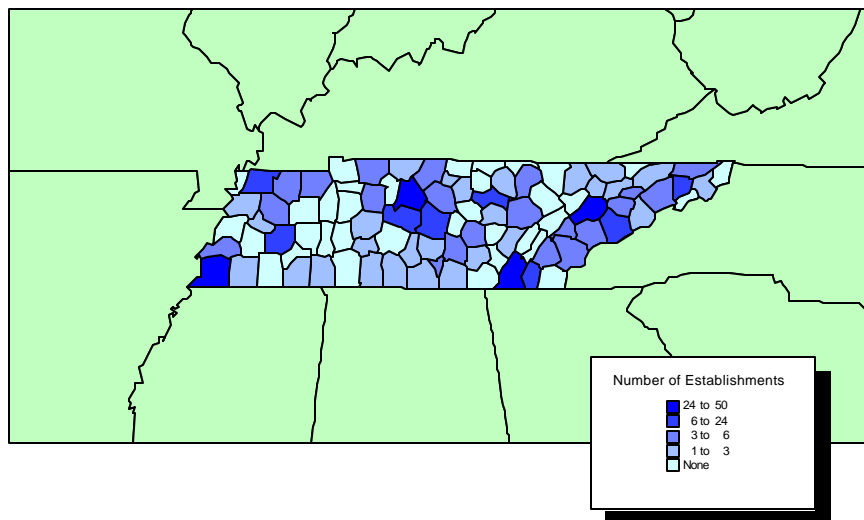


Figure 14. Number of Food & Kindred Products Establishments in Tennessee, 1996.

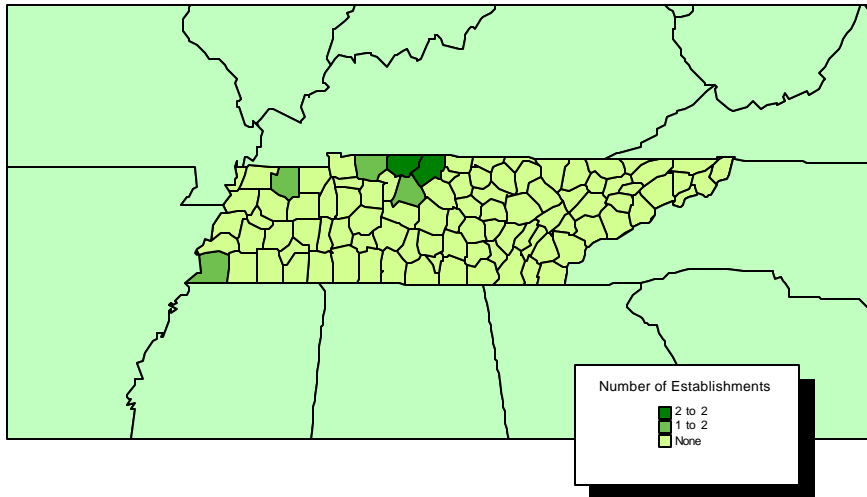


Figure 15. Number of Tobacco Products Establishments in Tennessee, 1996.

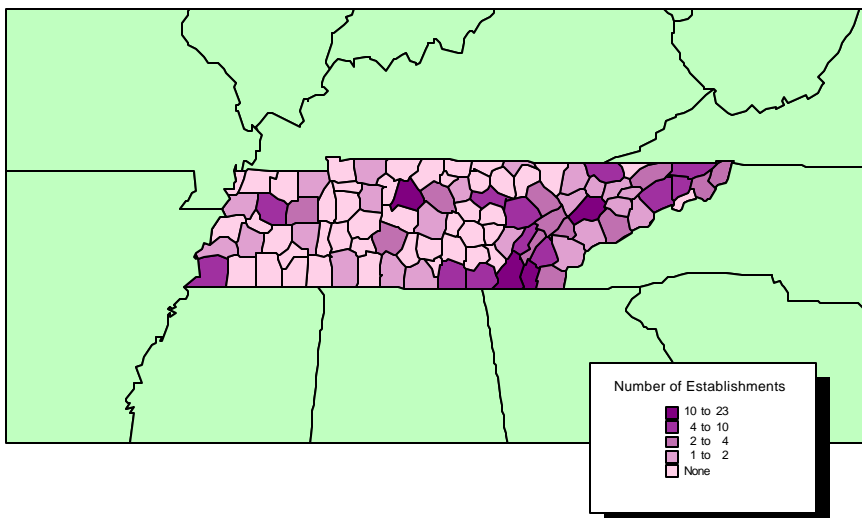


Figure 16. Number of Textile Mill Products Establishments in Tennessee, 1996.

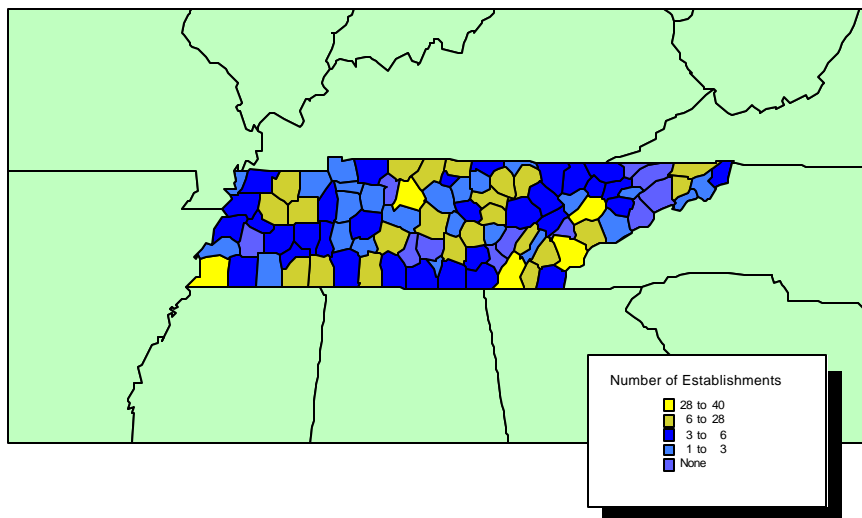


Figure 17. Number of Apparel & Other Textile Products Establishments in Tennessee, 1996.

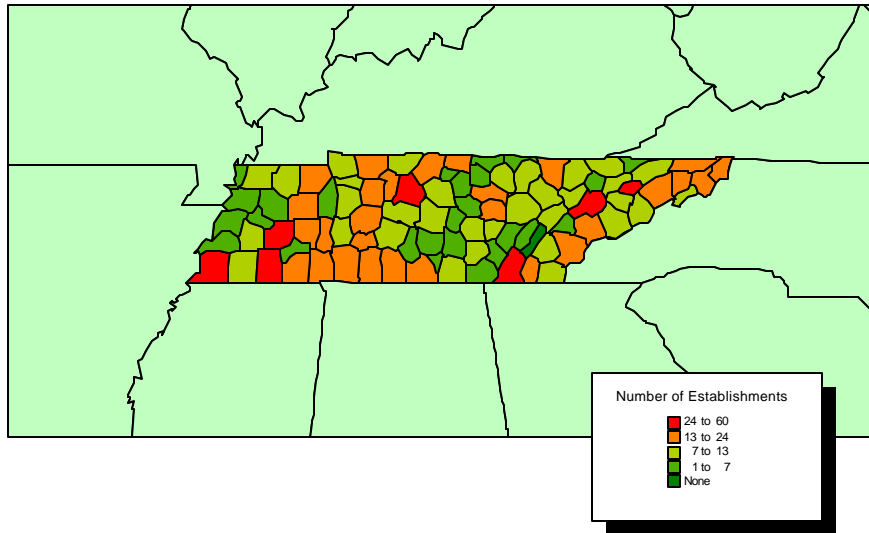


Figure 18. Number of Lumber & Wood Products Establishments in Tennessee, 1996.

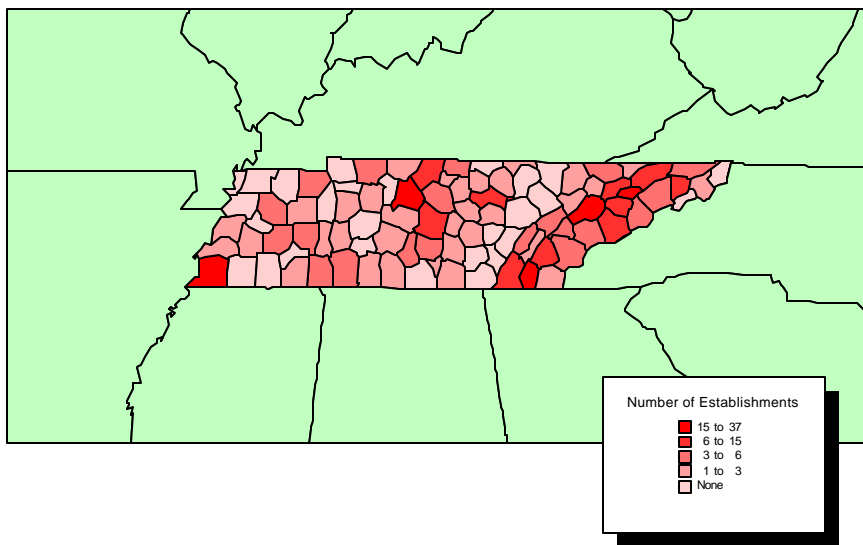


Figure 19. Number of Furniture & Fixtures Establishments in Tennessee, 1996.

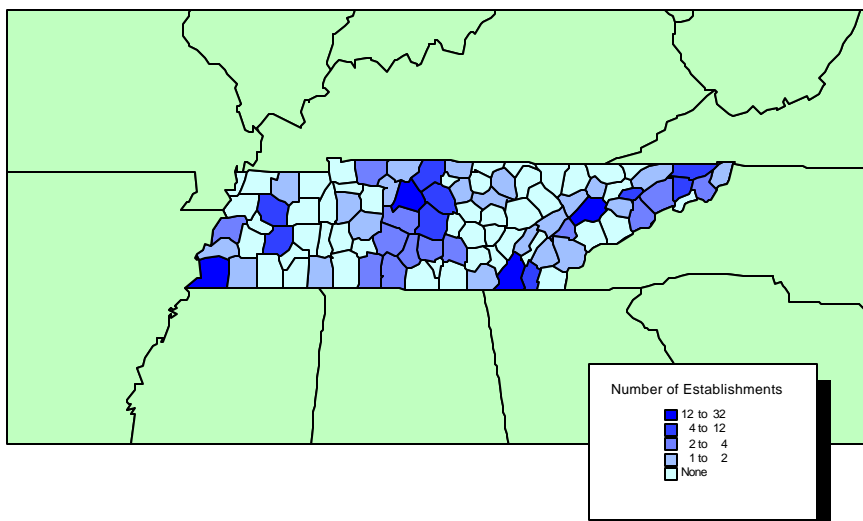


Figure 20. Number of Paper & Allied Products Establishments in Tennessee, 1996.

Data and Methods Used

The Tennessee Agri-Industry model is used to model industry and institutional interrelationships in each of five regions within Tennessee. The Tennessee Agri-Industry model uses the Impact Analysis for Planning (IMPLAN) model and databases, adjusted for agricultural data from the *1997 Census of Agriculture* (see Appendix Section 1 for further details about the data adjustment and model) (Olson and Lindall, 1999). The five regions are based on those used by the Bureau of Economic Analysis to represent areas of economic consumption (consumption regions), as displayed in Figure 21 (for county listings, see Appendix Section 1, Table A.2). Regional values are then aggregated to the state level.

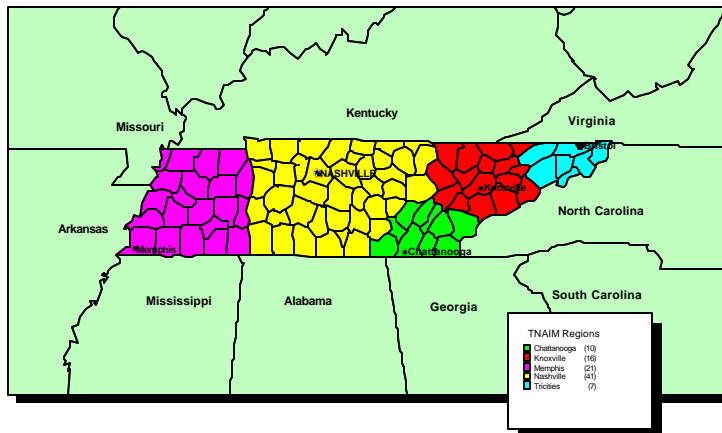


Figure 21. Tennessee Agri-Industry Model Analysis Regions

IMPLAN employs a regional social accounting system and can be used to generate a set of balanced economic/social accounts and multipliers. The social accounting system is an extension of input-output analysis.² Input-output analysis can provide important and timely

² Input-output (I-O) analysis, also known as inter-industry analysis, is the name given to an analytical work conducted by Wassily Leontief in the late 1930's. The fundamental purpose of the I-O framework is to analyze the interdependence of industries in an economy through market-based transactions.

information on the interrelationships in a regional economy and the impacts of changes on that economy. Input-output analysis has been expanded beyond market-based transaction accounting to include non-market financial flows by using a social accounting matrix or SAM framework (Pyatt and Round, 1985). The model describes the transfers of money between industries and institutions and contains both market-based transactions and non-market financial flows, such as inter-institutional transfers (see Figure 22). The 'Make' and 'Use' components of the SAM include the commodities made and used by industries. Factors represent the value-added by industries, including wages and compensation to workers, interest, profits, and indirect business taxes. Capital includes expenditures made by industries and institutions to obtain equipment and construction. The SAM takes into account corporate profits as 'Enterprises'. The SAM also accounts for non-industrial financial flows, including factor exports and imports, institution exports, factor distribution, and inter-institutional transfers. Factor exports (imports) are payments, such as employee compensation or stock dividend received (paid) from outside the region. Institution exports would include situations such as a person from inside the region working outside the region. Factor distributions are payments from the factor sectors to institutions, such as households or governments. Inter-institutional transfers include payments between institutions, such as federal government grants to state governments, welfare, social security payments, and taxes paid to governments.

The model uses regional purchase coefficients generated by econometric equations that predict local purchases based on a region's characteristics. Output from the model includes descriptive measures of the economy including total industry output, employment, and value-added for over 500 industries in the Tennessee economy. Total industry output is defined as the

	Industry	Commodity	Factors	Institutions	Enterprises	Capital	Trade	Total
Industry		Make					Exports	Total Industry Output
Commodity	Use			Consumption		Consumption		Total Commodity Output
Factors	Value Added						Exports	Total Factor Income
Institutions		Sales	Transfers	Transfers	Transfers		Exports	Total Institutional Income
Enterprises								Total Enterprise Income
Capital								Total Capital Income
Trade	Imports		Factor Trade	Imports		Transfers	Exports	Total Trade Income
Total	Total Industry Outlay	Total Commodity Outlay	Total Factor Outlay	Total Institutional Outlay	Total Enterprise Outlay	Total Capital Outlay	Total Regional Exports	

Figure 22. Social Accounting Matrix Framework

Source: *Implan Pro Manual, Version 2.0.*

value of production by industry per year. Employment represents total wage and salary employees, as well as self-employed jobs in a region, for both full-time and part-time workers. Total value added is defined as all income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses. The model also can be used for predictive purposes, by providing estimates of multipliers.

Multipliers measure the response of the economy to a change in demand or production. Multiplier analysis generally focuses on the effects of exogenous changes on: a) output of the sectors in the economy, b) income earned by households because of the new outputs, and c) employment (in physical terms) that is expected to be generated because of the new outputs. The notion of multipliers rests upon the difference between the initial effect of an exogenous change (final demand) and the total effects of a change. Direct effects measure the response for a given industry given a change in final demand for that same industry. Indirect effects represent the response by all local industries from a change in final demand for a specific industry. Induced effects represent the response by all local industries caused by increased (decreased) expenditures of new household income and inter-institutional transfers generated (lost) from the direct and indirect effects of the change in final demand for a specific industry. This study uses Type I and Type SAM (Social Accounting Matrix) multipliers. Type I multipliers are calculated by dividing direct plus indirect effects by the direct effects, where the Type SAM multipliers = $(\text{direct} + \text{indirect} + \text{induced effects}) / \text{direct effects}$. The Type SAM multipliers take into account the expenditures resulting from increased incomes of households as well as inter-institutional transfers resulting from the economic activity. Therefore, Type SAM multipliers assume that as final demand changes, incomes increase along with inter-institutional transfers. As these people

and institutions increase expenditures this leads to increased demands from local industries.

Economic Impacts at the State & In-state Region Levels

The direct values for total industry output (TIO), total value-added (TVA), employment, and wages and salaries for agriculture and forestry in 1997 are presented in Table 4. The values are also presented according to the analysis regions within the state.

In 1997, agriculture and forestry related industries contributed a total of \$31.4 billion in direct economic activity to the state of Tennessee or close to 12 percent of the state's economy. Employment in agriculture and forestry related industries is about 293.4 thousand persons or 8.9 percent of the workforce. Total value added was close to \$10 billion with nearly \$6 billion in wages and salaries. Much of the industry output generated from agriculture and forestry were through secondary or manufactured products. Employment was more evenly divided between primary and secondary industries for agriculture, where as for forestry, close to 71% of the workforce was employed in secondary industries. Wages are generated about 10 to 1 in secondary industries compared with primary industries for agriculturally related industries and about 2 to 1 in secondary industries compared with primary for forestry products.

About 43 percent of the value of output from primary agriculture originates in the Nashville Region, followed by the Memphis Region (Figure 23). However, the greatest value for total industry output from secondary agriculture is from the Memphis Region followed by the Nashville Region. For both primary and secondary forestry products, the Memphis Region has the greatest value for total industry output followed by the Nashville Region for primary forestry and the Knoxville Region for secondary forestry. The Knoxville Region contributes 26 percent of the value from secondary forestry, almost twice the Region's share from secondary agriculture. The Chattanooga Region's largest share, 20%, is for secondary agriculture, followed

by secondary forestry. The Tri-Cities Region's contribution ranges from 5 to 9 percent of the state's industry output from both primary and secondary agriculture and forestry.

Table 4. Direct Economic Activity in Agriculture and Forestry

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
All Sectors (Including Non-Agricultural and Non-Forestry):				
State ^c	270,157	144,956	3,291,824	86,833
Memphis	76,565	42,360	909,334	25,230
Nashville	103,653	54,756	1,234,582	32,380
Chattanooga	30,623	16,125	349,163	9,492
Knoxville	41,490	22,366	551,049	13,687
Tri-Cities	17,826	9,349	247,696	6,044
Agriculture & Forestry:				
State ^c	31,450	9,814	293,388 ^d	5,857
Memphis	10,171	3,110	67,488	1,766
Nashville	8,872	2,737	101,365	1,535
Chattanooga	5,540	1,765	41,490	1,122
Knoxville	5,045	1,666	57,454	1,089
Tri-Cities	1,820	536	25,403	345
Primary & Secondary Agriculture:				
State ^c	21,060	6,204	218,305 ^d	3,534
Memphis	6,524	1,840	47,059	995
Nashville	6,577	1,945	82,694	1,026
Chattanooga	3,873	1,181	29,813	727
Knoxville	2,986	927	38,435	588
Tri-Cities	1,099	310	20,116	198
Primary Agriculture:				
State ^c	2,899	868	114,332 ^d	318
Memphis	893	242	22,031	86
Nashville	1,257	369	51,210	136
Chattanooga	248	52	7,594	21
Knoxville	303	132	19,553	51
Tri-Cities	196	74	13,756	25
Secondary Agriculture:				
State ^c	18,161	5,336	103,972	3,215
Memphis	5,631	1,598	25,028	909
Nashville	5,320	1,577	31,484	890
Chattanooga	3,624	1,130	22,219	706
Knoxville	2,683	796	18,882	538
Tri-Cities	902	236	6,360	174

Table 4. (Continued)

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Primary & Secondary Forestry:				
State ^c	10,390	3,610	75,084	2,323
Memphis	3,647	1,270	20,430	771
Nashville	2,294	792	18,671	509
Chattanooga	1,667	584	11,676	395
Knoxville	2,059	738	19,019	501
Tri-Cities	722	227	5,287	147
Primary Forestry:				
State ^c	3,451	1,226	21,990	716
Memphis	1,662	587	7,972	350
Nashville	702	242	6,472	133
Chattanooga	499	184	2,215	108
Knoxville	279	108	3,194	60
Tri-Cities	309	104	2,135	66
Secondary Forestry:				
State ^c	6,938	2,384	53,094	1,607
Memphis	1,985	682	12,457	422
Nashville	1,592	550	12,199	376
Chattanooga	1,168	399	9,461	288
Knoxville	1,780	630	15,825	441
Tri-Cities	413	122	3,152	80

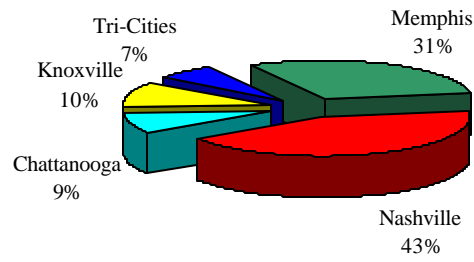
^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

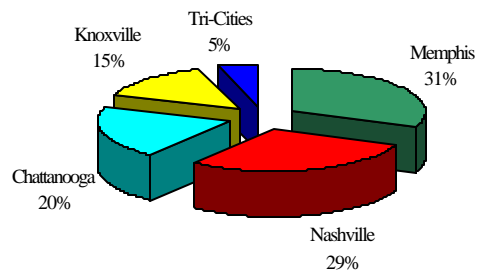
^c State totals may not add due to rounding.

^d Located in the state but not disaggregated to individual regions.

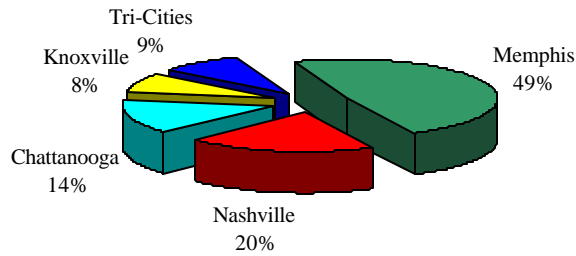
Primary Agriculture



Secondary Agriculture



Primary Forestry



Secondary Forestry

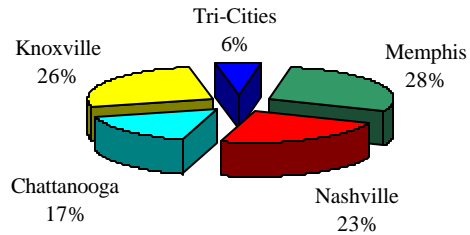


Figure 23. Direct Total Industry Output from Agriculture and Forestry by Market Level and Analysis Region.

Primary Agricultural Products:

The largest output value from farm production is from cattle and calves, which comprises nearly 18% of the value (see Table 5). Poultry and eggs, hay and pasture, and oil-bearing crops, primarily soybeans, follow cattle and calves. Each of these also comprise greater than 10 percent of the value of output from farm production. Greenhouse and nursery products, dairy farm products, cotton, and tobacco are also important farm products. Primary agricultural products also include agricultural, forestry, and fishery services, as well as landscape and horticultural services.

Table 5. State Level: Direct Economic Activity in Farm Production

Rank	Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
	All Farm Production:	2,420	528	94,241	130
1	Cattle	426	70	15,306	24
2	Poultry and Eggs	293	31	2,355	10
3	Hay and Pasture	280	84	32,429	8
4	Oil Bearing Crops	245	63	6,963	8
5	Greenhouse and Nursery Products	213	73	5,353	24
6	Dairy Farm Products	209	45	3,374	14
7	Cotton	208	39	2,028	7
8	Tobacco	189	41	12,013	18
9	Feed Grains	148	35	3,676	2
10	Hogs, Pigs and Swine	72	7	1,814	3
11	Vegetables	49	19	1,329	6
12	Food Grains	44	11	1,762	1
13	Miscellaneous Livestock	33	7	4,823	3
14	Fruits	6	2	253	1
15	Miscellaneous Crops	3	1	256	0 ^c
16	Sheep, Lambs and Goats	1	0 ^c	321	0 ^c
17	Grass Seeds	1	0 ^c	186	0 ^c
18	Other Meat Animal Products	1	0 ^c	2	0 ^c

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

^c Values of 0 are nonzero values that are less than 1.

The direct economic activity from farm production of the top ten sectors for each region within the state is summarized in Table 6. Cotton and soybeans are primary contributors to total industry output from farm production in the Memphis region. In the Nashville region, cattle, poultry and eggs, hay and pasture, greenhouse and nursery products, and tobacco are important sectors. In the Chattanooga region, poultry contributes the greatest output, while in the Knoxville region greatest total industry output values are from cattle and hay and pasture. For the Tri-Cities region, tobacco, cattle, and hay and pasture contribute the greatest total industry output.

Table 6. Region Level: Direct Economic Activity in Farm Production (Top Ten Sectors)

Rank	Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Memphis:					
1	Cotton	205	38	1,965	7
2	Oil Bearing Crops	201	43	4,901	5
3	Feed Grains	101	18	1,889	1
4	Cattle	61	6	1,368	2
5	Hogs, Pigs and Swine	47	4	780	1
6	Hay and Pasture	34	6	2,583	1
7	Food Grains	30	5	999	0 ^c
8	Greenhouse and Nursery Products	23	7	429	2
9	Dairy Farm Products	10	1	99	0 ^c
10	Vegetables	7	1	154	0 ^c
Nashville:					
1	Cattle	233	38	7,909	14
2	Poultry and Eggs	166	15	1,181	5
3	Hay and Pasture	150	44	16,178	4
4	Greenhouse and Nursery Products	145	40	2,916	13
5	Tobacco	110	21	5,296	9
6	Dairy Farm Products	101	21	1,452	7
7	Oil Bearing Crops	41	19	1,789	2
8	Feed Grains	41	14	1,465	1
9	Hogs, Pigs and Swine	24	3	689	1
10	Miscellaneous Livestock	20	4	2,615	2

Table 6. (Continued)

Rank	Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Chattanooga:					
1	Poultry and Eggs	86	7	587	2
2	Dairy Farm Products	43	7	585	2
3	Cattle	36	4	1,069	1
4	Hay and Pasture	28	6	2,679	1
5	Vegetables	6	2	175	1
6	Greenhouse and Nursery Products	6	2	154	1
7	Tobacco	4	1	224	0 ^c
8	Oil Bearing Crops	3	1	163	0 ^c
9	Feed Grains	2	1	96	0 ^c
10	Fruits	2	0 ^c	22	0 ^c
Knoxville:					
1	Cattle	57	13	2,950	4
2	Hay and Pasture	39	16	6,232	1
3	Greenhouse and Nursery Products	32	18	1,226	6
4	Tobacco	31	8	2,956	4
5	Dairy Farm Products	28	9	647	3
6	Poultry and Eggs	23	5	346	2
7	Vegetables	9	6	288	2
8	Miscellaneous Livestock	3	1	797	0 ^c
9	Feed Grains	2	1	129	0 ^c
10	Hogs, Pigs and Swine	1	0 ^c	164	0 ^c
Tri-Cities:					
1	Tobacco	40	10	3,471	4
2	Cattle	39	9	2,011	3
3	Hay and Pasture	29	13	4,757	1
4	Dairy Farm Products	27	8	591	2
5	Vegetables	13	7	167	2
6	Poultry and Eggs	13	3	181	1
7	Greenhouse and Nursery Products	8	6	628	2
8	Miscellaneous Livestock	2	1	668	0 ^c
9	Feed Grains	1	1	97	0 ^c
10	Fruits	0 ^c	0 ^c	37	0 ^c

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

^c Values of 0 are nonzero values that are less than 1.

Secondary Agricultural Products:

As shown in Table 7, among secondary agricultural products, food and kindred products contribute the largest total industry output. Statewide, over one-half of the value of total industry output from processed agricultural products comes from food processing. In addition, food processing is second to apparel in employing the most people and pays the largest amount of wages across the state. The value of total industry output from the food-processing sector is followed in value by apparel manufacturing and textile milling. A more detailed presentation of the total industry output from processing by sub-sector is shown in the Appendix Section 2.

Table 7. Direct Economic Activity in Secondary Agricultural Products

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Food & Kindred Products:				
State ^c	9,641	2,570	35,917	1,407
Memphis	3,293	861	10,260	478
Nashville	2,519	653	9,680	324
Chattanooga	2,231	693	9,498	378
Knoxville	1,324	306	5,521	187
Tri-Cities	273	58	958	40
Apparel:				
State ^c	3,415	1,159	39,168	866
Memphis	697	212	8,538	165
Nashville	1,190	391	14,153	302
Chattanooga	408	138	4,729	103
Knoxville	945	361	9,545	251
Tri-Cities	176	57	2,203	44
Textiles:				
State ^c	2,591	717	18,803	552
Memphis	403	92	2,412	79
Nashville	551	160	2,982	105
Chattanooga	887	259	7,202	202
Knoxville	378	111	3,548	91
Tri-Cities	371	96	2,658	76
Agricultural Machinery:				
State ^c	987	293	3,985	140
Memphis	586	167	2,322	78
Nashville	271	86	1,021	41
Chattanooga	71	24	397	13
Knoxville	3	1	15	0 ^d
Tri-Cities	55	15	230	7

Table 7. (Continued)

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Tobacco Products:				
State ^c	756	275	1,190	84
Memphis	284	112	402	35
Nashville	469	163	782	49
Chattanooga	0	0	0	0
Knoxville	0	0	0	0
Tri-Cities	3	0 ^d	6	0 ^d
Agricultural Chemicals:				
State ^c	440	178	816	81
Memphis	334	140	524	66
Nashville	87	30	243	12
Chattanooga	7	3	17	1
Knoxville	9	3	22	1
Tri-Cities	4	1	10	1
Leather Goods:				
State ^c	332	144	4,093	86
Memphis	34	13	570	8
Nashville	234	94	2,621	58
Chattanooga	20	13	376	8
Knoxville	24	14	231	7
Tri-Cities	21	9	294	6

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

^c State totals may not add due to rounding.

^d Values of 0 are nonzero values that are less than 1.

Primary Forest Products:

As shown in Table 8, the largest output value from primary forest products is from pulp, paper, and paperboard mills with the Memphis Region comprising over 63% of the state's value. Sawmills, planing and flooring mills employ the largest number of individuals. For this industry, the Nashville Region employs the largest number followed by Memphis and Knoxville. For IMPLAN analysis, forest products is defined as the production of stumpage, pulpwood, fuel wood, Christmas trees, and fence posts. Forestry products, on the other hand, are establishments that operate timber tracts, tree farms, and forest nurseries as well as conduct reforestation activities. The Nashville Region has the largest output values for sawmills, planing, and flooring mills; forest and forestry products; and logging.

Table 8. Direct Economic Activity in Primary Forest Products

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Pulp, Paper and Paperboard Mills:				
State ^c	1,966	714	6,928	448
Memphis	1,251	449	4,230	275
Nashville	91	34	379	23
Chattanooga	409	154	1,391	99
Knoxville	24	7	114	5
Tri-Cities	190	69	815	46
Sawmills, Planing & Flooring Mills:				
State ^c	1,060	375	10,465	239
Memphis	312	106	2,935	67
Nashville	466	157	4,277	99
Chattanooga	32	9	342	6
Knoxville	179	76	2,229	50
Tri-Cities	71	26	682	17
Forest and Forestry Products:				
State ^c	250	78	3,392	7
Memphis	51	16	491	1
Nashville	70	26	1,293	2
Chattanooga	42	15	376	1
Knoxville	48	15	659	1
Tri-Cities	38	7	573	2
Logging:				
State ^c	176	59	1,205	22
Memphis	47	16	317	6
Nashville	76	25	524	9
Chattanooga	17	6	106	2
Knoxville	27	9	194	3
Tri-Cities	9	3	65	1

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

^c State totals may not add due to rounding.

Secondary Forest Products:

Likewise, for secondary forest products, paper and allied products followed by furniture manufacturing have the largest output values (see Table 9). For paper and allied products, the Memphis Region has the largest values for output, value added, employment, and wages. The furniture industry for this analysis is comprised of household, office, and public building furniture. This industry employs the largest number of individuals in the state for secondary forest products. For furniture, the Knoxville Region followed by the Chattanooga Region has the

largest values for output, value added, employment, and wages. For the other wood products category, wood containers, wood partitions and fixtures, miscellaneous wood products, the Knoxville Region has the largest output value, however, the Memphis Region employs the largest number of individuals. Mobile homes and wood buildings are important industries for the state. The Knoxville Region has the largest values for output, employment, and wages for these industries. The Memphis Region has the largest values for output and employment for millwork, veneer, plywood, and structural wood industries. For this same industry, employment for both the Nashville and Knoxville Regions is equally divided.

Estimated Total Economic Impacts of Agriculture and Forestry:

The economic impacts of agriculture and forestry include not only the direct impacts from the industry, but also the impacts the industry has on input supplying industries (indirect effects) and also on expenditures by households and other institutions (induced effects). The total economic impacts from agriculture and forestry include direct, indirect, and induced effects. The total industry output, value added, employment, and wages resulting from agriculture and forestry including each of these effects are shown in Table 10. About 68 percent of the total impacts from the sector come from primary and secondary agriculture, while forest products contribute about 32 percent. Of sector related employment, 71 percent is contributed by impacts from primary and secondary agriculture, with 29 being contributed from primary and secondary forest products. Intrastate trade represents values purchased or imported from outside the regions. A more detailed total impact presentation of output, value added, employment, and wages by sub-sector is shown in the Appendix Section 3.

Table 9. Direct Economic Activity in Secondary Forest Products

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Paper and Allied Products:				
State ^c	2,795	862	14,083	572
Memphis	1,223	394	4,963	228
Nashville	706	211	4,099	158
Chattanooga	334	99	1,826	73
Knoxville	303	96	1,705	70
Tri-Cities	231	62	1,490	42
Furniture:				
State ^c	2,257	796	20,804	577
Memphis	266	83	2,205	58
Nashville	401	136	3,012	92
Chattanooga	733	262	6,538	192
Knoxville	769	282	8,073	212
Tri-Cities	89	32	976	23
Other Wood Products:				
State ^c	785	271	7,031	164
Memphis	200	81	2,266	54
Nashville	170	70	1,822	40
Chattanooga	61	22	646	13
Knoxville	284	77	1,845	47
Tri-Cities	70	19	452	10
Mobile Homes and Wood Buildings:				
State ^c	637	262	5,597	166
Memphis	128	56	1,064	35
Nashville	201	83	1,771	53
Chattanooga	5	2	50	1
Knoxville	302	121	2,710	77
Tri-Cities	0 ^d	0 ^d	2	0 ^d
Millwork, Veneer, Plywood, & Struct. Wood:				
State ^c	464	192	5,579	130
Memphis	168	68	1,960	48
Nashville	114	49	1,494	33
Chattanooga	36	15	400	10
Knoxville	122	52	1,493	35
Tri-Cities	24	9	232	6

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

^c State totals may not add due to rounding.

^d Values of 0 are nonzero values that are less than 1.

Table 10. Estimated Total Economic Impacts from Agriculture and Forestry

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Agriculture & Forestry:				
State	56,848	23,828	609,735	13,865
Memphis	18,025	7,437	160,058	4,237
Nashville	15,296	6,326	184,296	3,555
Chattanooga	9,103	3,707	85,356	2,235
Knoxville	8,525	3,612	104,804	2,195
Tri-Cities	2,872	1,106	40,955	681
Intrastate Trade	3,027	1,640	34,266	962
Primary & Secondary Agriculture:				
State	38,639	15,731	435,809	8,996
Memphis	11,699	4,638	107,181	2,593
Nashville	11,361	4,590	145,037	2,515
Chattanooga	6,456	2,561	60,965	1,522
Knoxville	5,206	2,136	68,157	1,277
Tri-Cities	1,769	667	30,097	412
Intrastate Trade	2,148	1,139	24,372	677
Primary Agriculture:				
State	5,356	2,256	154,654	1,036
Memphis	1,652	683	32,446	311
Nashville	2,268	933	68,247	427
Chattanooga	382	125	9,867	59
Knoxville	528	264	24,145	119
Tri-Cities	298	131	16,261	55
Intrastate Trade	228	120	3,688	65
Secondary Agriculture:				
State	33,283	13,475	281,155	7,960
Memphis	10,047	3,955	74,734	2,281
Nashville	9,093	3,658	76,791	2,089
Chattanooga	6,074	2,436	51,097	1,462
Knoxville	4,678	1,872	44,012	1,158
Tri-Cities	1,470	535	13,837	357
Intrastate Trade	1,921	1,019	20,684	613
Primary & Secondary Forestry:				
State	18,208	8,097	173,926	4,869
Memphis	6,327	2,799	52,877	1,644
Nashville	3,935	1,736	39,258	1,040
Chattanooga	2,647	1,146	24,392	714
Knoxville	3,319	1,476	36,648	918
Tri-Cities	1,103	439	10,857	269
Intrastate Trade	877	501	9,894	284
Primary Forestry:				
State	6,303	2,826	57,716	1,622
Memphis	2,985	1,326	23,818	771
Nashville	1,245	543	13,225	301
Chattanooga	812	362	6,216	207
Knoxville	471	219	6,063	122

Table 10. (Continued)

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Tri-Cities	478	199	4,674	121
Intrastate Trade	312	177	3,720	100
Secondary Forestry:				
State	11,905	5,272	116,210	3,247
Memphis	3,342	1,472	29,059	872
Nashville	2,690	1,193	26,034	739
Chattanooga	1,835	785	18,175	506
Knoxville	2,848	1,257	30,585	795
Tri-Cities	624	241	6,184	148
Intrastate Trade	566	324	6,173	187

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

Primary Agriculture Products Total Impacts:

Figures 24 through 28 show the estimated direct, indirect, and induced effects for the cattle, poultry and eggs, hay and pasture, oil-bearing crops, greenhouse and nursery products, dairy farm products, cotton, tobacco, and feed grains agricultural sectors. The top ten indirect and induced sectors impacted are also listed. Using cattle as an example, indirect effects (input supplying industries) explained 33.5% (\$295 million) of the total impact on output. The sectors most impacted in descending order include cattle; wholesale trade; real estate; hay and pasture; motor freight transport and warehousing; feed grains; maintenance and repair other facilities; railroads and related services; agriculture, forestry, fishery services; and federal electric utilities. Following along this same line, induced effects (expenditures by households and other institutions) explained 18% (157 million) of the total impact on output. Again in descending order the sectors most impacted include owner-occupied dwellings; wholesale trade; doctors and dentists; real estate; state and local government non-education; state and local government education; eating and drinking; hospitals; new industrial and commercial buildings; and banking.

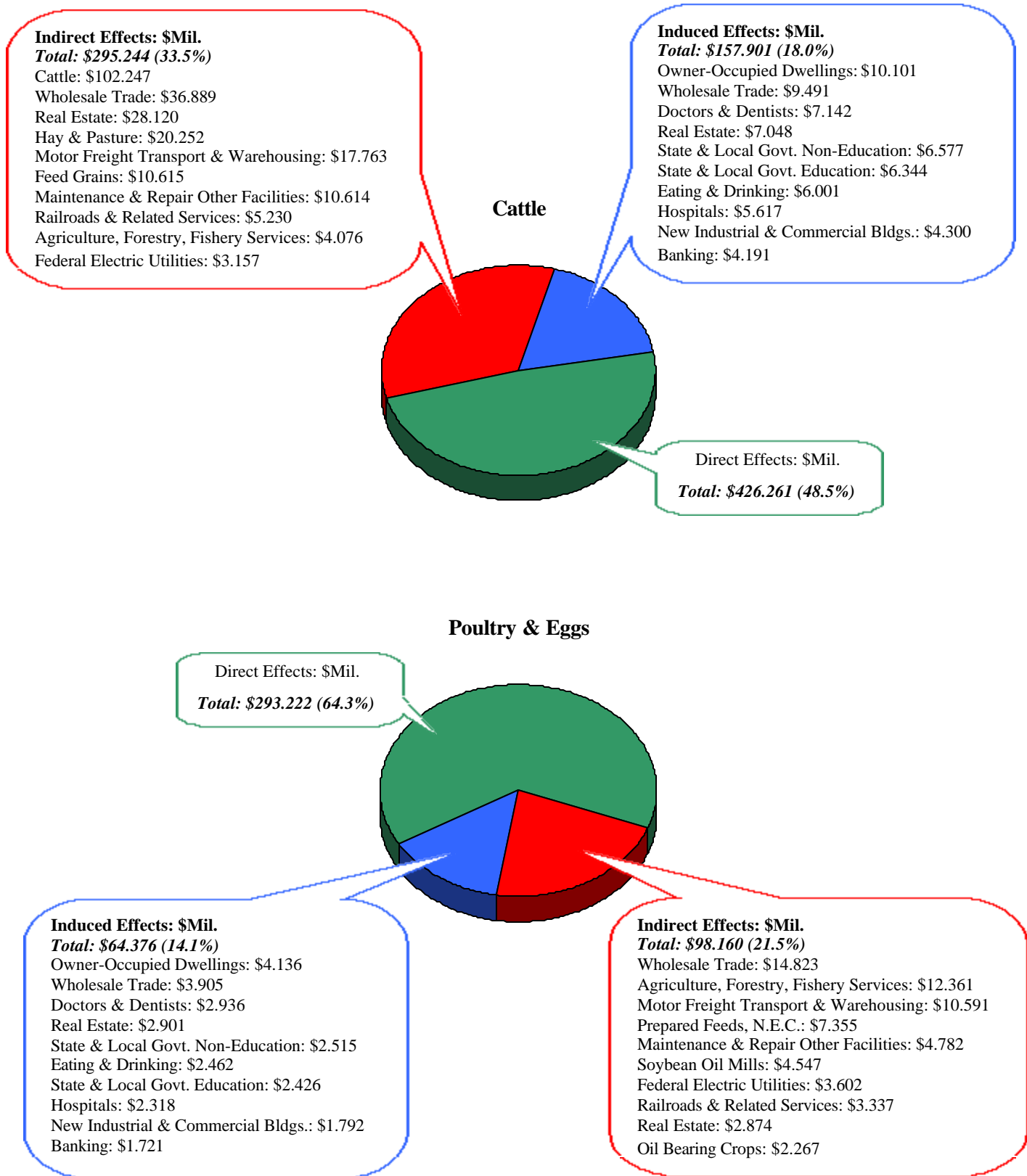


Figure 24. Estimated Direct, Indirect, and Induced Impacts for Cattle and Poultry & Eggs.

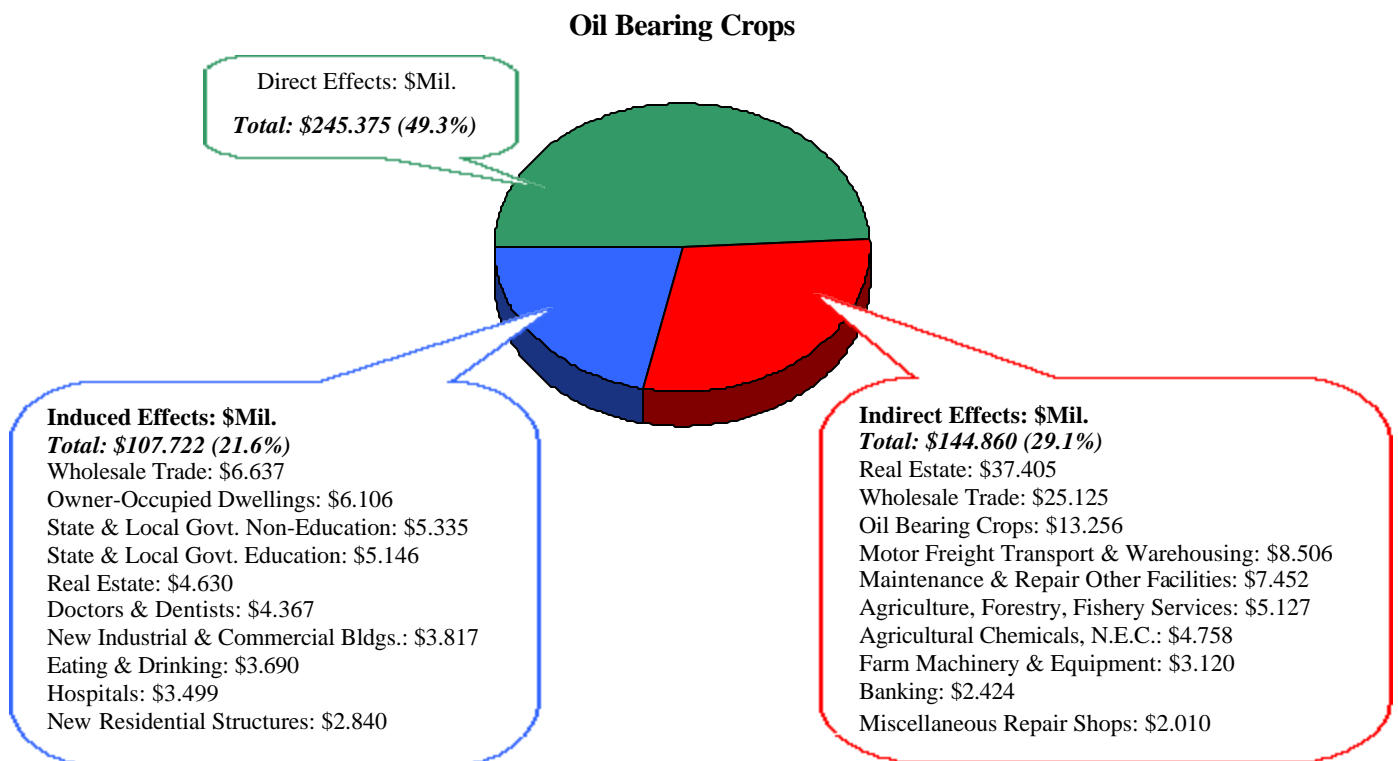
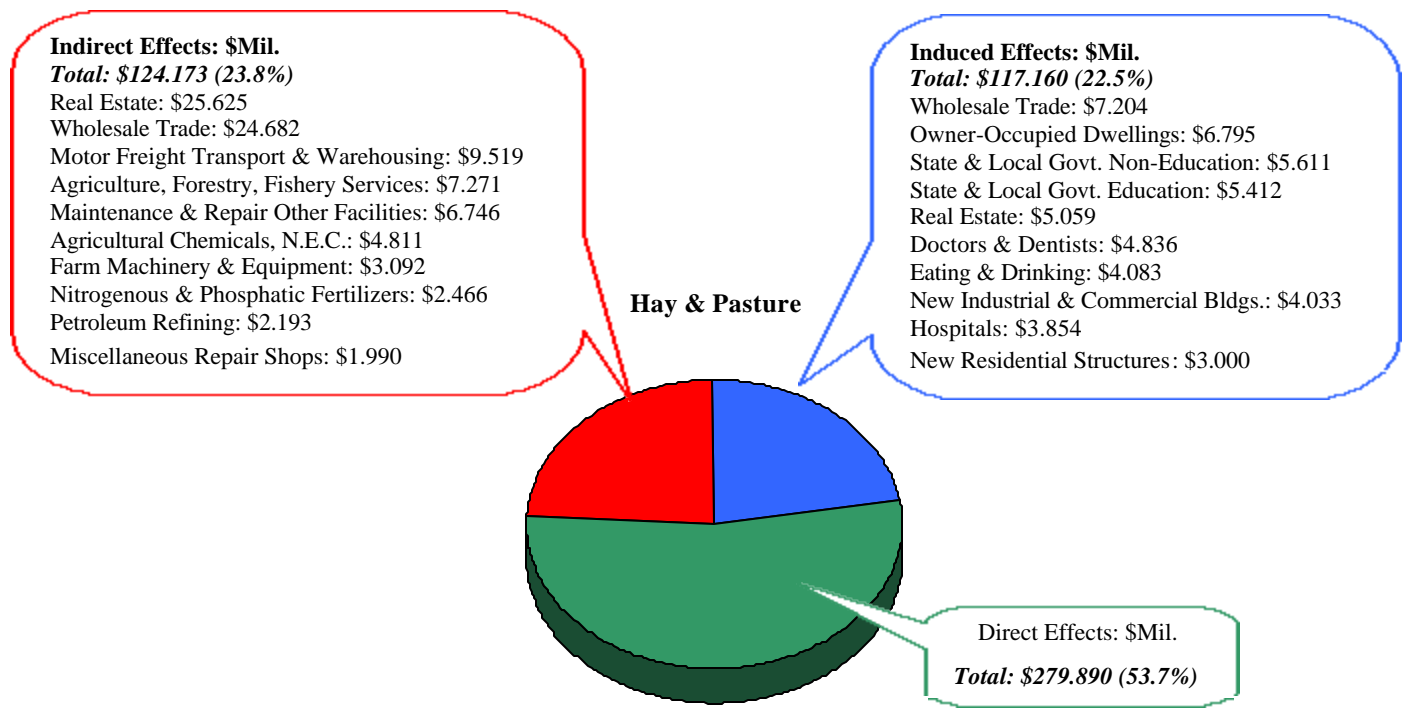


Figure 25. Estimated Direct, Indirect, and Induced Impacts for Hay & Pasture and Oil Bearing Crops.

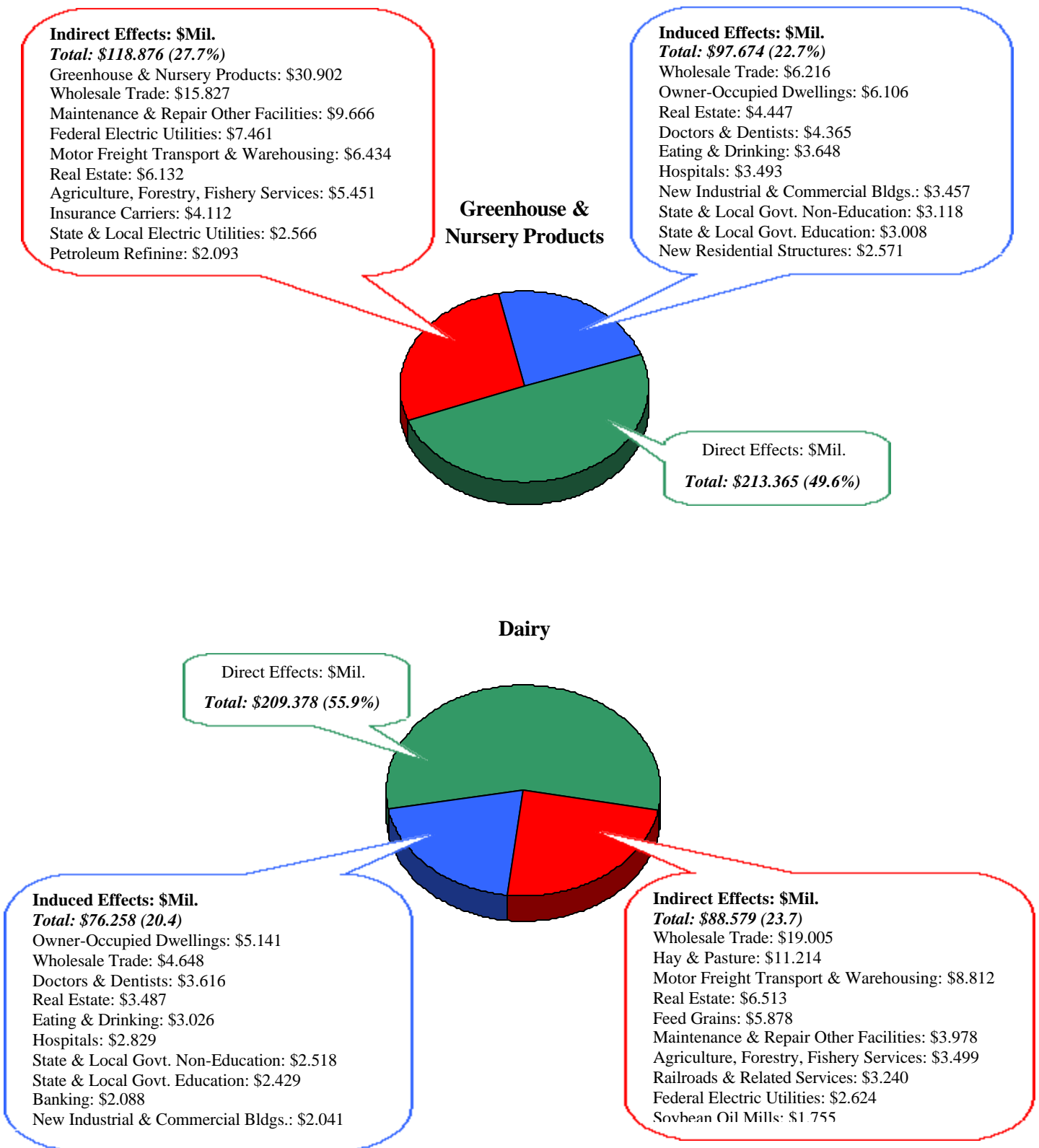


Figure 26. Estimated Direct, Indirect, and Induced Impacts for Greenhouse & Nursery Products and Dairy.

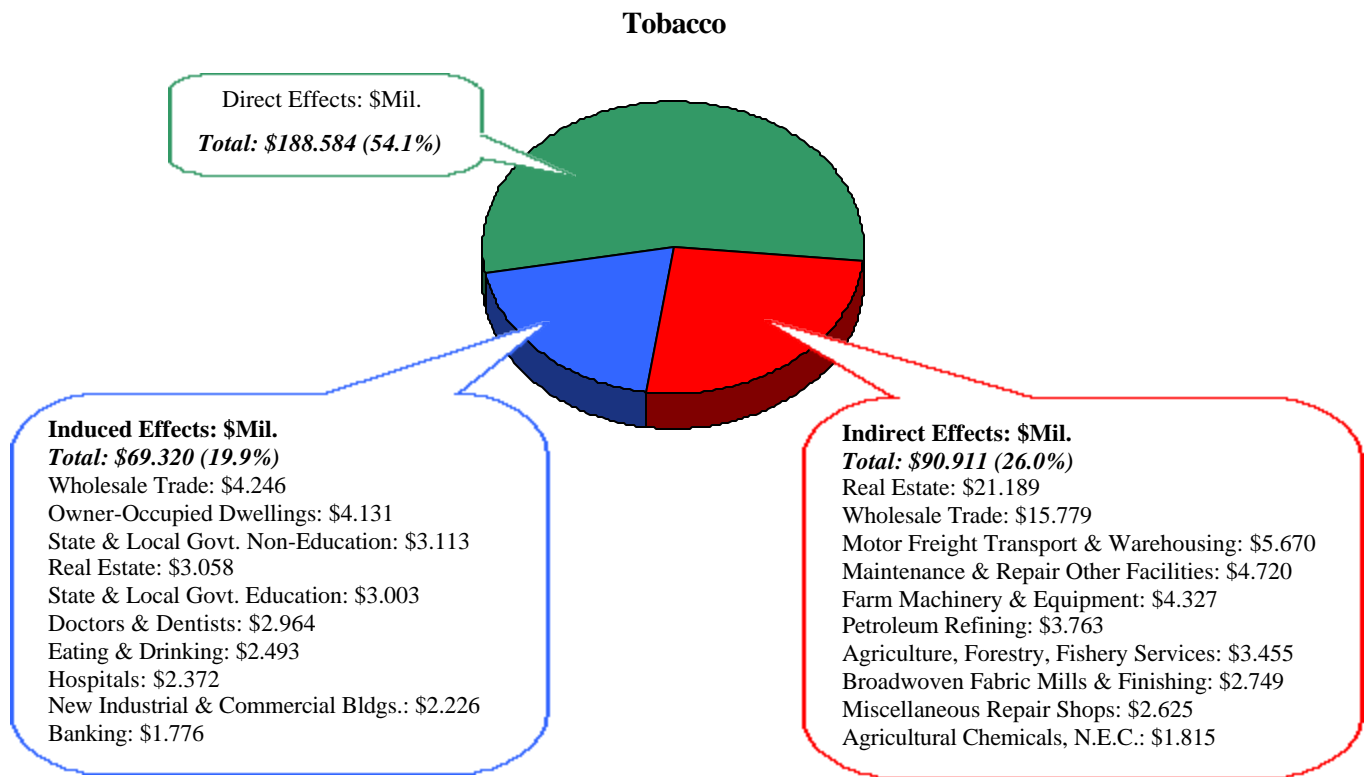
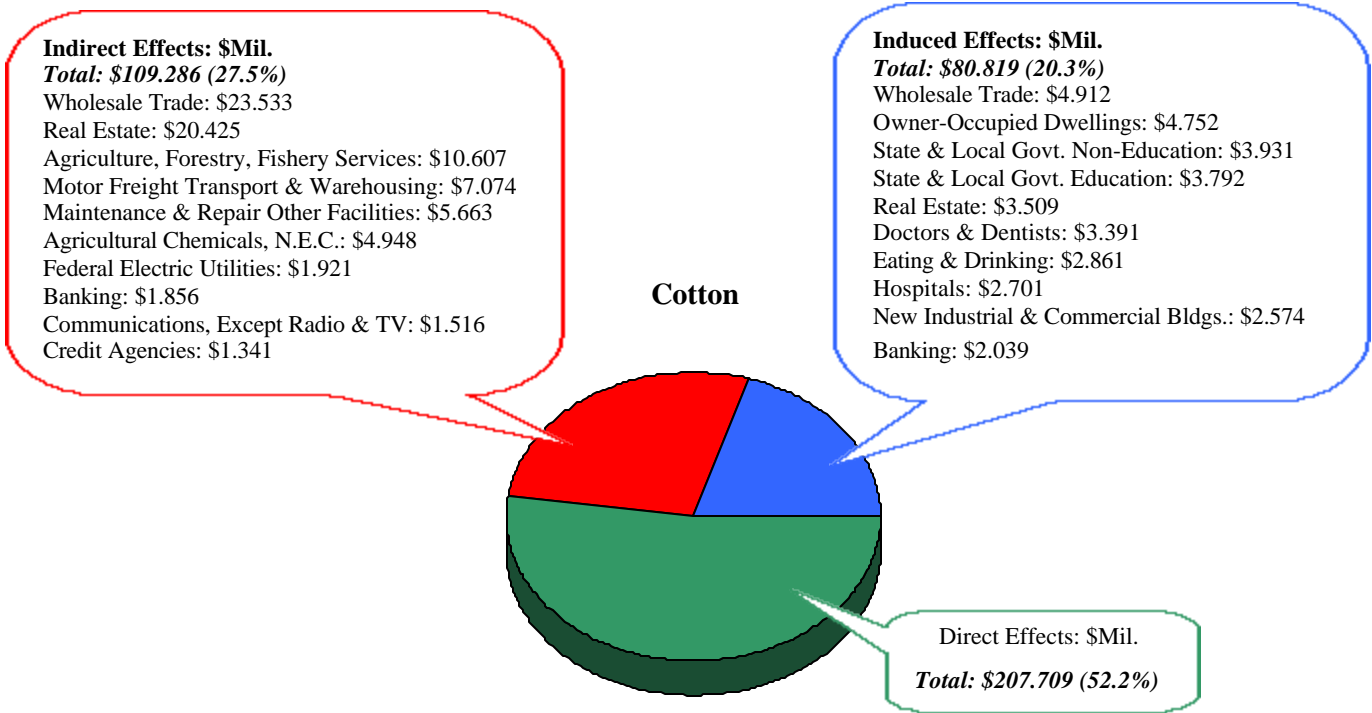


Figure 27. Estimated Direct, Indirect, and Induced Impacts for Cotton and Tobacco.

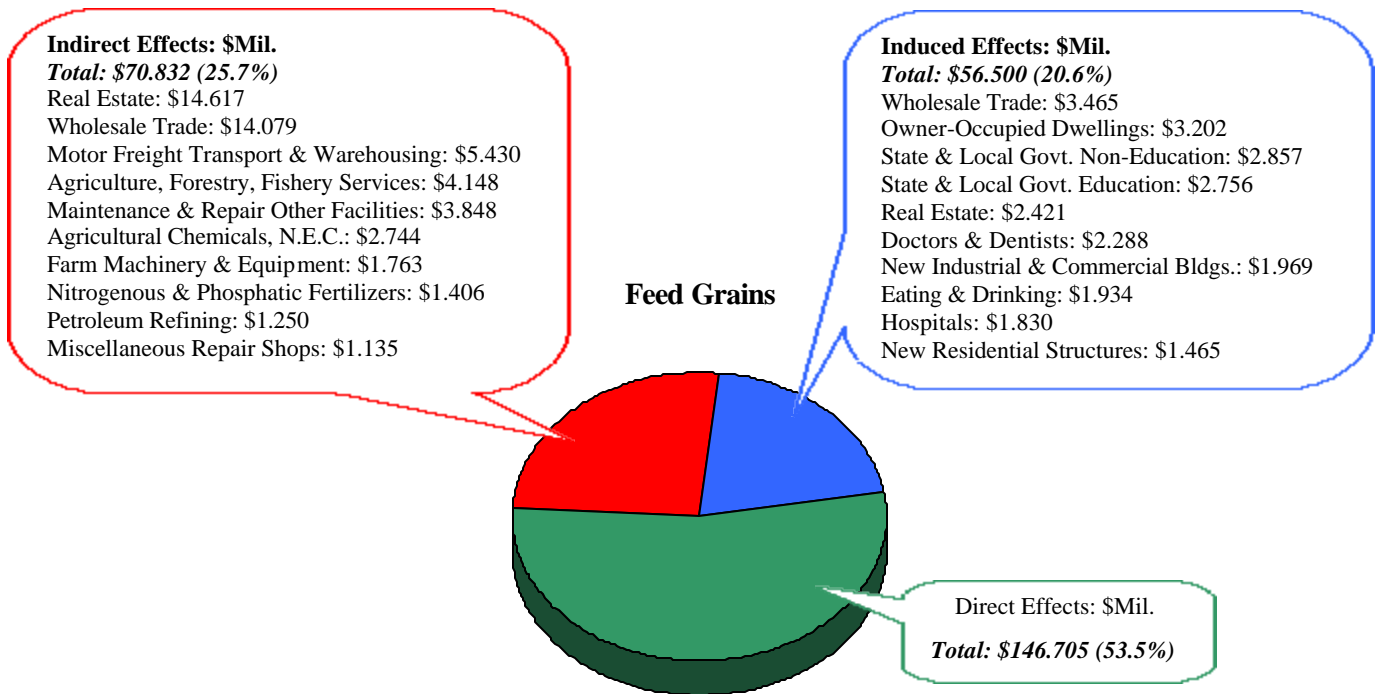


Figure 28. Estimated Direct, Indirect, and Induced Impacts for Feed Grains.

Secondary Agriculture Products Total Impacts:

Table 11 shows the estimated total economic impacts from secondary agricultural products. Food and kindred products contributes the greatest total economic impact values for all categories (output, value added, employment, and wages). The Memphis Region, followed by the Nashville Region, has the largest values for each of the categories analyzed for this sector. Both combined regions account for 56-59% of the total values for the state. The Nashville Region has the largest output, value added, employment, and wage values for apparel followed by the Knoxville Region. The Chattanooga region has the largest values for the value categories analyzed for textiles. For both the agricultural machinery and agricultural chemicals sectors, the Memphis Region has the largest output values. Likewise, the Nashville Region has the largest output values for both the tobacco products and leather goods sectors.

Table 11. Estimated Total Economic Impacts from Secondary Agricultural Products

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Food & Kindred Products:				
State	16,877	6,572	122,182	3,729
Memphis	5,817	2,236	38,643	1,277
Nashville	4,199	1,589	29,959	871
Chattanooga	3,541	1,420	25,730	796
Knoxville	2,251	817	17,207	483
Tri-Cities	404	126	2,689	80
Intrastate Trade	665	384	7,954	222
Apparel:				
State	6,352	2,733	74,774	1,775
Memphis	1,222	495	14,833	328
Nashville	2,015	864	24,620	567
Chattanooga	662	274	7,863	182
Knoxville	1,645	740	18,625	468
Tri-Cities	285	111	3,698	76
Intrastate Trade	523	249	5,135	154
Textiles:				
State	5,409	2,175	49,688	1,423
Memphis	752	261	6,137	180
Nashville	937	376	7,570	227
Chattanooga	1,711	668	15,958	444
Knoxville	724	283	7,605	192
Tri-Cities	654	250	6,314	174
Intrastate Trade	631	337	6,104	206
Agricultural Machinery:				
State	1,799	723	13,263	390
Memphis	1,093	428	7,740	231
Nashville	455	190	3,225	101
Chattanooga	119	50	963	28
Knoxville	4	2	37	1
Tri-Cities	83	29	597	16
Intrastate Trade	45	24	701	13
Tobacco Products:				
State	1,492	631	9,245	292
Memphis	541	237	3,223	107
Nashville	913	378	5,546	176
Chattanooga	0	0	0	0
Knoxville	0	0	0	0
Tri-Cities	6	1	33	1
Intrastate Trade	32	15	443	8
Agricultural Chemicals:				
State	780	369	4,933	190
Memphis	571	275	3,352	144
Nashville	153	67	1,021	33
Chattanooga	12	5	72	2

Table 11. (Continued)

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Knoxville	15	7	102	3
Tri-Cities	6	2	37	1
Intrastate Trade	23	13	1,370	7
Leather Goods:				
State	575	272	7,070	160
Memphis	52	23	806	14
Nashville	421	192	4,849	114
Chattanooga	30	19	511	11
Knoxville	39	23	436	12
Tri-Cities	33	15	468	9
Intrastate Trade	0 ^c	0 ^c	0 ^c	0 ^c

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

^c Region Purchase Coefficient (RPC) for the state was less than the average for each region.

Primary Forest Products Total Impacts:

For primary forest products total impacts the pulp, paper and paperboard mills contributes the largest output value compared to other sectors analyzed (see Table 12). The Memphis Region followed by the Chattanooga and Tri-Cities Regions contribute the largest values for the categories analyzed. For the remaining sectors -- sawmills, planing and flooring mills, forest and forestry products, and logging -- the Nashville Region followed by the Memphis Region contribute the largest values for the categories studied except for employment for the forest and forestry products sector where the Knoxville Region is second followed by the Memphis Region. Wages for this same sector were also equally divided between these two regions.

Table 12. Estimated Total Economic Impacts from Primary Forest Products

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Pulp, Paper and Paperboard Mills:				
State	3,683	1,677	27,689	996
Memphis	2,277	1,021	16,319	603
Nashville	170	79	1,328	48
Chattanooga	677	305	4,712	184
Knoxville	43	18	354	11
Tri-Cities	306	133	2,426	83
Intrastate Trade	210	121	2,550	67
Sawmills, Planing & Flooring Mills:				
State	1,926	855	21,136	509
Memphis	552	239	5,808	142
Nashville	837	361	8,747	213
Chattanooga	49	19	561	11
Knoxville	309	151	4,002	91
Tri-Cities	110	47	1,231	29
Intrastate Trade	69	38	787	23
Forest and Forestry Products:				
State	433	186	6,525	69
Memphis	87	39	1,091	13
Nashville	124	56	2,123	19
Chattanooga	62	27	751	8
Knoxville	80	34	1,326	13
Tri-Cities	51	14	910	7
Intrastate Trade	29	16	324	9
Logging:				
State	262	108	2,365	49
Memphis	68	28	599	13
Nashville	114	46	1,027	21
Chattanooga	23	10	191	4
Knoxville	40	16	380	7
Tri-Cities	12	4	106	2
Intrastate Trade	5	4	62	2

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

Secondary Forest Products Total Impacts:

Paper and allied products has the largest output value for the state followed by furniture; other wood products; mobile homes and wood buildings; and, finally, millwork, veneer, plywood, and structural wood (see Table 13). For paper and allied products, the Memphis and Nashville Regions combined contribute 68% of the output value for the state. Likewise, for

Table 13. Estimated Total Economic Impacts from Secondary Forest Products

Sector	TIO ^a (Million \$)	TVA ^b (Million \$)	Employment (Number)	Wages (Million \$)
Paper and Allied Products:				
State	4,754	1,996	38,541	1,218
Memphis	2,051	870	14,890	502
Nashville	1,188	491	10,039	316
Chattanooga	504	199	4,051	130
Knoxville	490	207	4,264	132
Tri-Cities	343	125	3,095	79
Intrastate Trade	178	104	2,202	59
Furniture:				
State	4,017	1,815	43,296	1,156
Memphis	452	192	4,553	120
Nashville	684	303	6,641	187
Chattanooga	1,167	512	12,228	333
Knoxville	1,310	597	15,467	391
Tri-Cities	141	61	1,731	39
Intrastate Trade	263	150	2,676	86
Other Wood Products:				
State	1,227	532	12,764	309
Memphis	335	163	3,964	98
Nashville	284	139	3,291	78
Chattanooga	99	44	1,123	25
Knoxville	358	123	2,932	71
Tri-Cities	104	37	944	21
Intrastate Trade	47	26	510	16
Mobile Homes and Wood Buildings:				
State	1,076	517	11,287	310
Memphis	209	104	2,089	62
Nashville	333	160	3,456	96
Chattanooga	8	3	87	2
Knoxville	484	228	5,255	137
Tri-Cities	0 ^c	0 ^c	4	0 ^c
Intrastate Trade	42	22	396	13
Millwork, Veneer, Plywood, & Struct. Wood:				
State	831	412	10,323	253
Memphis	296	145	3,563	91
Nashville	200	101	2,606	61
Chattanooga	58	28	686	17
Knoxville	206	103	2,666	63
Tri-Cities	36	16	411	10
Intrastate Trade	35	19	391	11

^a Total Industry Output – value of production by industry by year.

^b Total Value Added – income to workers paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses.

^c Values of 0 are nonzero values that are less than 1.

employment, both combined regions contribute close to 65% of the total state value for this sector. The furniture industry has the largest total employment impacts for secondary forest products. The Knoxville Region followed by the Chattanooga Region has the largest values. The Knoxville Region followed by the Memphis and Nashville Regions has the largest output values for other wood products. However, for value added, employment, and wages, the Memphis Region followed by the Nashville and Knoxville Regions has the largest values for this manufacturing sector. For mobile homes and wood buildings, the Knoxville Region followed by the Nashville Region has the largest values for all categories. The Memphis Region has the greatest values for output, value added, employment, and wages for millwork, veneer, plywood, and structural wood. Within this manufacturing sector, the Knoxville and Nashville regions, ranked second and third, respectively, in terms of value for the categories analyzed, are very similar.

Summary and Conclusions

The agro-forestry industrial complex contributes \$56.7 billion to the Tennessee economy, accounting for 21 percent of the economic activity conducted within the state and employing 293,000 individuals (Table 14). Outdoor hunting, fishing, and bird watching enthusiasts generate an additional 3.6 billion dollars annually. The agro-forestry industrial complex includes the primary industries typically associated with agriculture and forest operations such as the growing of crops, the breeding and feeding of livestock and the management and logging of trees. Also included in the industrial complex are the input supply industries, the value-added sub-sectors, food and kindred products manufacturing, apparel and textiles, and forestry products manufacturing.

Regionally, the agro-forestry industrial complex is more important to the economies of the Chattanooga and Memphis regions on relative terms than to the other regions of the state. In

Chattanooga, over \$9 billion (30 percent) of the economic activity that occurs in that region is attributed to the agro-forestry industrial complex. In the Memphis region the amount of economic activity is \$18 billion, however, this represents only 24 percent of the total for the region.

Table 14. Regional Importance of Agriculture to that Region's Economy

Location	Total Economic Activity (Million \$)	Estimated Agro-forestry Industrial Complex Contributions to the State's Economy (Million \$)	Proportion (ratio)
State	270,157	56,848	0.21
Memphis	75,565	18,025	0.24
Nashville	103,653	15,296	0.15
Chattanooga	30,623	9,103	0.30
Knoxville	41,490	8,525	0.21
Tri-Cities	17,826	2,872	0.16

Agriculture, a subset of the agro-forestry industrial complex in Tennessee, includes farming and related industries, as well as value-added food and fiber products, processing and manufacturing. Agriculture accounts for 14.2 percent of the state's economy and generates \$38.5 billion in output. About 218,000 Tennesseans, with 114,000 in the production sector, are employed in agriculture.

With more than 42 percent of Tennessee's total land area in farms, primary agriculture, through the sale of raw agricultural products, generates nearly \$2.4 billion in farm cash receipts annually. Tennessee farmers earn more than 63 percent of their cash receipts from cattle and calves, cotton, broilers, tobacco, and dairy sales. The largest generator of cash receipts in 1997 was the sale of cattle and calves (\$0.4 billion), with livestock accounting for \$1 billion in cash receipts.

The output and employment multipliers for primary agricultural and forestry activities range from 1.49 to 2.06 for total industrial output and 1.06 to 2.35 for employment (Table 15). For instance, if the hardwood flooring industry increases total industry output by \$1 million, then

the state's economy will increase by an estimated \$2.06 million overall and for each job created in this same industry an estimated 0.9 additional jobs will be added. Cotton farmers that produce \$1 million in total industry output generate an additional \$0.47 million indirectly through the purchase of inputs and \$0.84 million in total economic activity within the state.

Through the use of IMPLAN, information on the interrelationships in a regional economy and the impacts of changes on that economy can be evaluated and analyzed. Not only can the model assist in the evaluation of growth projections and the magnitude of impacts for different levels of economic activity, but it also can serve as a useful planning tool for policy-makers in evaluating potential impacts of their decisions concerning agriculture and forestry industries for the state. In this analysis, a baseline for 1997 was developed tying economic activity and information from the U.S. 1997 agricultural census together. The state was divided into five trade regions. Look for these five regions in future analyses as individual sectors are examined and the impacts of additions to the state's agro-forestry industrial complex are evaluated using the 1997 analysis as a guide.

Table 15. Primary Agricultural and Forestry Output and Employment Multipliers

IMPLAN Sector	TIO ^a		Employment	
	Indirect	Indirect & Induced	Indirect	Indirect & Induced
Dairy Farm Products	1.41	1.77	1.66	1.98
Poultry and Eggs	1.33	1.54	1.58	1.98
Ranch Fed Cattle	1.64	2.00	1.47	1.61
Range Fed Cattle	1.52	1.84	1.40	1.53
Cattle Feedlots	1.41	1.71	1.91	2.35
Sheep, Lambs and Goats	1.39	1.70	1.06	1.08
Hogs, Pigs and Swine	1.59	1.87	1.55	1.72
Other Meat Animal Products	1.43	1.71	1.28	1.39
Miscellaneous Livestock	1.41	1.74	1.06	1.09
Cotton	1.47	1.84	1.67	2.23
Food Grains	1.48	1.87	1.13	1.27
Feed Grains	1.42	1.78	1.22	1.43
Hay and Pasture	1.38	1.78	1.04	1.09
Grass Seeds	1.48	1.85	1.03	1.06
Tobacco	1.42	1.77	1.08	1.16
Fruits	1.46	1.90	1.15	1.29
Vegetables	1.40	1.87	1.23	1.48
Miscellaneous Crops	1.33	1.68	1.08	1.14
Oil Bearing Crops	1.54	1.95	1.25	1.47
Greenhouse & Nursery Products	1.54	1.99	1.33	1.59
Agricultural, Forestry, Fishery Services	1.27	1.88	1.11	1.37
Landscape & Horticultural Services	1.23	1.95	1.10	1.33
Logging Camps & Logging Contractors	1.19	1.49	1.34	1.96
Sawmills & Planing Mills, General	1.32	1.65	1.50	2.20
Hardwood Dimension & Flooring Mills	1.47	2.06	1.31	1.90
Special Product Sawmills, N.E.C	1.17	1.65	1.10	1.50

^a Total Industry Output – value of production by industry by year.

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Appendix Section 1: IMPLAN Model Data Adjustment Procedures

IMPLAN Model Data Adjustment Procedures

Market values from the *1997 Census of Agriculture* for both the crops and livestock product sectors for each county were collected. For counties where data was withheld to avoid disclosing information for individual farms (noted with a “D” in the census), the following procedure was implemented to provide estimates of market values. First, the total market values for the state for the particular agricultural sector were obtained from the census. Next, the individual counties with market value information were summed. The differences, or state overage, in these two figures were obtained. For the “D” counties BEA production values were derived using a production per farm or a production per acre approach based on the counties with known values for that BEA region. Once this information was derived the proportionate county share for the state overage for “D” counties were totaled. If acres and production values were unknown then a market value per farm by BEA region based on the same methodology was used.

For example, for the commodity wheat there were 35 counties that had a “D” for the market value figure. However, for some of the “D” counties in which market value data was not disclosed acreage yields or production values were listed. For “D” counties with acreage yield information an average yield per acre estimate was calculated per BEA region based on known county data for that region. Likewise, for other “D” counties the average production estimate per farm for each BEA region was derived based on known county information. These values were used to derive unknown production estimates for individual farms in each county. Once each counties proportionate share was derived the state’s market value overage for that particular commodity was distributed.

Table A.1 shows the bridge between the *1997 Census of Agriculture* and IMPLAN’s agricultural categories. Adjustments were required for some census agricultural sectors values to

fit the IMPLAN model. For instance, the census value for cattle & calves needed distribution among ranch fed cattle, range fed cattle, and cattle feedlots. The ratio of these individual values from the IMPLAN model for the state was used as a guideline to distribute data for each individual county. For IMPLAN's Sheep, Lambs, & Goats sector the census-recorded data for sheep, lambs, and wool. Goats are included in the Miscellaneous Livestock sector. For IMPLAN's Fruits and Tree Nuts sectors, the census aggregated information for fruits, nuts, and berries. This value was recorded under IMPLAN's Fruits agricultural sector. As a result, a zero value was tabulated for IMPLAN's Tree Nuts sector. Furthermore, the ratio of these individual IMPLAN values for Fruits and Tree Nuts for the state revealed that fruit represented 99.9% of the aggregated fruit & nut category. IMPLAN data was used for the Hay & Pasture and Grass Seeds agricultural sectors. Further model adjustments included employment and all components of value added where appropriate.

Table A.1. Bridge Between IMPLAN and 1997 Census of Agriculture Sectors

IMPLAN Sector	Agricultural Sectors (1997 Census)
1 Dairy Farm Products	Dairy Products
2 Poultry & Eggs	Poultry & Poultry Products (includes eggs)
3 Ranch Fed Cattle	Cattle & Calves (state IMPLAN ratio equals 89%)
4 Range Fed Cattle	Cattle & Calves (4% state ratio)
5 Cattle Feedlots	Cattle & Calves (7% state ratio)
6 Sheep, Lambs & Goats*	Sheep, lambs, & wool
7 Hogs, Pigs, & Swine	Hogs & Pigs
9 Miscellaneous Livestock	Other Livestock & Livestock Products (includes goats)
10 Cotton	Cotton & Cottonseed
11 Food Grains	Wheat, Barley, Oats, Other grains
12 Feed Grains	Corn for grain; Sorghum for grain
13 Hay & Pasture	Used IMPLAN data
14 Grass Seeds	Used IMPLAN data
15 Tobacco	Tobacco
16 Fruits	Fruits, nuts, & berries (fruits represents 99.9% of the aggregated)
17 Tree Nuts	Included in above; zero value
18 Vegetables**	Vegetables, sweet corn, & melons
20 Miscellaneous Crops	Other crops
21 Oil Bearing Crops	Soybeans
23 Greenhouse/Nursery Prod.	Nursery & greenhouse crops

*Goats are included in Miscellaneous Livestock category.

**Includes snap beans and tomatoes.

Table A.2. Modeling Analysis Regions: County Listing

Memphis	Nashville		Chattanooga	Knoxville	Tri-Cities
Benton	Bedford	Macon	Bledsoe	Anderson	Carter
Carroll	Cannon	Marshall	Bradley	Blount	Greene
Chester	Cheatham	Maury	Hamilton	Campbell	Hawkins
Crockett	Clay	Montgomery	McMinn	Claiborne	Johnson
Decatur	Coffee	Moore	Marion	Cocke	Sullivan
Dyer	Cumberland	Overton	Meigs	Grainger	Unicoi
Fayette	Davidson	Perry	Monroe	Hamblen	Washington
Gibson	DeKalb	Pickett	Polk	Hancock	
Hardeman	Dickson	Putnam	Rhea	Jefferson	
Hardin	Fentress	Robertson	Sequatchie	Knox	
Haywood	Franklin	Rutherford		Loudon	
Henderson	Giles	Smith		Morgan	
Henry	Grundy	Stewart		Roane	
Lake	Hickman	Sumner		Scott	
Lauderdale	Houston	Trousdale		Sevier	
McNairy	Humphreys	Vanburen		Union	
Madison	Jackson	Warren			
Obion	Lawrence	Wayne			
Shelby	Lewis	White			
Tipton	Lincoln	Williamson			
Weakley		Wilson			