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The Virginia
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The Importance of Agriculture and Forestry to Virginia's Economy

By Terance J. Rephann

Agriculture and forestry are a highly visible part of Virginia's economic base. Nearly 21 million acres, or 82 percent, of the commonwealth's total land area is forest, crop land, or pasture and range. Additional land is forested park land and public open space.[1] In addition, Virginia's farms generated an estimated $2.7 billion in cash receipts, and forest landowners received nearly $350 million for harvested timber in 2006.[2]

This article is based on a recent study prepared under contract for the Office of the Virginia Secretary of Agriculture and Forestry.[3] The new study, which uses regional input-output analysis, shows that the economic impacts of agriculture and forestry are far larger than commodity sales alone. The agriculture and forestry sectors have strong linkages with other industries in Virginia, including processing and distribution industries that add value throughout the value chain. Many of these would not exist in their current form without the availability of state agriculture and forest raw materials. These industries purchase from other industries that in turn purchase from others in a cascading series of transactions that creates a stimulating effect across the economic spectrum. In addition, agriculture and forestry-related employment supports the expenditures of households that circulate throughout the economy creating additional earnings and employment.

Terance J. Rephann

A Snapshot of Virginia Agriculture and Forestry Production

Virginia has a rich and varied agricultural sector. It plays a prominent role in several national commodity markets (**Table 1**), ranking third for fresh tomatoes, and fifth in tobacco. Apples, potatoes, snap beans, broilers, and turkeys are also significant commodities. In terms of overall cash receipts, nearly three-fifths is derived from livestock and poultry (**Figure 1**). Poultry

[1] Ruben N. Lubowski, Marlow Vesterby, Shawn Bucholtz, Alba Baez, and Michael J. Roberts, *Major Uses of Land in the United States, 2002* (Washington, D.C.: U.S. Department of Agriculture, 2006). http://www.ers.usda.gov/Publications/EIB14/ (11/10/07).

[2] U.S. Department of Agriculture, Economic Research Service, Farm Income: Data Files. http://www.ers.usda.gov/Data/FarmIncome/finfidmuxls.htm (11/15/07) and unpublished data from the Virginia Department of Forestry.

[3] Terance J. Rephann, *The Economic Impact of Agriculture and Forestry on the Commonwealth of Virginia* (Charlottesville: University of Virginia, Weldon Cooper Center for Public Service, 2008). http://www.coopercenter.org/publications/ECONOMICS/Impact%20Studies.php.

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Although Virginia farm employment has declined, productivity improvements attributable to increased mechanization and the adoption of new technologies allowed farm cash receipts to increase from 1990 to 2006.

Table 1: Virginia's Top 10 Commodities in U.S. Market, 2006

Commodity	National Rank	Percentage of U.S. Production
Tomatoes, fresh market	3	6.06
Tobacco	5	6.42
Apples	6	2.18
Potatoes, summer	6	8.24
Beans, snap, fresh market	7	4.16
Turkeys	8	8.21
Peanuts	8	1.43
Grapes	8	0.09
Sweet potatoes	9	0.30
Broilers	10	2.88

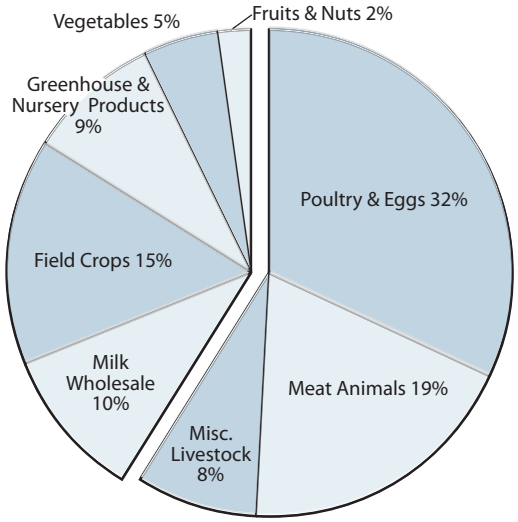
Source: U.S. Department of Agriculture, Economic Research Service, Farm Income: Data Files. http://www.ers.usda.gov/Data/FarmIncome/finfidmuxls.htm (11/15/07).

and eggs alone account for nearly a third of total cash receipts. Field crops account for another 15 percent of the total.

Although Virginia farm employment has declined (**Figure 2**), productivity improvements attributable to increased mechanization and the adoption of new technologies allowed farm cash receipts to increase from 1990 to 2006. The composition of this output, however, has been in continuous flux. Decreases in the output of several farm products such as peanuts, tobacco, dairy, and hogs have been offset by gains in other commodities such as poultry, equine, aquaculture, greenhouse and nursery products, and cotton (**Figure 3**).

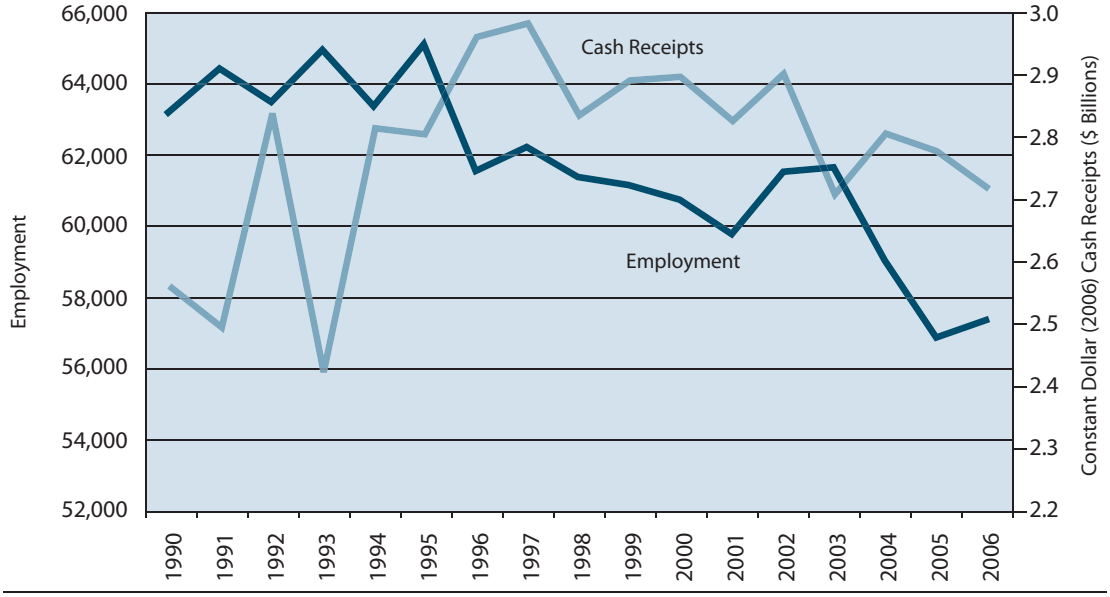
Farm production shows strong geographical patterns in Virginia. Farm employment as a share of total employment is greatest in the southwestern and southern parts of the state. However, the picture is more complex and differentiated than that simple snapshot. Virginia's agriculture sector shows substantial regional diversity because of strong regional specialization by farm commodity. For instance, cotton is primarily a southeastern crop. Over three-quarters of tobacco production can be found in the southern and southwestern regions. Half of poultry production occurs in the northern region. Vegetable production is concentrated in the

Figure 1: Virginia Cash Receipts by Commodity, 2006



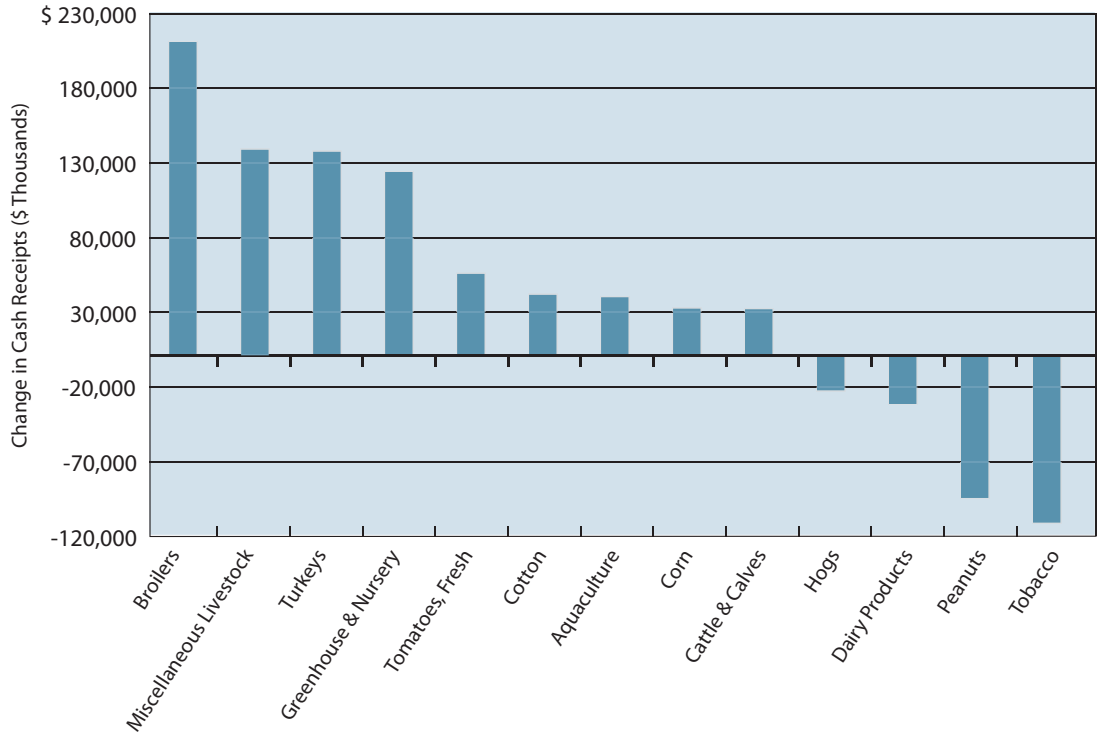
Source: U.S Department of Agriculture, Economic Research Service, Farm Income: Data Files. http://www.ers.usda.gov/Data/Farm-Income/finfidmuxls.htm (11/15/07).

Figure 2: Farm Employment and Cash Receipts in Constant Dollars, 1990-2006



Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Local area personal income. http://www.bea.gov/regional/reis (5/20/08); U.S. Department of Agriculture, Economic Research Service, Farm Income: Data Files. http://www.ers.usda.gov/Data/FarmIncome/finfidmuxls.htm (11/15/07); and IMPLAN deflators.

Figure 3: Change in Virginia Cash Receipts by Commodity, 1990 - 2006



Source: U.S. Department of Agriculture, Economic Research Service, Farm Income: Data Files, http://www.ers.usda.gov/Data/FarmIncome/finfidmuxls.htm (11/15/07).

east, while fruit production shows a more northern pattern.

Virginia's forests are also quite diverse.[4] Although hardwood stands dominate the forests overall, softwoods are more common removal species in the southeast and coastal regions. Oak-hickory is the dominant forest type, followed by loblolly pine, shortleaf pine, and oak-pine.

Virginia's forest resources are distributed throughout the state. The more forested areas exist in the west and south, while the less forested areas are found in the Washington, D.C. environs and the eastern shore. The commonwealth's timber inventory is increasing, and this growth is expected to continue into the near future. However, the long-term outlook is more uncertain because of urbanization pressures, environmental changes, diseases, and pests. Forest management problems can also arise from new property ownership patterns and fragmentation of larger tracts into smaller parcels.

After a period of significant growth during the late 1980s and throughout the 1990s, forest stumpage value, which is the sales value of timber, changed little over the period 1999-2006 (**Figure 4**). Virginia produced an estimated 503 million cubic feet of products from roundwood logs in 2005.[5] Approximately 45 percent of this was saw logs, 40 percent pulpwood, and the remainder composite panels, veneer logs, and other industrial products such as poles, posts, and mulch. Virginia mills produced 1.6 billion board-feet of lumber in 2006, including nearly 8 percent of the hardwood lumber in the nation, making the state the third largest producer in this category after Pennsylvania and Tennessee.[6]

Although production in the agriculture and forestry sectors has held fairly steady in recent years, both sectors face opportunities and

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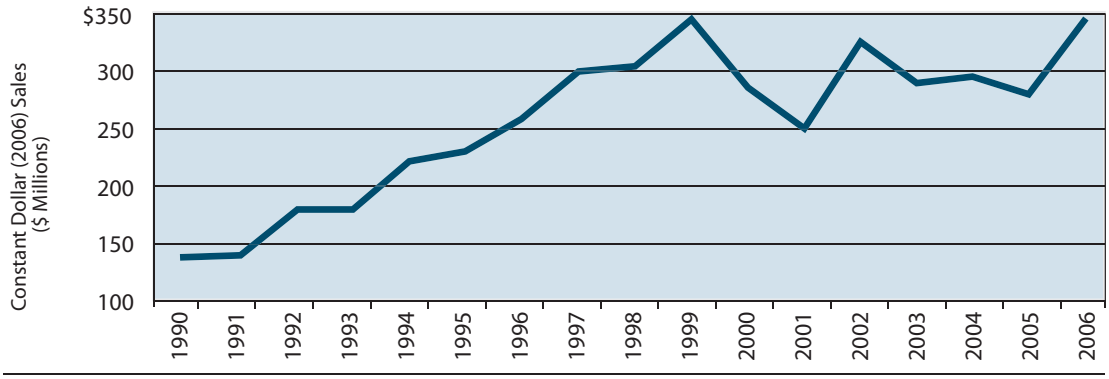
[4] Anita K. Rose, *Virginia's Forests, 2001* (Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station, 2007). http://www.srs.fs.usda.gov/pubs/rb/rb_srs120.pdf (12/19/07).

[5] Tony G. Johnson and Charles W. Becker, *Virginia's Timber Industry—An Assessment of Timber Product Output and Use, 2005* (Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station, 2007). http://www.srs.fs.usda.gov/pubs/rb/rb_srs125.pdf (6/4/08).

[6] U.S. Department of Commerce, U.S. Census Bureau. Lumber Production and Mill Stocks. *Current Industrial Reports*, MA 321T(06)-1. Washington, D.C., 2006. http://www.census.gov/industry/1/ma321t06.pdf (2/5/08).

Figure 4: Virginia Timber Constant Dollar Sales, 1990-2006



Source: Unpublished data from Virginia Department of Forestry and Implan deflators.

The total impact of the agriculture and forestry industries on the Virginia economy can be measured by using input-output analysis. The technique estimates the "indirect" and "induced" effects of agriculture and forestry sales.

challenges if they are to maintain their importance within the economy. Their significance will be shaped by numerous factors in the areas of production technology, consumer demand, energy, urban population growth, government policy, and the global economy.

Measuring Economic Impacts

The total impact of the agriculture and forestry industries on the Virginia economy can be measured by using input-output analysis.[7] The technique estimates the "indirect" and "induced" effects of agriculture and forestry sales. The two effects occur when money retained in the state circulates through the economy. For instance, businesses that provide inputs such as supplies and services to agricultural and forestry industries must purchase other inputs in order to produce the product or service, and so forth. These effects are referred to as "indirect impacts." Also, the spending of new household income attributable to the direct and indirect effects of agriculture and forestry will induce subsequent rounds of spending. These effects are called "induced impacts." The incremental effect of each round of spending dissipates because a portion of the spending leaks out of the state economy.

A widely used input-output model is IMPLAN, which stands for IMpact analysis for PLANning.[8] It has been used extensively to measure the economic effects of various events and public policies such as plant closures, the opening of sports stadiums, and energy policies. In addition, it has been utilized in many studies of the economic impact of the forestry and agriculture industries.

Economic impacts are evaluated using three different measures: total industrial output, employment, and value-added. Total industrial output represents the total value of industry production during a specific time period (usually a year). Employment includes both full-time and part-time jobs. Value-added refers to the additional value created in, or added to, products at different stages of production.

In this analysis, industrial categories were also defined based on their degree of dependency on Virginia agricultural and forestry products. Agriculture and forestry-related industries were aggregated into the following components: (a) production, (b) core, (c) extended, and (d) distribution.

(a) "Production" activities are those industries associated with growing and harvesting basic farm, timber, and non-timber forest commodities.

(b) "Core" activities are manufacturing industries that are heavily dependent on state farm and forest commodities for production. It is unlikely that these industries would exist in anything like their current form if commodity production did not occur in the state. Examples of these industries are poultry processing, which depends on local broiler production, and milling lumber, which draws on nearby timber stocks.

(c) "Extended" activities are manufacturing industries that are somewhat less dependent on Virginia farm and forest commodity inputs. Examples of these industries are soft drink manufacturing, which uses syrups and concentrates produced outside the state, and wood kitchen cabinet and countertop manufacturing, which uses lumber, particle board, and other processed wood inputs.

[7] For additional background on this tool of analysis, see: Ronald Miller and Peter D. Blair, *Input-Output Analysis: Foundations and Extensions* (Englewood Cliffs, NJ: Prentice-Hall, 1985).

[8] Minnesota Implan Group, Inc., *Implan Professional Version 2.0: User's Guide, Analysis Guide, and Data Guide.* (Stillwater, MN, 2004).

(d) "Distribution" industries consist of selected warehousing and wholesaling industries as well as landscaping services that are closely related to agriculture and forestry product distribution.

Lastly, the study makes impact estimates of federal agricultural support payments to Virginia's farmers.

Results of the Input-Output Analysis

In 2006, Virginia agriculture and forest-related industries directly generated $42 billion in total output, approximately 196,000 jobs, and over $13 billion in value-added. Agricultural production was the largest component of employment. However, agriculture extended processing activity accounted for over 40 percent of total output and value-added (**Table 2**).

Table 2: Virginia Agriculture and Forestry Industries Direct Effects, 2006

	Output ($ Millions)	Employment	Value-added ($ Millions)
Agriculture			
Production	2,890.9	55,085	1,333.1
Core	6,954.4	21,755	1,090.7
Extended	17,472.1	27,550	5,661.8
Distribution	1,443.1	26,648	761.3
Government payments	176.6	4,808	120.9
Total	28,937.1	135,846	8,967.7
Forestry			
Production	1,601.4	6,931	464.1
Core	6,108.1	21,479	1,777.9
Extended	4,854.1	27,309	1,585.2
Distribution	757.8	4,528	516.9
Total	13,321.5	60,247	4,344.1
Grand total	**42,258.6**	**196,093**	**13,311.9**

Sources: Virginia Employment Commission, Quarterly Census of Employment and Wages (2nd quarter, 2006) and IMPLAN.

The full economic impact of agriculture and forestry-related industries in Virginia (including direct, indirect, and induced effects) was $79 billion in total industry output in 2006 (**Table 3**). The total value-added impact was $37 billion, which constitutes approximately 9.9 percent of Virginia gross domestic product (GDP).[9] The total employment impact was 501,500 employees, which makes up 10.3 percent of employment in the state.[10]

[9] U.S. Department of Commerce, Bureau of Economic Analysis, Gross Domestic Product by State. http://www.bea.gov/regional/gsp/ (12/5/07).

[10] U.S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income. http://www.bea.gov/regional/reis/ (5/20/08). Total employment is by place of work including full and part-time workers as well as the self-employed and the military.

Table 3: Virginia Total, Direct, Indirect, and Induced Impacts of Agriculture and Forestry Combined, 2006

	Output ($ Millions)	Employment	Value-added ($ Millions)
Direct	42,258.6	196,093	13,311.9
Indirect	11,817.2	74,970	6,868.7
Induced	24,526.4	230,422	16,373.0
Total	78,602.2	501,485	36,553.5

Table 4 breaks down the direct, indirect, induced, and total impacts separately for the agriculture and forestry sectors. The agriculture sector accounted for $55 billion in total industry output, approximately 357,000 jobs, and nearly $26 billion in value-added. The forestry sector had a total impact of approximately $23 billion in total industry output, approximately 144,380 jobs, and nearly $11 billion in value-added. Therefore, when the agriculture and forestry industry is broken down into its two components, agriculture-related activities account for approximately 70 percent of total output, employment and value-added impacts, with forestry-related activities making up the remainder.

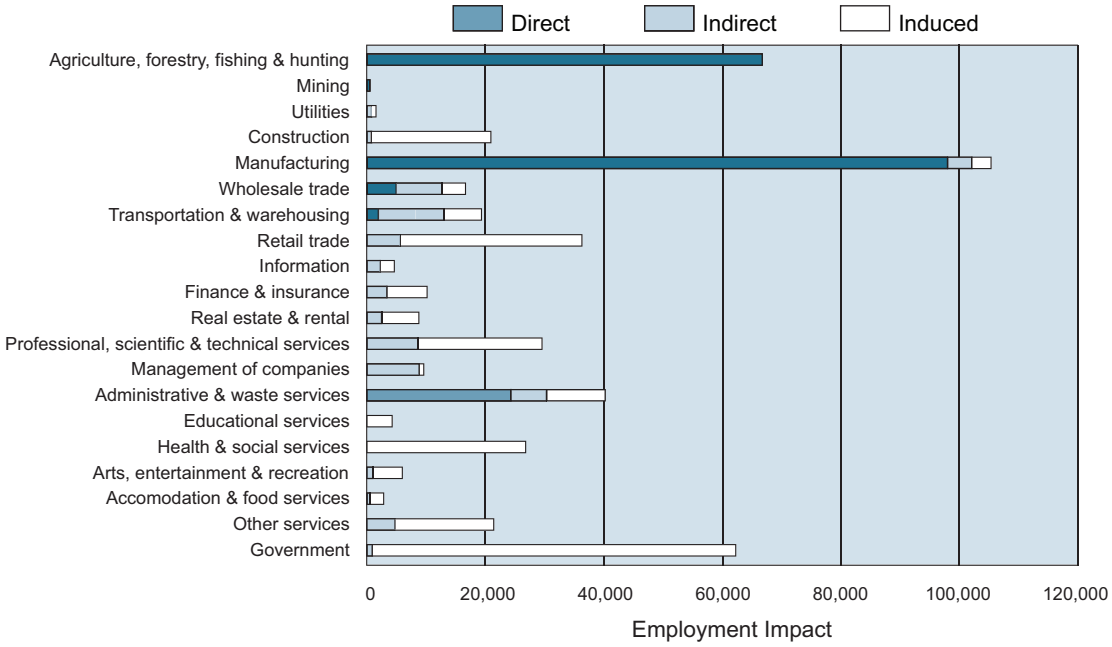
Table 4: Virginia Total, Direct, Indirect, and Induced Impacts of Agriculture and Forestry, 2006

	Output ($ Millions)	Employment	Value-added ($ Millions)
Agriculture			
Direct	28,937.1	135,846	8,967.7
Indirect	8,859.1	56,603	5,212.4
Induced	17,377.9	164,656	11,639.7
Total	55,174.1	357,105	25,819.9
Forestry			
Direct	13,321.5	60,247	4,344.1
Indirect	2,958.1	18,367	1,656.3
Induced	7,148.6	65,766	4,733.3
Total	23,428.2	144,380	10,733.7
Grand total	**78,602.2**	**501,485**	**36,553.5**

The impacts of agriculture and forestry were felt in other sectors of the economy as well (**Figure 5**). The largest effects were in the manufacturing and agriculture and forestry industries, where direct effects were dominant. However, agriculture and forestry stimulated large public and private services responses through the effects of industry purchases and subsequent rounds of indirect and induced spending. The effects reverberated throughout the economy, touching every sector. For some industries, such as transportation and warehousing, the impacts were primarily indirect. For others, such as construction, retail trade, health and social services, and government, the impacts were chiefly induced.

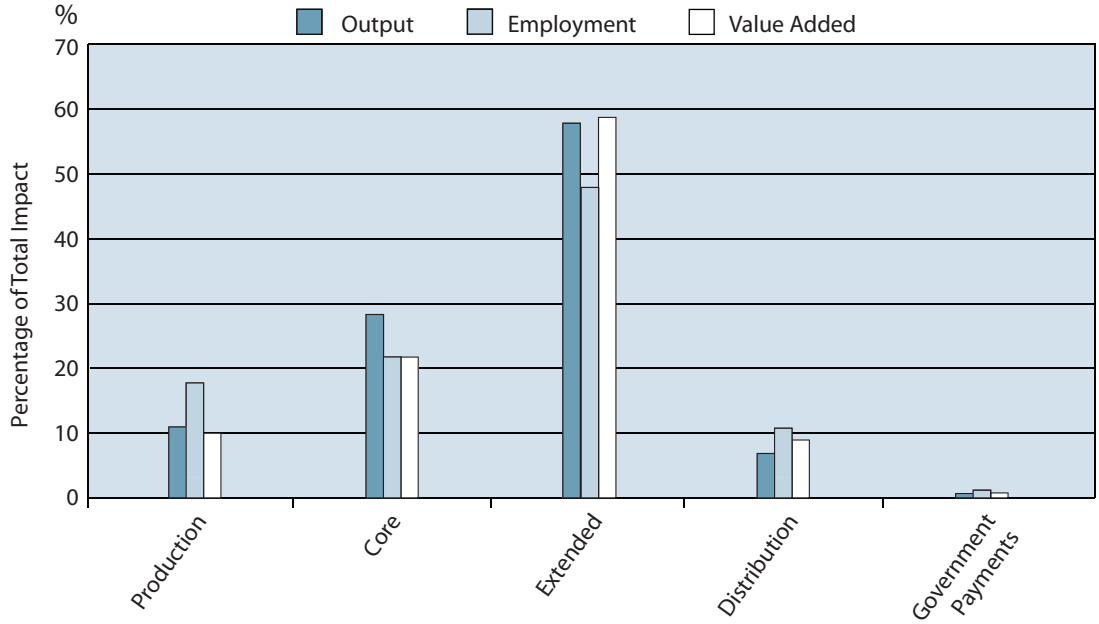
The full economic impact of agriculture and forestry-related industries in Virginia (including direct, indirect, and induced effects) was $79 billion in total industry output in 2006.

Figure 5: Distribution of Virginia's Agriculture and Forestry Direct, Indirect, and Induced Employment Impacts by Industry , 2006



The impacts were estimated by farm and forestry sectors and further broken down into their production, core processing, extended processing, distribution, and government payments components (**Figure 6**). Production industry impacts make up 17 percent of the total employment impact but only 10 percent of value-added and output impacts. Core processing makes up 23 percent of the employment and value-added impacts but 27 percent of output impact. Extended processing is the largest impact category, constituting 47 percent of employment impact, 56 percent of output impact, and 58 percent of value-added impact. Distribution activities account for 11 percent of employment impact, 8 percent of value-added impact, and 6 percent of output impact. Government payments account for approximately 1 percent of each. Therefore, the bulk of the total impacts are connected to agribusiness processing and

Figure 6: Total Virginia Impacts by Agriculture and Forestry Component, 2006



distribution activities with a somewhat weaker connection to Virginia production industries.

The Value and Limitations of Input-Output Analysis

Impact studies such as this one can be beneficial in helping us understand the diffuse influences that agriculture and forestry have on Virginia businesses, households, and government. Moreover, an input-output model can offer some insight into the channels that natural resources follow in the value chain as the impact builds.

Expanding markets for Virginia agriculture and forestry products by offering competitively priced, quality products that satisfy consumer tastes can increase the total impacts of these sectors. These actions increase the direct effects. Creating higher value-added products, such as specialty food products and engineered wood products, through innovation and product upgrading and strengthening linkages among industries and institutions within the state economy also can play a role. They help to determine the magnitude of indirect and induced effects.

There are, however, limitations to input-output analysis. For instance, the method makes some restrictive assumptions that are not completely met in practical applications, particularly when estimating the effect of large increments or decrements in expenditure or economic activity that occur when analyzing the impact of large sectors of the economy. Input-output analysis assumes that relative prices are unchanged, commodity supply expands without a change in price, and production technologies are constant. If these assumptions are relaxed and agriculture and forestry-related labor and capital are able to move to other sectors, impact estimates will be smaller. For example, if the farm and forestry industries were to disappear from the commonwealth tomorrow, some surplus labor, capital, and consumer expenditures would flow into other sectors of the Virginia economy, thereby mitigating some of the negative impacts of the loss of these industries.

The agriculture and forestry industries also affect the economy in ways that are not measured here. For instance, this study does not account for many agritourism and forest recreation impacts. They are excluded because of the difficulty of measuring all consumer expenditures associated with agritourism and forestry recreation. These activities include freshwater fishing, hunting, hiking and backpacking, camping, horse racing, horseback riding, wineries,[11] agricultural festivals, state and county fairs, and agritourism such as on-farm festivals, hayrides, corn mazes, pumpkin patches, and tours. However, figures available from other studies suggest that these activities may generate state output impacts that amount to several billion dollars.[12]

In addition, no attempt is made to gauge the wider social benefits and costs of agriculture and forestry. Agriculture and forestry have tangible societal and ecological effects. Forests, in particular, provide benefits in the form of carbon sequestration, stabilization of soils, wildlife habitat and biodiversity, flood mitigation, and improved water quality. Scenic amenities also improve quality of life. On the other hand, improper agricultural and logging practices impose costs arising from water quality degradation, noxious odors, and airborne pathogens. Therefore, the full economic value of agriculture and forestry will always be a subject of debate and discussion.

Conclusion

The agriculture and forestry industries have played a huge role in Virginia's economy throughout its history. Although direct farming and logging employment has declined and now makes up less than 2 percent of total Virginia employment, it would be a mistake to dismiss the industries' continued economic importance. The agriculture and forestry industries influence the location decisions of other industries in the value chain. In addition, state agribusinesses purchase from other industries and make payments to households. These expenditures circulate throughout the economy generating a large total impact, 10.3 percent of total state employment. By measuring the impact of the forestry and agriculture sectors in this fashion now and in the future, it will be possible to gauge how these sectors are evolving as levers in Virginia's economy. ●

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11 Virginia agricultural commodities sold in wineries and on farms is captured in this analysis. However, tourist spending on transportation, lodging, and other products and services is not.

12 American Sportfishing Association, *Sportfishing in America* (Alexandria, VA: 2002); International Association of Fish and Wildlife Agencies, *Economic Importance of Hunting in America* (Washington, D.C.: 2002). Rob Morris, *Economic Impact of Virginia Wine, 2005: Preliminary Findings.* MKF Research LLC, 2007 http://www.virginiavineyardsassociation.com/presentations/MKF_Rob%20Morris.pdf (2/6/08), John L. Knapp, *The Virginia Horse Center's Economic Impact in 2004* (Charlottesville, VA: University of Virginia, 2005). http://www.coopercenter.org/publications/ECONOMICS/Impact%20Studies.php (6/10/08).

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