The Economic Contribution of the Dairy Industry in Virginia

Prepared for the Virginia State Dairymen's Association

Terance J. Rephann, Ph.D.

September 4, 2015

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Introduction

Virginia's dairy industry plays an important part in the Virginia economy. The industry includes not only dairy cattle farming and milk production but also closely connected milk processing such as fluid milk, butter, cheese, ice cream, and dried and condensed milk product manufacturing. Virginia's dairy industry directly employed an estimated 7,975 workers in 2014 and accounted for an estimated $2.298 billion in total output, $451 million in value-added, and $159 million in labor income. When the multiplier effects resulting from payments to Virginia-based businesses and labor are counted, the economic contribution increases to 13,819 workers, $3.2 billion in total industry output, $953 million in value-added, and $452 million in labor income.

This report examines in greater detail the characteristics of Virginia's dairy industry and the contribution that the industry makes to the state economy. The report is divided into three parts. The first section examines characteristics of Virginia's dairy industry, including both production and processing sectors. The second section describes the methods and data used in the study to measure the economic contribution of the industry. The third section presents the results. Results are provided in aggregate and by component production and processing industry.

Virginia's Dairy Industry

Milk is one of Virginia's top agricultural products, ranking third in 2014 with $478 million in cash receipts compared to $1.360 billion for poultry and eggs, and $714 million for beef cattle. Virginia's dairy sector ranked 22nd among U.S. states in terms of cash receipts in 2014 (USDA, ERS 2015). Dairy farming operations can be found throughout the commonwealth, but tend to be more concentrated in the Shenandoah Valley and Southwest regions where foraging presents the best opportunities for land utilization (Rephann 2013). The leading producer is Rockingham County, which, with 25,000 milk cows, accounted for over one in four of Virginia's estimated 93,000 milk cows in 2014 (see **Table 1**). Other large producers are Franklin County (9,700 milk cows), Augusta County (7,000), and Pittsylvania County (6,900), each with more than 5,000 milk cows. The top 10 producing counties account for over 68 percent of the total state milk cow inventory.

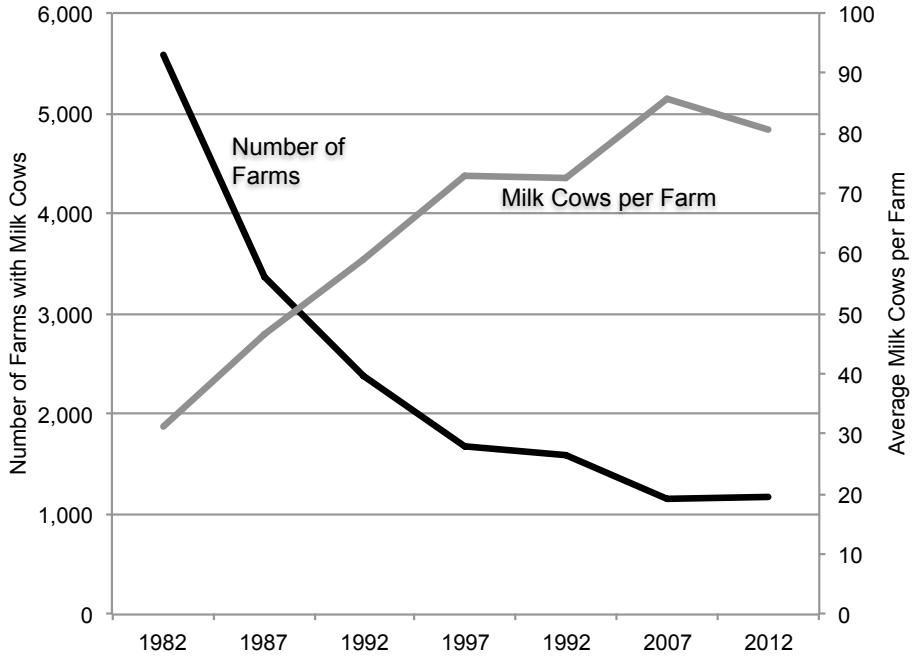
Table 1. Estimated Milk Cows by Virginia Locality, 2014

Locality	Number of milk cows
Rockingham County	25,000
Franklin County	9,700
Augusta County	7,000
Pittsylvania County	6,900
Fauquier County	3,700
Wythe County	2,600
Washington County	2,500
Culpeper County	2,200
Montgomery County	2,000
Shenandoah County	1,800
Other counties	29,600
TOTAL	93,000

Source: U.S. Department of Agriculture, National Agricultural Statistical Service, Quick Stats (http://www.nass.usda.gov/Quick_Stats/).

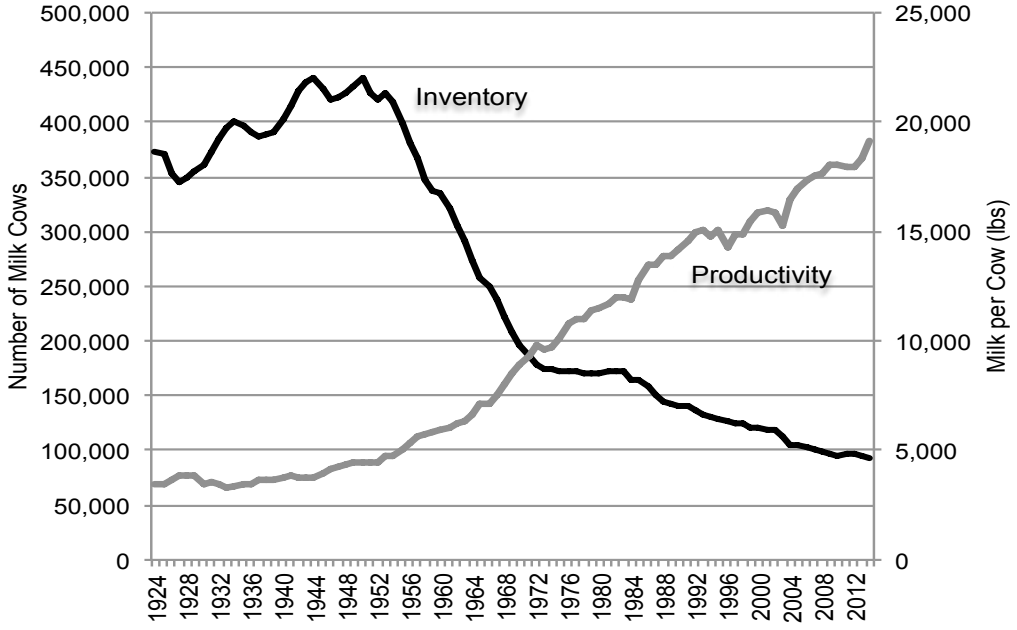
Like elsewhere in the United States, Virginia's dairy farm sector has undergone profound change and restructuring in recent decades (Miller and Blayney 2006). The number of farms reporting raising dairy cattle has dwindled while average milk cowherds on the remaining farms have more than doubled in size over the last thirty years (see **Figure 1**). Milk cow inventories are now roughly half of what they were in 1971, but increased farm economies of scale, improved cattle breeding, health and nutrition, and increased utilization of capital and advanced technology have doubled milk productivity per cow (see **Figure 2**). As a result, there has been relatively little overall change in Virginia milk production levels.

Figure 1. Number of Virginia Dairy Farms and Average Milk Cow Herd per Farm, 1982-2012



Source: U.S. Department of Agriculture, National Agricultural Statistical Service, And Various Agricultural Censuses

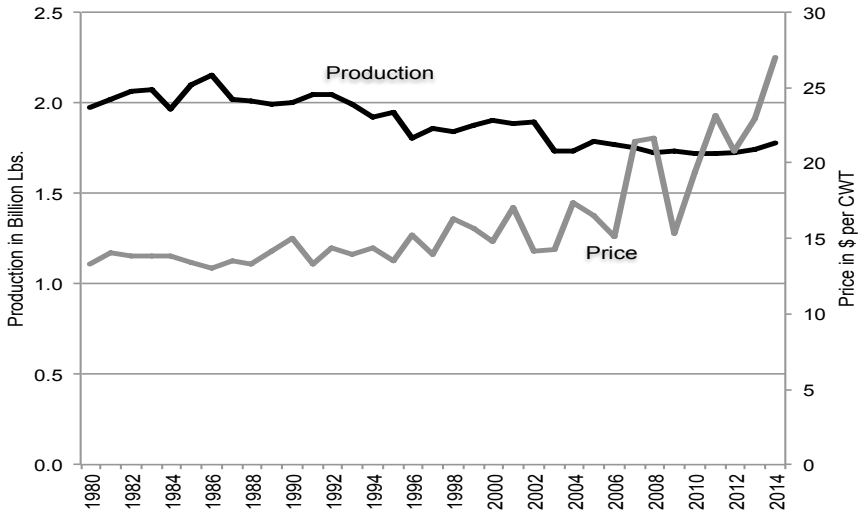
Figure 2. Virginia Dairy Cow Inventory and Milk Productivity, 1924-2014



Source: U.S. Department of Agriculture, National Agricultural Statistical Service, Quick Stats (http://www.nass.usda.gov/Quick_Stats/).

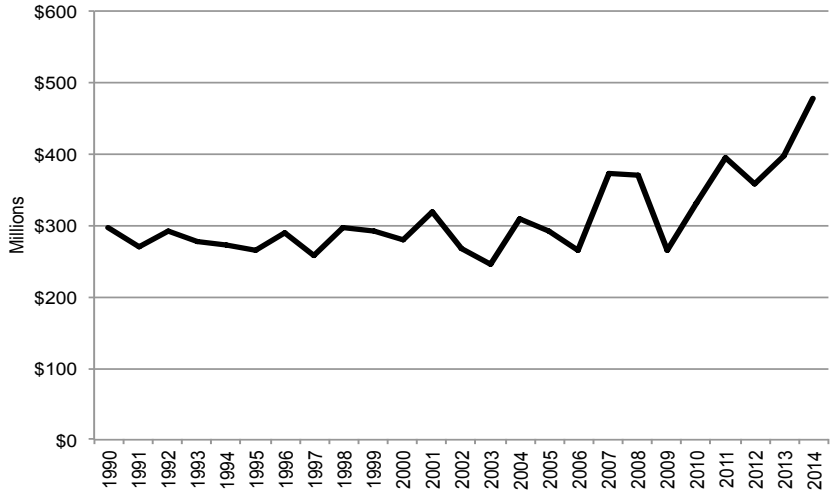
In recent years, Virginia dairy cash receipts have increased largely because of more favorable milk prices (see **Figure 3**). Raw milk prices increased 76 percent from 2006 to 2014. As a result, cash receipts advanced 80 percent over the same period to reach an all-time high of $478 million in 2014 (see **Figure 4**).

Figure 3. Virginia Milk Production and All Milk Price, 1980-2014



Source: University of Wisconsin Department of Agricultural and Applied Economics, Dairy Marketing and Risk Management Program (http://future.aae.wisc.edu) and U.S. Department of Agriculture, National Agricultural Statistical Service, Quick Stats (http://www.nass.usda.gov/Quick_Stats/).

Figure 4. Virginia Dairy Cattle and Milk Production Cash Receipts, 1990-2014



Source: U.S. Department of Agriculture, Economic Research Service and National Agricultural Statistics Service

Several Virginia food-processing industries are heavily dependent on Virginia raw milk producers and are closely identified with the dairy industry. They include fluid milk manufacturing, creamery butter manufacturing; cheese manufacturing; dry, condensed, and evaporated dairy product manufacturing; and ice cream and frozen dessert manufacturing. Virginia-based enterprises in these industries tend to use Virginia milk

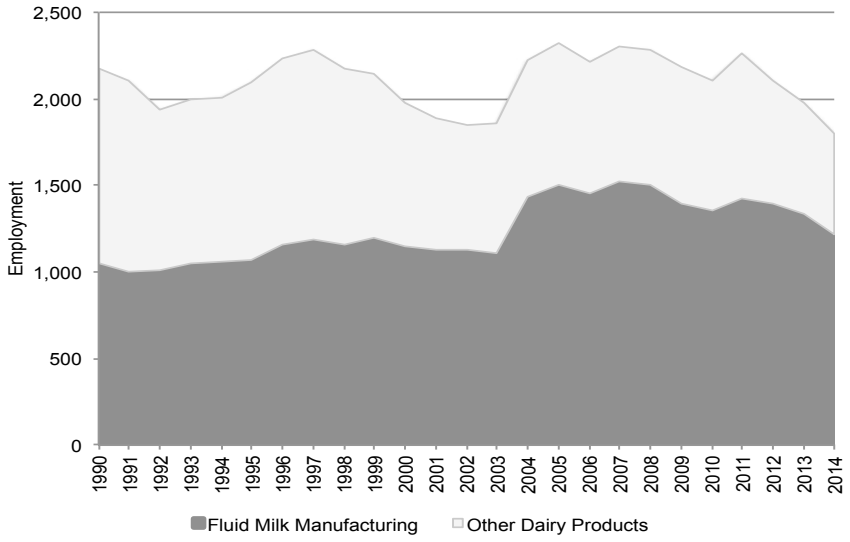
rather than import it from elsewhere because raw milk is heavy and highly perishable.[1] These industries have also been identified in other statewide economic impact analyses as important components of state dairy industries (Sumner, Medellín-Azuara and Coughlin 2015; Watson et al. 2014; Stevens et al. 2008). Major Virginia dairy processors include Dean Foods in Richmond, HP Hood LLC in Winchester, Whitewave Foods in Rockingham County, and the Maryland and Virginia Milk Producers Cooperative Association affiliated Marva Maid Dairy plant in Newport News and Valley Milk Products LLC plant in Shenandoah County.

Virginia employment in dairy processing industries has remained relatively constant over the last 25 years, with employment fluctuating around a long-term average of 2,100 employees (see **Figure 5**). However, employment dropped to 1,804 in 2014, a low for the period. Approximately two-thirds of dairy product manufacturing employment in 2014 was in fluid milk manufacturing.

Processing employment trends reflect both supply and demand factors. Dairy processing industries have experienced employment attrition in part due to manufacturing productivity improvements through firm consolidation and manufacturing automation. On the demand side, decreasing domestic fluid milk consumption per capita has constrained fluid milk market growth. However, domestic demand for cheese, yogurt, and specialty products such as whey protein nutraceuticals and international demand for dried milk has increased. Demand has also increased for organic and craft or boutique milk products. Small creameries that also often offer small batch production value-added products through a retail storefront typically produce these products. Since these small operations are often categorized by their principal activity (e.g., retail trade), they may not be adequately captured in the employment figures reported here.

1 This study validated the inclusion of these industries using a methodology similar to that used in a recent study of Virginia agriculture and forest industries to identify value-added industries closely connected to Virginia produced food and fiber (Rephann 2013). Value-added industries that depend on state raw or processed milk are characterized as dependent on Virginia supplies for their presence in the state. These industries are identified using supply multipliers (see Miller and Blair 2009 for a fuller explanation) derived from the Virginia IMPLAN input-output model. Industries with dairy cattle and milk production supply multipliers in excess of .027 were identified as dairy dependent industries, including fluid milk and butter manufacturing (.239), cheese manufacturing (.234), dry, condensed and evaporated dairy product manufacturing (.187), and ice cream and frozen dessert manufacturing(.052).

Figure 5. Virginia Dairy Product Manufacturing Employment, 1990-2014



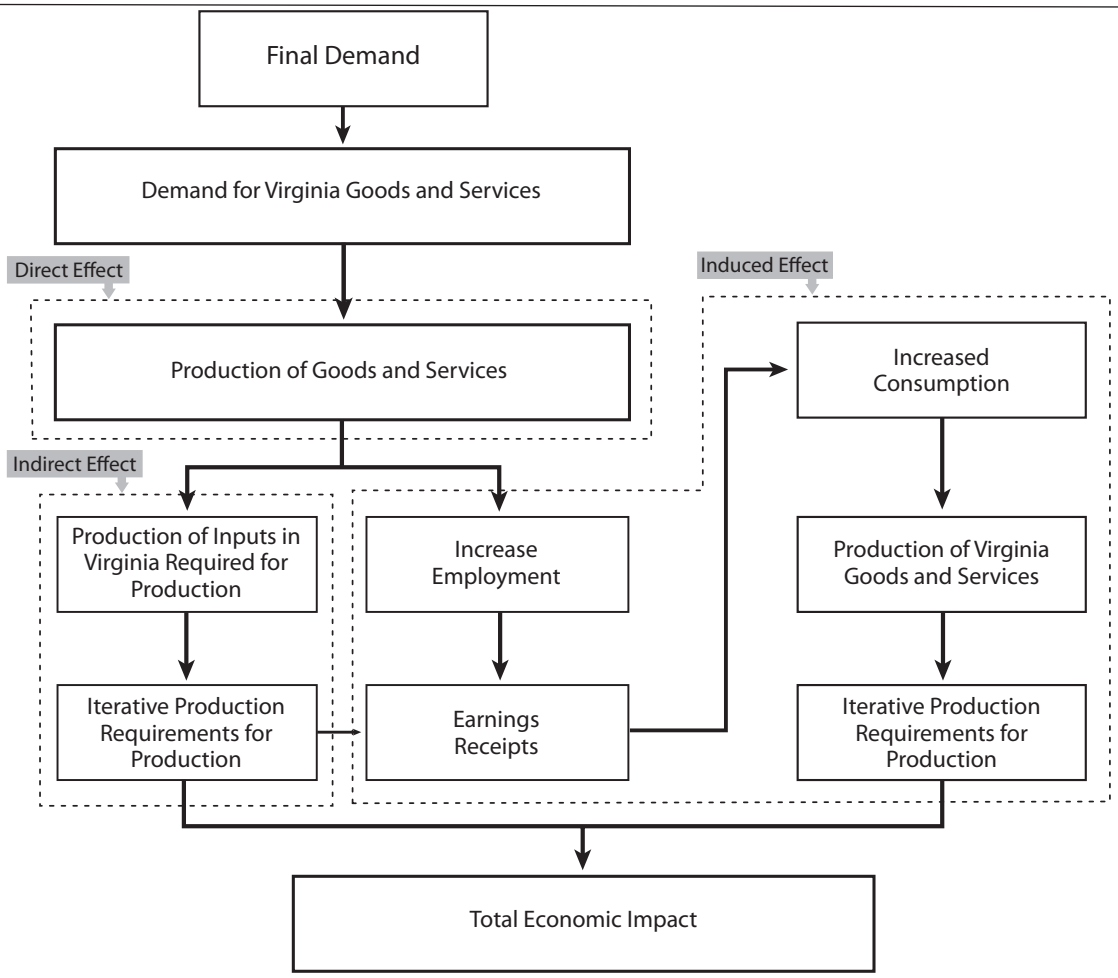
Source: Virginia Employment Commission, Quarterly Census of Employment and Wages

Methodology and Data

This study examines the contribution of the Virginia dairy industry with input-output analysis. Input-output analysis produces industry economic multipliers that show how changes in the industry activity affect the state economy. While studies such as this type are often called "economic impact" studies, a more accurate description is "economic contribution" or "economic footprint" study (Watson et al. 2007). An "economic contribution" analysis traces the gross economic activity that results from a given expenditure. It does not consider whether the expenditure used to generate the economic activity might have been used elsewhere in the economy to generate economic activity and gauge the comparative effect of that alternative activity. While this distinction is important, we will continue to use the term "economic impact" to refer to the results of this analysis as is customary for these kinds of studies.

The total economic impact consists of three parts: a "direct effect," "an indirect effect," and an "induced effect" (see **Figure 6**). The "direct effect" consists of the injection of economic activity or expenditure into the region. For example, the output of Virginia's dairy industry would count as the direct effect. The direct expenditure to support this output then causes a "ripple effect" on the state economy when money is re-spent.

Figure 6. Economic Impact Diagram



For instance, state businesses provide supplies and services to farms such as feed, veterinarian services, utilities and insurance.[2] These businesses spend a portion of their sales revenues on their supplies and services from other state firms who, in turn, purchase a portion of their supplies and services from other state firms. This cascading sequence of spending continues until the subsequent rounds of spending dissipate due to leakages in the form of spending outside the state. The cumulative effect of these cascading rounds of inter-industry purchases is referred to as the "indirect effect." The final component of total impact (the "induced effect" or "induced impact") is attributable to the spending of households. For instance, businesses pay households for their labor services. These households then purchase goods and services from state firms who in turn receive a portion of their labor, material and service inputs from within the state. Again leakages occur at each round due to purchases of goods and services outside the state. The "induced effect" is the sum of the impacts associated with these household purchases.

The impact analysis for this study used IMPLAN (Impact analysis for PLANning). This model has been used in many economic impact studies, including the last economic impact study of Virginia agriculture and forestry (Rephann 2013) and many other state dairy industry economic impact studies--see, for example, recent studies for California (Sumner, Medellín-Azuara and Coughlin 2015), Idaho (Watson et al. 2014) and Florida (Stevens et al. 2008). Impacts are evaluated within IMPLAN using four different measures: (a) total sales or total industrial output (TIO), (b) value-added, (c) labor income and (4) employment. Total sales or industry output is the total value of industry production during a period. It measures sales of intermediate inputs for use in production as well as sales of products to final consumers. Value-added is a subset of total industrial output. It reflects only sales to final consumers and therefore avoids the double counting that occurs when intermediate inputs are included. It is the most commonly used measure of economic activity. Value-added is the concept behind gross domestic product (GDP) and can be compared to the GDP numbers provided by the Bureau of Economic Analysis for states and metropolitan areas. It can also be represented as total factor income plus indirect business taxes. Labor income represents payments to workers and business owners in the form of employee compensation and proprietary income. Employment is measured in terms of person-years of employment. A person-year of employment is a job of one year in duration. Employment includes full-time and part-time employment as well as the self-employed and is measured by place of work.

This study draws data from two sources. Employment data was obtained from the Virginia Employment Commission (VEC) Quarterly Census of Employment and Wages (QCEW) for 2014. Industry employment figures North American Industrial Classification System (NAICS) categories were assigned to the appropriate IMPLAN categories.[3] The employment numbers are converted to sales/output equivalent figures by the model for use in generating impact estimates. For the dairy cattle and milk production farm sector, U.S. Department of Agriculture commodity cash receipts data for 2014 was obtained from the U.S. Department of Agricultural, National Agricultural Statistical Service Milk Production, Disposition, and Income Annual Summary Report.

2 In order to avoid double counting agricultural and forestry-industry inputs, firm inputs from these industries were disallowed. Double counting occurs when you include the impact of a sector as a direct effect and then count it again as the indirect effect of another sector because it serves as an input to that sector. This suppression was accomplished by setting regional purchase coefficients (RPCs), which represent the portion of state demand purchased from state producers, to zero in each of the agriculture and forestry-related sectors included in the model. This approach is recommended by Miller and Blair (2009), pp. 621-625.

3 2014 employment figures for two sectors were not disclosed because of privacy concerns: creamery butter manufacturing (NAICS=311512) and dry, condensed, and evaporated dairy product manufacturing (311520). Supplemental information from the U.S. Census Bureau's County Business Patterns was used to infer that there was one firm in the former sector with 10-19 employees. Therefore, employment for the creamery butter industry was estimated to be the midpoint of the interval (15 employees). Dry, condensed, and evaporated dairy product manufacturing was provided by three firms with employment in larger size classes. The employment for this sector was estimated as a residual (514 employees).

Results

The direct effect of the Virginia dairy industry in 2014 by IMPLAN sector is reported in Table 2. The industry accounted for $2.298 billion in total output, 7,875 employees, $451 million in value-added, and $159 million in labor income. Dairy cattle and milk production is the largest component in terms of employment at 77 percent. However, dairy product manufacturing accounts for over 60 percent of value-added.

The purchases of the four value-added manufacturing industries play a key role in supporting Virginia dairy farm production. These state businesses account for the bulk (64.2 percent) of the dairy industry direct employment, output, value-added and labor income including 3,906 jobs, $307.8 million in output, $115.2 in value-added, and $16.1 million in labor income. Other in-state purchasers (e.g., confectionary industries, other farm sectors) institutional purchasers (e.g., government), out-of-state purchasers and international exports account for the remainder of demand for the Virginia dairy farm industry.

Table 2. Virginia Dairy Industry Direct Employment, Output, Value Added and Labor Income, 2014

Component	Employment	Output	Value-added	Labor Income
Dairy Cattle and Milk Production	6,071	$478,440,017	$179,103,248	$25,011,621
Fluid Milk and Butter	1,231	$1,363,744,069	$210,415,580	$92,775,989
Cheese Manufacturing	11	$9,499,076	$768,672	$572,906
Dry, Condensed, and Evaporated Dairy Product Manufacturing	514	$427,035,629	$56,613,945	$37,380,096
Ice Cream and Frozen Dessert Manufacturing	48	$19,667,791	$4,479,433	$3,075,823
Total Dairy Industry	7,875	$2,298,386,582	$451,380,878	$158,816,435

Table 3 presents the total (direct+indirect+induced) economic impact of the dairy industry by component industry. It indicates that the total industry output or sales impact was $3.2 billion in 2014, employment impact was 13,819, value-added impact was $953 million, and labor income impact was $452 million.

Table 3. Virginia Total, Direct, Indirect, and Induced Impacts of Dairy Industry, 2014

Impact	Employment	Output	Value-added	Labor Income
Dairy Cattle and Milk Production				
Direct	6,071	$478,440,017	$179,103,248	$25,011,621
Indirect	1,485	$214,010,226	$87,980,900	$44,474,408
Induced	366	$48,164,710	$29,567,310	$15,938,808
Total	7,922	$740,614,953	$296,651,458	$85,424,838
Multiplier	1.30	1.55	1.66	3.42
Fluid Milk and Butter				
Direct	1,231	$1,363,744,069	$210,415,580	$92,775,989
Indirect	1,882	$336,137,140	$190,255,235	$121,574,382
Induced	1,119	$147,383,822	$90,475,785	$48,772,337
Total	4,232	$1,847,265,030	$491,146,601	$263,122,707
Multiplier	3.44	2.53	2.33	2.84
Cheese Manufacturing				
Direct	11	$9,499,076	$768,672	$572,906
Indirect	11	$1,942,993	$1,119,822	$730,122
Induced	7	$898,439	$551,533	$297,313
Total	29	$12,340,507	$2,440,027	$1,600,341
Multiplier	2.64	1.30	3.17	2.79

Table 3. Virginia Total, Direct, Indirect, and Induced Impacts of Dairy Industry, 2014 (continued)

Impact	Employment	Output	Value-added	Labor Income
Dry, Condensed, and Evaporated Dairy Product Manufacturing				
Direct	514	$427,035,629	$56,613,945	$37,380,096
Indirect	603	$114,656,327	$63,031,623	$40,422,107
Induced	407	$53,653,335	$32,936,864	$17,754,935
Total	1,524	$595,345,291	$152,582,433	$95,557,138
Multiplier	2.97	1.39	2.70	2.56
Ice Cream and Frozen Dessert Manufacturing				
Direct	48	$19,667,791	$4,479,433	$3,075,823
Indirect	35	$6,500,472	$3,625,849	$2,412,828
Induced	29	$3,767,273	$2,312,674	$1,246,654
Total	111	$29,935,536	$10,417,955	$6,735,305
Multiplier	2.32	1.52	2.33	2.19
Total Dairy Industry				
Direct	7,875	$2,298,386,582	$451,380,878	$158,816,435
Indirect	4,017	$673,247,158	$346,013,429	$209,613,848
Induced	1,927	$253,867,579	$155,844,166	$84,010,046
Total	13,819	$3,225,501,319	$953,238,473	$452,440,329
Multiplier	1.75	1.40	2.11	2.85

The impacts of agriculture and forestry were felt in other sectors of the economy (see **Table 4**). The largest effects were in agriculture, forestry, fishing, and hunting and manufacturing where dairy industry direct effects were dominant. However, the dairy industry also affected every other industry indirectly, accounting for hundreds of jobs in nearly every sector, including 582 jobs in transportation and warehousing, 450 jobs in administrative and waste services, 448 jobs in retail trade, and 427 jobs in professional, scientific, and technical services through the effects of industry and labor purchases and subsequent rounds of spending.

Table 4. Total Impact of Virginia's Dairy Industry by Major Sector, 2014

	Employment	Output	Value-added	Labor Income
Ag, Forestry, Fish & Hunting	6,937	$525,612,451	$195,379,681	$35,650,461
Mining	17	$5,295,434	$1,892,399	$704,303
Utilities	47	$45,838,952	$26,469,418	$6,845,052
Construction	188	$19,258,468	$11,214,450	$10,215,507
Manufacturing	2,019	$1,955,387,346	$295,266,604	$147,080,046
Wholesale Trade	370	$70,150,545	$53,427,107	$30,497,903
Retail trade	448	$30,238,604	$21,069,331	$13,521,496
Transportation & Warehousing	582	$82,016,372	$38,124,808	$29,318,265
Information	105	$38,497,591	$20,525,110	$9,804,170
Finance & insurance	295	$73,153,088	$41,919,072	$20,113,958
Real estate & rental	366	$104,522,010	$72,799,169	$8,066,970
Professional, scientific & technical services	427	$71,798,896	$53,071,200	$36,797,008
Management of companies	273	$64,970,077	$40,102,562	$34,778,912
Administrative & waste services	450	$31,384,628	$19,521,584	$15,978,257
Educational services	71	$4,574,081	$2,927,595	$2,549,686
Health & social services	375	$37,732,297	$23,099,682	$20,888,614
Arts, entertainment & recreation	105	$5,563,421	$2,683,048	$2,037,669
Accommodation & food services	359	$21,869,261	$11,645,674	$8,016,205
Other services	297	$22,746,834	$14,714,864	$13,659,033
Government & other	90	$14,890,960	$7,385,115	$5,916,815
Total	13,819	$3,225,501,319	$953,238,473	$452,440,329

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