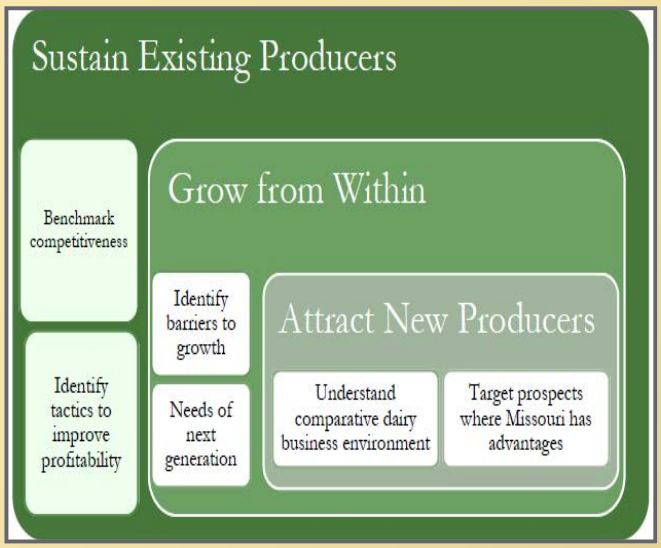
January 2015



Missouri Dairy Industry Revitalization Study

Executive Summary

UNIVERSITY OF MISSOURI
Extension
Commercial Agriculture Program

Missouri Dairy Industry Revitalization Study – Executive Summary

A comprehensive study was completed by the University of Missouri to provide insight for future efforts to revitalize the Missouri dairy industry. Funding was provided by the Missouri Agricultural and Small Business Development Authority (MASBDA). These six publications were developed in 2015 to provide stakeholders a foundational base for educating the industry and developing a future action plan to revitalize this industry.

Other publications from this study include:

Section 1: Historical Perspective
Section 1 provides an in-depth discussion about Missouri's dairy industry historical trends concerning its dairy cow inventory, farms, production, prices, production economics and processing industry.

Section 2: Economic Contribution
Section 2 discusses what the economic contributions such as jobs, value-added and industry sales are from Missouri dairy farms and the Missouri dairy product manufacturing industry.

Section 3: Needs Assessment
A survey was conducted in fall 2014 to Missouri Grade A dairy farms and industry stakeholders. This survey was intended to gather their perspectives on producers' needs and characteristics of Missouri dairy farms. Section 3 provides a summary of all survey responses received.

Section 4: Value Chain, Marketing and Processing
Section 4 provides a discussion about dairy product demand and current opportunities to enhance the farmer's position in the value chain. Further processing opportunities and dairy niche marketing are discussed in this section.

Section 5: Comparative Analysis to Identify Gaps
What is the competiveness of Missouri's dairy industry versus other U.S. states? Section 5 seeks to create a common understanding of the Missouri dairy industry's competitive position, benchmark Missouri's dairy industry and environment against other states and look at ways that other states have attempted to revitalize their dairy industries.

Complete copies of all publications can be found at http://dairy.missouri.edu/revitalization/.

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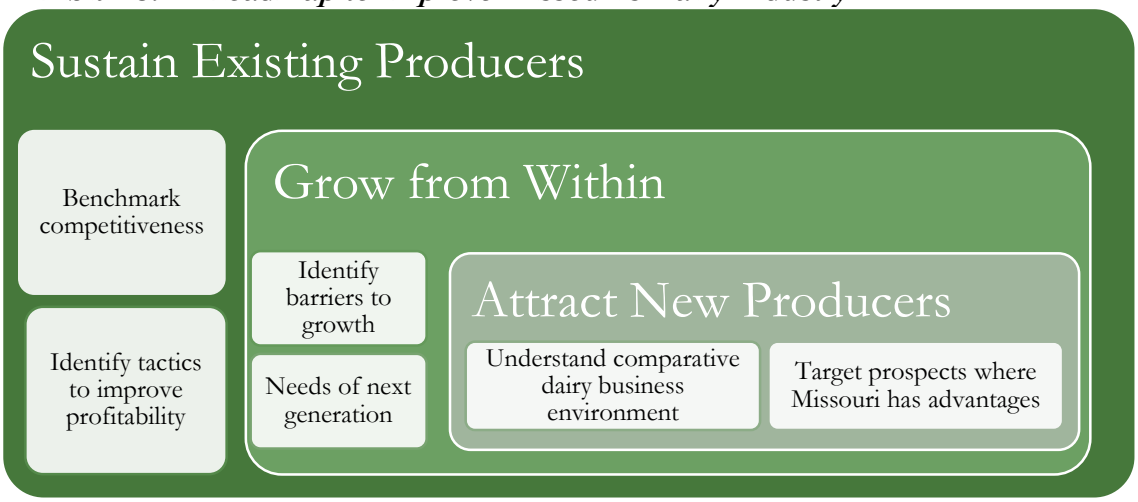
Missouri Dairy Industry Revitalization Study
Executive Summary

The number of Missouri's dairy farms and processing plants are declining slowly, as they have for decades. Unless reversed, the state will lose thousands of milk production and processing jobs. This Missouri Dairy Industry Revitalization Study examines the state of the Missouri dairy industry and offers producer and stakeholder ideas to reverse the decline. The Missouri Agricultural and Small Business Development Authority provided funding for the study and the University of Missouri dairy team conducted the study. This summary highlights key points and issues told in later sections.

Competitiveness of Missouri's Dairy Industry

An understanding of the dairy industry's competitive position is necessary for stakeholders to see changes needed to reverse the decline. Existing producers benchmarked against other producers identify areas to improve. For producers wanting to expand or for next-generation producers, seeing the barriers is important. For all stakeholders allied to the dairy industry, understanding how Missouri compares to other states in attracting new dairies is important. For Missouri to sustain and expand a dairy industry, existing producers, next-generation producers and new farmers recruited from outside the state are needed. Finally, learning how other states revitalize their dairy industries offers lessons.

Exhibit ES.1 – Roadmap to Improve Missouri's Dairy Industry



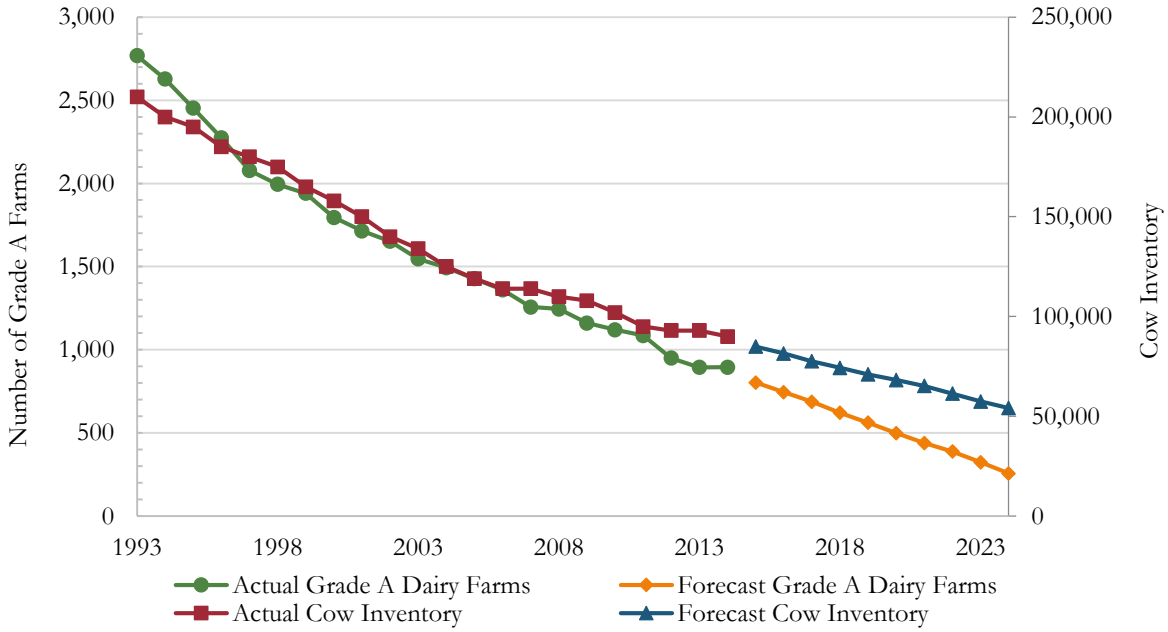
Missouri's Evolving Dairy Industry

In 1990, Missouri farms had 226,000 milk cows. By 2014, the milk cow count fell to 90,000 cows. While dairy farms are found throughout Missouri, most are in the South Central and Southwest regions. Missouri ranks 24th with other states in milk cows. In December 2014, 1,248 dairy farms operated in Missouri. Of these, 896 were Grade A, and 352 were manufacturing-grade, which includes Amish farms and some goat or sheep dairies. From 2000 to 2014, dairies fell 45.5 percent.

Milk production ranked 25th among other states in 2013. From 1990 to 2013, production fell from 3.04 billion pounds to 1.35 billion pounds. On a milk per cow basis, Missouri ranked 44th in 2013. One reason for the low rank is southern Missouri's reliance on pasture-based rather than confinement dairy systems.

Long-term projections suggest, unless current trends are reversed, fewer dairies will be in Missouri and the dairy cow numbers will drop. Exhibit ES.2 shows these forecasts. Since 1993, Grade A dairy farms in Missouri dropped 5.3 percent annually. Dairy cow numbers dropped 3.8 percent annually. Assuming these trends continue in the next decade, Grade A dairies in Missouri will fall from 896 to 257 and the milk cow numbers will drop to 54,166 cows in 2024.

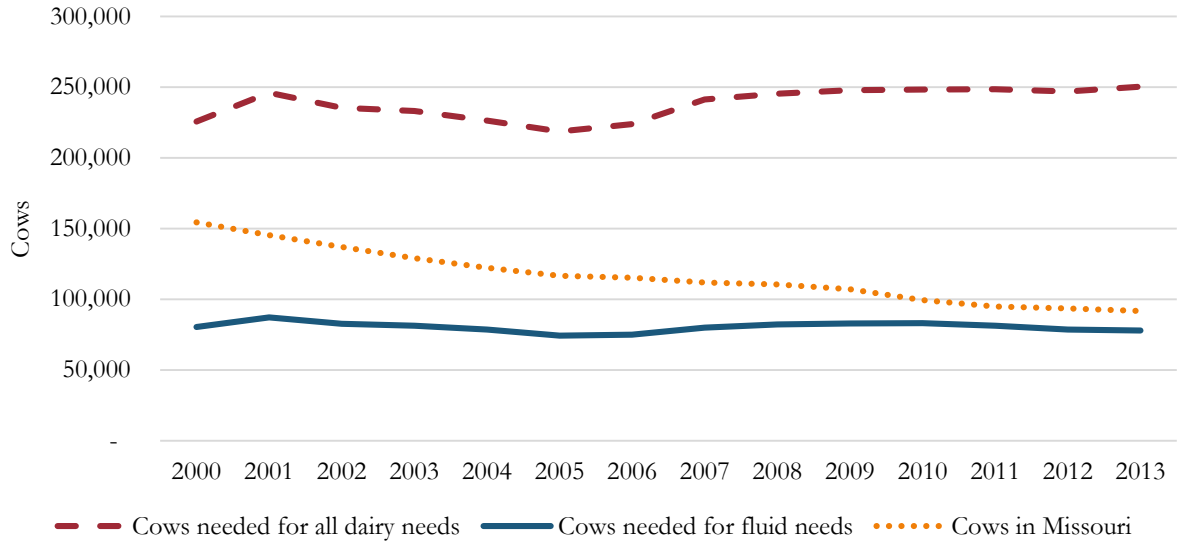
Exhibit ES.2 – Missouri Grade A Dairy Farms, Milk Cow Inventory, 1993 to 2014 and Forecasts through 2024



Dropping milk production in Missouri and closure of dairy manufacturing plants means that Missouri's dairy industry produced just enough milk to meet its fluid demands. National per capita fluid milk and cream use averaged 189 pounds in 2013. Thus, the state's dairy farms must produce 189 pounds of milk per person or import milk to satisfy in-state fluid milk needs. On a milk equivalent basis, per capita use of all dairy products in the U.S. averaged 607 pounds in 2013. Missouri produced 223 pounds of milk per capita in 2013, meeting the required 189 pounds of fluid milk per capita. However, Missouri production was deficient to meet the demand for all dairy products.

Exhibit ES.3 illustrates the difference between milk needs and supply in cows. The yellow dotted line illustrates the recorded change in Missouri milk cow numbers. The blue line estimates the milk cows needed to meet fluid milk needs. Missouri cows more than met the fluid milk needs between 2000 and 2013. But, note the gap between actual Missouri milk cow inventory and cows needed for fluid milk consumption has narrowed. The red dashed line shows Missouri needed about 250,000 milk cows in each of the past five years to produce milk to meet all dairy needs. Considering Missouri milk cow numbers fell below 100,000 the past three years, the state isn't close to having enough cows to meet milk needs for all dairy products.

Exhibit ES.3 – Missouri's Evolution toward a Fluid-Only Milk Supply, 2000 to 2013



As Missouri milk production dropped, dairy processing plants followed suit. In the past five years, the number of dairy product plants grew in the U.S. but fell in Missouri. Missouri had 47 dairy product plants in 2009. By 2013, they dropped to 36. The dairy plant trend reflects the food-industry trend to fewer, larger plants with higher volumes and lower costs. Large plants are a greater share of packaged food suppliers. However, small firms have adapted by filling market niches.

Missouri Dairy Producer Needs

In late 2014, an 18-question survey of all Grade A dairy producers in Missouri gathered their needs associated with growing the state's dairy industry. In all, 276 producers answered. Responses by district roughly represented the geographic distribution of Missouri dairy operations.

The top four dairy producer needs identified were:
1. Higher milk prices and profit margins,
2. More dairy infrastructure,
3. More competitive milk markets, and
4. Manage heat stress and other production issues.

The top four challenges for their farms were:
1. Labor,
2. Animal health,
3. Forage issues, and
4. Weather.

Regarding five-year plans for their dairy farms, 44 percent said they plan to continue operating as is. One-fourth plan to expand size by 10 to 50 percent. And 13.2 percent plan to quit. Smaller shares said that they would downsize (3.5%), expand less than 10 percent (7%) or expand more than 50 percent (7%).

People employed in the dairy industry were also surveyed at the same time on their views on dairy industry needs. Thirty-one stakeholders answered. Those were dairy cooperative field men, veterinarians, vendors and nutrition consultants. As in the producer survey, the stakeholder identified producer needs and greatest challenges. The top two needs they saw were higher profit margins and business/risk management. Stakeholders said financing and business management were the two greatest challenges for farmers.

Both producer and stakeholder surveys asked about Missouri dairy infrastructure and training needs. For producers, the top infrastructure concerns that present big problems now or may become problems were manure/lagoon spreading contractors, dairy equipment sales and service and dairy quality forage contractors.

From a list of 23 topics, producers and stakeholders were asked to rate training priorities. Producers said their top training priorities were reproductive management, mastitis prevention and treatment and forage quality improvement. Stakeholders named financial and business management, milk and feed price risk management, reproductive management and heat stress.

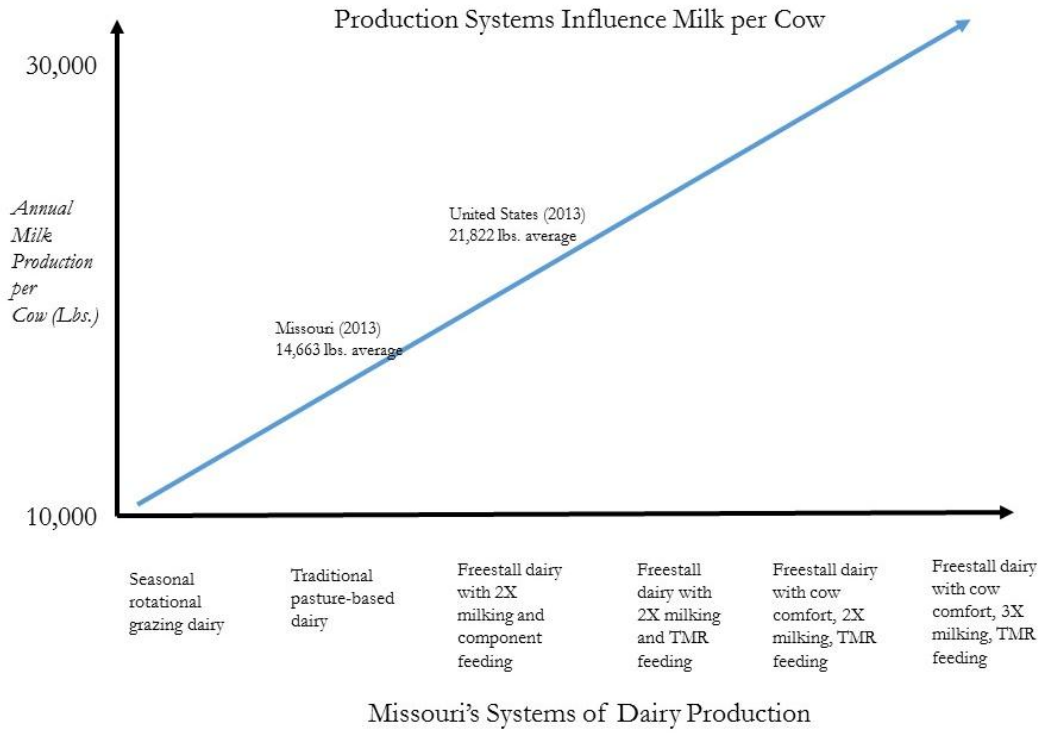
Current Competitive Landscape in Dairy Industry

Since 2007, dairy farming areas expanding in the U.S. include areas across western Texas, Southwestern Kansas, Northeastern Iowa, Minnesota, Wisconsin and Michigan. In Southeast, pockets of growth appear in Georgia and Florida. In Missouri, growth pockets from new, larger grazing dairies were in Southwest and Southeast Missouri. Other growth was in Mennonite areas near Versailles and Memphis, Missouri, and in West Central and North Central Missouri. Declines are in the Ozarks, mostly in South Central Missouri, which traditionally was Missouri's most dairy-dense area.

Missouri's dairy industry is a mix of distinct types of dairy farming. Traditionally, the Ozarks were home to pasture-based dairies. In Northern Missouri and counties along Missouri and Mississippi rivers, confinement or partial confinement dairies evolved. Soil types and cropping potential determined systems dairy producers chose over the decades. In the last 20 years, larger confinement farms appeared throughout Missouri. Rotational grazing dairies grew in the southern half of Missouri.

System choices impose different limits on milk production per cow. This diversity makes benchmarking Missouri's dairy farms more challenging than just comparing per-cow milk production. However looking at benchmarks may reveal relative strengths and weaknesses. Exhibit ES.4 depicts milk per cow seen in Missouri and the system of production associated with it, as well as the average production in Missouri and the U.S.

Exhibit ES.4 – Common Production Systems in Missouri and Relative Milk Production



Missouri lags national averages on key production indicators. These lags indicate ways for the Missouri dairy industry to compete with other states. For example, the Dairy Herd Improvement Association (DHIA) 2014 rolling per-cow herd average was 17,105 pounds in Missouri and 21,116 pounds in the U.S. Tactics to raise the rolling herd average include more dry matter intake and better forage quality, lower heat stress and better genetics. Other gaps include somatic cell count, which averaged 338,400 in Missouri and 262,900 in the U.S. in 2014. Calving interval, averaged 15.1 months in Missouri and 14.3 months in the U.S. in 2014.

Eight tactics can improve Missouri dairy farm profits. The eight tactics are summer heat stress abatement, better care for replacement heifers, forage quality, milk quality, better cow housing comfort, dry matter intake, reproductive management and economies of scale.

From a regulatory standpoint, dairies must adhere to water quality rules which vary by state. Some states also set air quality standards. Water quality regulations in Missouri, Iowa, Kansas, South Dakota and Wisconsin were compared. Among the five states, Iowa was the most complex. South Dakota rules were least complex. Missouri ranks near the bottom of those states in regulation complexity.

Township and/or county rules affect dairies and may eliminate potential growth. Health or zoning ordinances are used by local governments to add requirements and fees to animal feeding operations. In Missouri, 17 counties have county health ordinances, five have county zoning, three have township zoning and planning, and one has a county health ordinance and township zoning and planning.

Missouri is a riparian-water-law state. Landowners have a right to reasonably use water sources that touch or underlie their land. A landowner can draw as much water as needed as long as the withdrawal

does not adversely impact other individuals. Missouri water users who draw or divert more than 100,000 gallons per day (equivalent to 70 gallons per minute) from streams, rivers, lakes, wells, springs or other water sources are considered major water users. Major water users must register their water use annually with the Missouri Department of Natural Resources. Groundwater availability in Missouri varies by geography. It is a strategic resource for agricultural producers.

Missouri Dairy Industry's Economic Contribution

Missouri dairy farm and dairy product plants give big dollar benefits to Missouri. In 2013, dairy farms generated $272.2 million in milk cash receipts. Missouri dairy farms provided a value-added impact of $131 million to Missouri's gross domestic product.

Dairy plants also contribute to the economy. During 2013, Missouri dairy plant employee wages totaled $275 million. Overall, the dairy plants in 2013 employed 5,354 people. Annual wages per employee averaged $51,340. The total direct, indirect and induced employment from dairy processing was 23,049 jobs. Total added to Missouri gross domestic product was nearly $2 billion. Missouri manufacturing plants produced $5.1 billion in sales.

Marketing and Processing Opportunities

In marketing and processing, milk may be used as a fluid product or made into dairy products. In the fluid market, milk lost traction with consumers between 1990 and 2013. Beverage milk sales dropped 5.2 percent. Opportunities for fluid milk include targeting active adults with flavored milk and developing milk-protein drinks. Fluid-milk use per capita is projected to decrease through 2023.

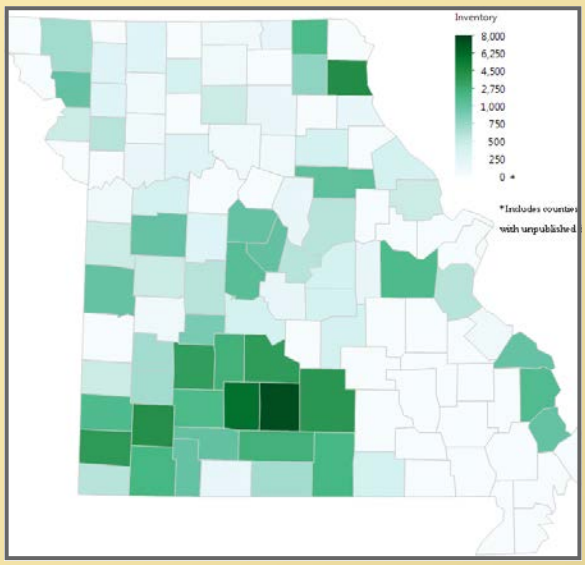
Producing and marketing branded products may be an option for selling milk at higher prices. Yogurt performs well. Greek yogurt especially gained use perhaps because of high-protein content. Butter use grew as consumers became comfortable choosing butter over margarine. Cheese consumption also continues to grow. Frozen consumption dropped 16.2 percent from 1990 to 2013.

Marketing differentiated products may include products with value-added traits. Such traits include products labeled: organic, natural, grass-fed, non-GMO and local. Other niche markets include heritage breeds, raw milk, lactose-free milk, milk with higher A2 beta-casein levels, dairies as agri-tourism, products based on protein content, exports and marketing milk from other species like goats.

For success, farm processing requires producers to learn to market and distribute products and operate and manage a dairy product plant. Farmstead processing includes risks most dairy farmers never see as commodity milk producers. New products must displace existing dairy products in the dairy case. Co-packing may be an option for those who want to create and brand a product but prefer to avoid capital investments. Co-packing allows more energy to be spent on marketing and less on operations.

For niche products, serving a market may involve relatively few participants who incur significant costs and risks to develop a brand and dairy products. Other opportunities may exist for virtual cooperatives to develop products, brands and co-packing agreements to reduce infrastructure costs to supply products in demand. However, existing dairy marketing coops may be reluctant to use member capital on risky new products. Proceeding without requests from food companies or retailers is risky. Producers wanting to develop and market value-added products should carefully research markets.

January 2015



Missouri Dairy Industry Revitalization Study

Section 1: Historical Perspective

UNIVERSITY OF MISSOURI
Extension
Commercial Agriculture Program

Missouri Dairy Industry Revitalization Study – *Section 1: Historical Perspective*

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Other publications from this study include:

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Section 2: Economic Contribution

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Section 5: Comparative Analysis to Identify Gaps

Complete copies of all publications can be found at http://dairy.missouri.edu/revitalization/.

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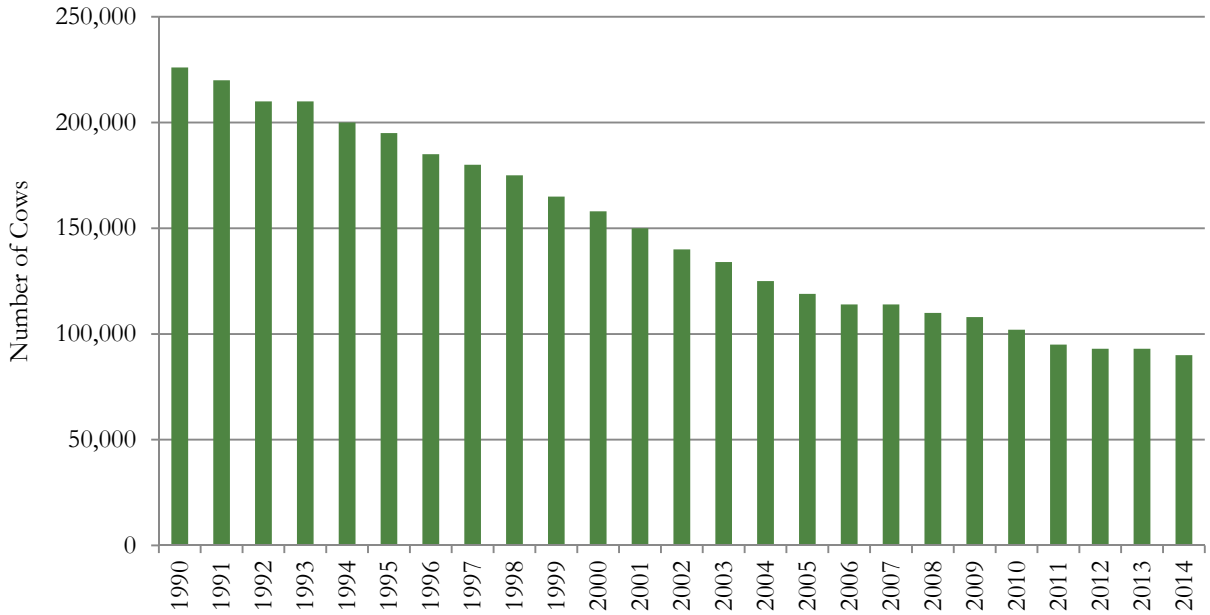
Missouri Dairy Industry Revitalization Study
Section 1: Historical Perspective

Table of Contents

1. Dairy Cow Inventory

The Missouri dairy cow inventory has decreased substantially during the past two decades. Exhibit 1.1 presents the Missouri dairy inventory trend for the past 25 years on Jan. 1 of each given year. During the 1990s and 2000s, the state's dairy cow inventory sharply declined. Since 2010, however, the inventory reductions have slowed. In 1990, Missouri farms maintained 226,000 milk cows. By 2014, the state's milk cow inventory had dropped 60.2 percent to 90,000 milk cows.

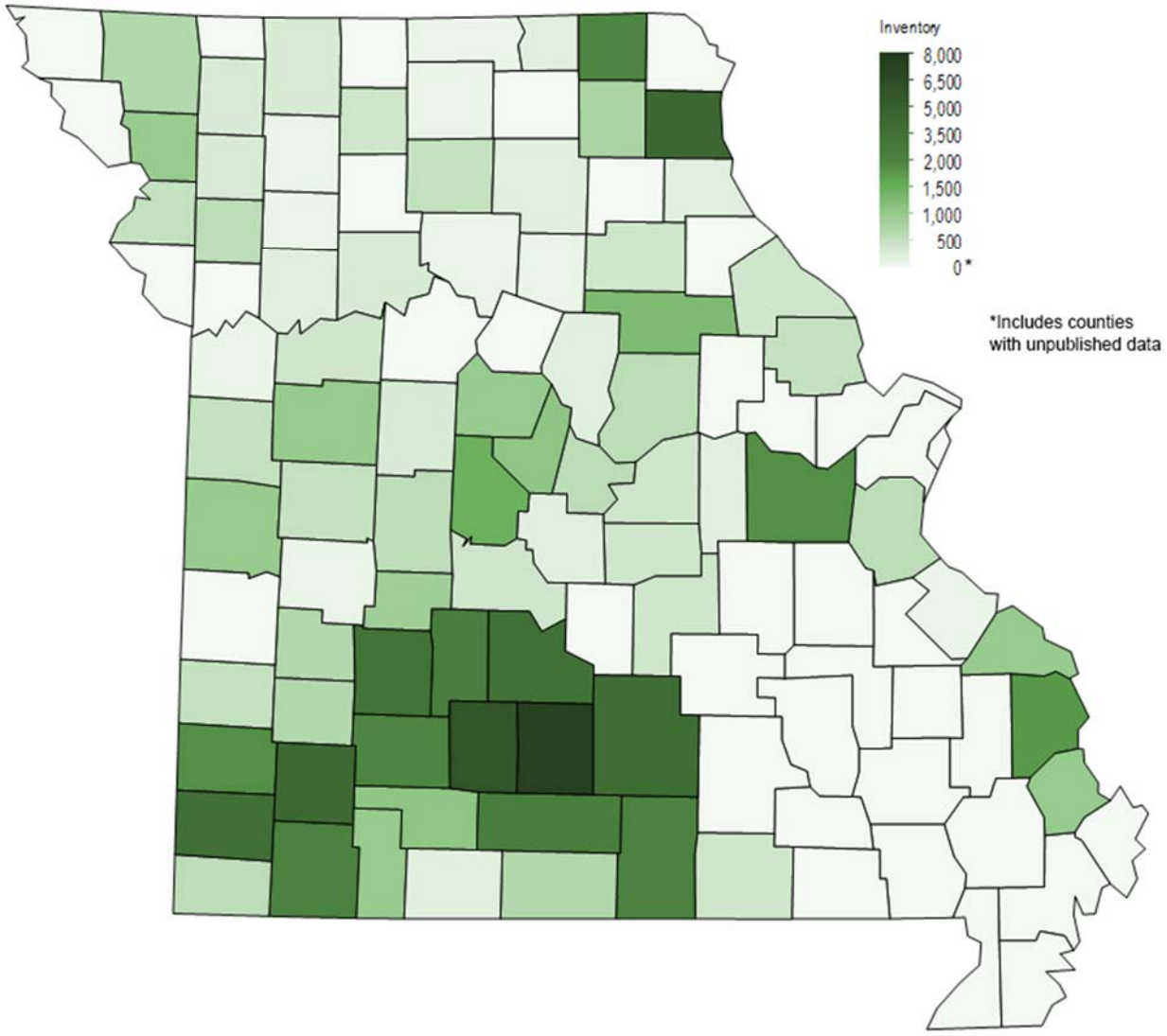
Exhibit 1.1 – Missouri Milk Cow Inventory, Jan. 1 Inventory, 1990 to 2014



Source: USDA, National Agricultural Statistics Service

Dairy cows are located throughout Missouri. However, the Missouri milk cow population tends to concentrate in the state's southwest and south central regions. During 2013, the five Missouri counties with the largest dairy cow inventories were Wright, Webster, Lawrence, Texas and Newton counties, though not all counties were reported. Exhibit 1.2 illustrates the distribution of dairy cows by county in 2013. Counties colored in white had fewer than 100 milk cows, or to avoid disclosing individual operation data, USDA didn't report data for the given county. Additionally, the authors added data for two counties that were not previously included based on personal knowledge. The appendix of this report includes USDA-reported dairy cow inventory data for each county.

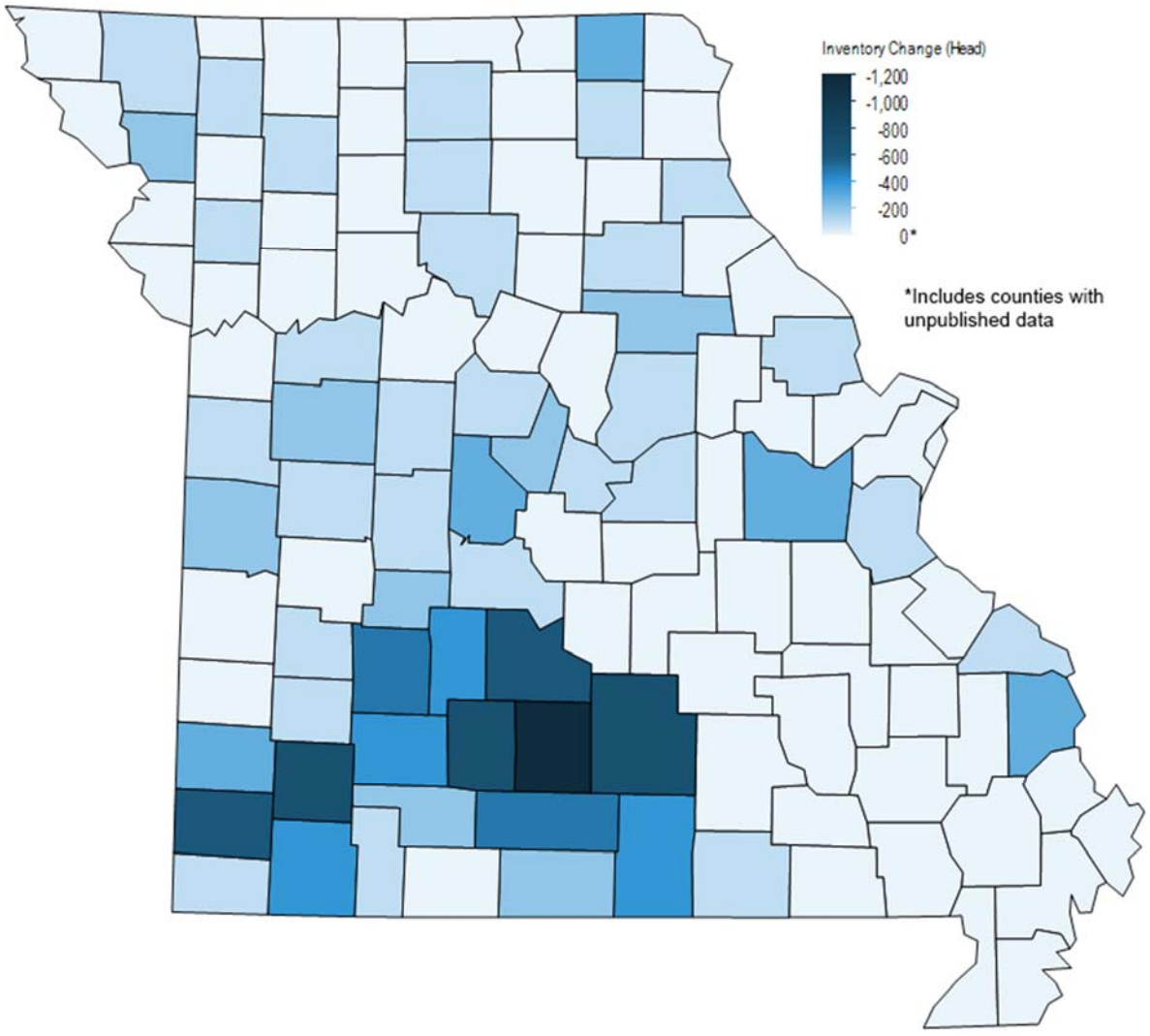
Exhibit 1.2 – Missouri Milk Cow Inventory by County, Jan. 1, 2013



Source: USDA, National Agricultural Statistics Service

Although many Missouri counties have recently experienced milk cow inventory reductions, the inventory changes have been most significant in south central and southwest Missouri. Exhibit 1.3 illustrates the change in Missouri milk cow inventory by county. Between 2009 and 2013, Missouri counties that decreased their milk cow inventories the most were Wright County, 1,200-cow reduction; Webster County, 900-cow reduction; Lawrence County, 700-cow reduction; Texas County, 700-cow reduction; Laclede County, 600-cow reduction; and Newton County, 600-cow reduction. Despite these counties leading the state in milk cow inventory contraction, they were still the state's six top counties for milk cow inventory in 2013. More than 20 counties didn't have a change in their milk cow inventory between 2009 and 2013.

Exhibit 1.3 – Missouri Milk Cow Inventory by County, Change from 2009 to 2013 (5-Year), Number of Cows



Source: USDA, National Agricultural Statistics Service

On Jan. 1, 2014, Missouri's dairy herd represented 1 percent of total U.S. milk cow inventory. Exhibit 1.4 lists dairy cow inventory data for Missouri and its surrounding states, and it also shares each state's milk cow inventory as a share of U.S. inventory. Of Missouri and its surrounding states, those with the largest milk cow inventories, as a share of the total U.S. herd, were Iowa, 2.2 percent; Kansas, 1.5 percent; Illinois, 1 percent; and Missouri, 1 percent. Missouri and its surrounding states collectively represented 8.1 percent of the U.S. dairy herd on Jan. 1, 2014. A decade earlier, they maintained nearly 10 percent of the U.S. herd on Jan. 1, 2004, which indicates that they decreased their share of the U.S. dairy cow herd by nearly 2 percentage points between 2004 and 2014.

Exhibit 1.4 – Milk Cow Inventory in Missouri and Surrounding States, Jan. 1, 2014

State	Inventory	% of U.S. Inventory
Iowa	205,000	2.2%
Kansas	136,000	1.5%
Illinois	96,000	1.0%
Missouri	90,000	1.0%
Kentucky	68,000	0.7%
Nebraska	53,000	0.6%
Tennessee	46,000	0.5%
Oklahoma	45,000	0.5%
Arkansas	8,000	0.1%

Source: USDA, National Agricultural Statistics Service

California, Wisconsin and New York led as the three U.S. states that maintained the largest dairy cattle inventories on Jan. 1, 2014. Their shares of the total U.S. inventory were 19.3 percent, 13.8 percent and 6.7 percent, respectively, in 2014. See Exhibit 1.5. Other states that were home to at least 5 percent of the U.S. milk cow inventory on Jan. 1, 2014, were Idaho, 6.1 percent; Pennsylvania, 5.8 percent; and Minnesota, 5 percent. Collectively, the top 10 states for milk cow inventory represented 72 percent of the U.S. dairy cattle herd at the beginning of 2014.

Exhibit 1.5 – Top 10 States for Milk Cow Inventory, Jan. 1, 2014

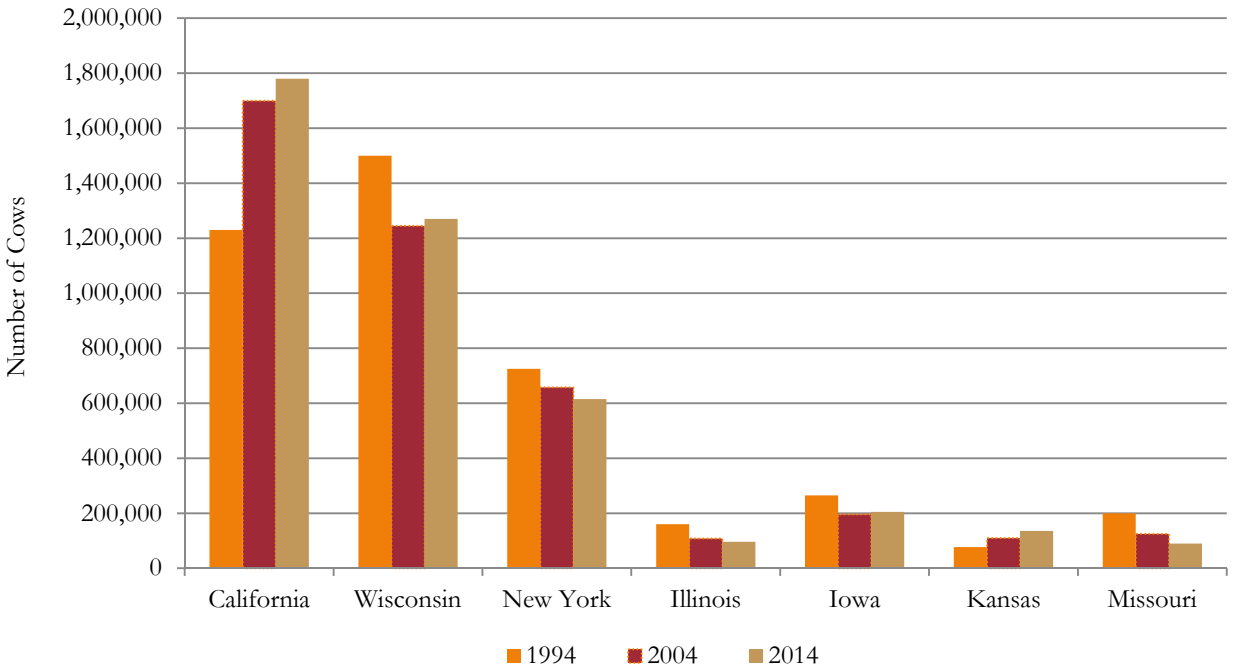
State	Inventory	% of U.S. Inventory
California	1,780,000	19.3%
Wisconsin	1,270,000	13.8%
New York	615,000	6.7%
Idaho	565,000	6.1%
Pennsylvania	530,000	5.8%
Minnesota	460,000	5.0%
Texas	440,000	4.8%
Michigan	381,000	4.1%
New Mexico	323,000	3.5%
Ohio	267,000	2.9%

Source: USDA, National Agricultural Statistics Service

In 2004, the same states ranked in the top 10 for milk cow inventory, though the order for some states varied somewhat in 2004 compared with 2014. Based on Jan. 1, 2004, data, the top 10 states for milk cow inventory represented 69.5 percent of the total U.S. dairy herd. Thus, these states increased their share of the U.S. dairy herd by 2.5 percentage points between 2004 and 2014, and the U.S. dairy industry became more geographically concentrated.

Exhibit 1.6 illustrates milk cow inventory of the past three decades for the three top dairy cow states in the U.S., the three top dairy cow states that border Missouri and Missouri itself. The graphic indicates that three of the selected states reduced their dairy cow inventories each period during the observed time period: New York, Illinois and Missouri. California and Kansas increased their dairy cow inventory from 1994 to 2004 and from 2004 to 2014. For Wisconsin and Iowa, dairy cow inventory dropped from 1994 to 2004, but it rebounded slightly from 2004 to 2014.

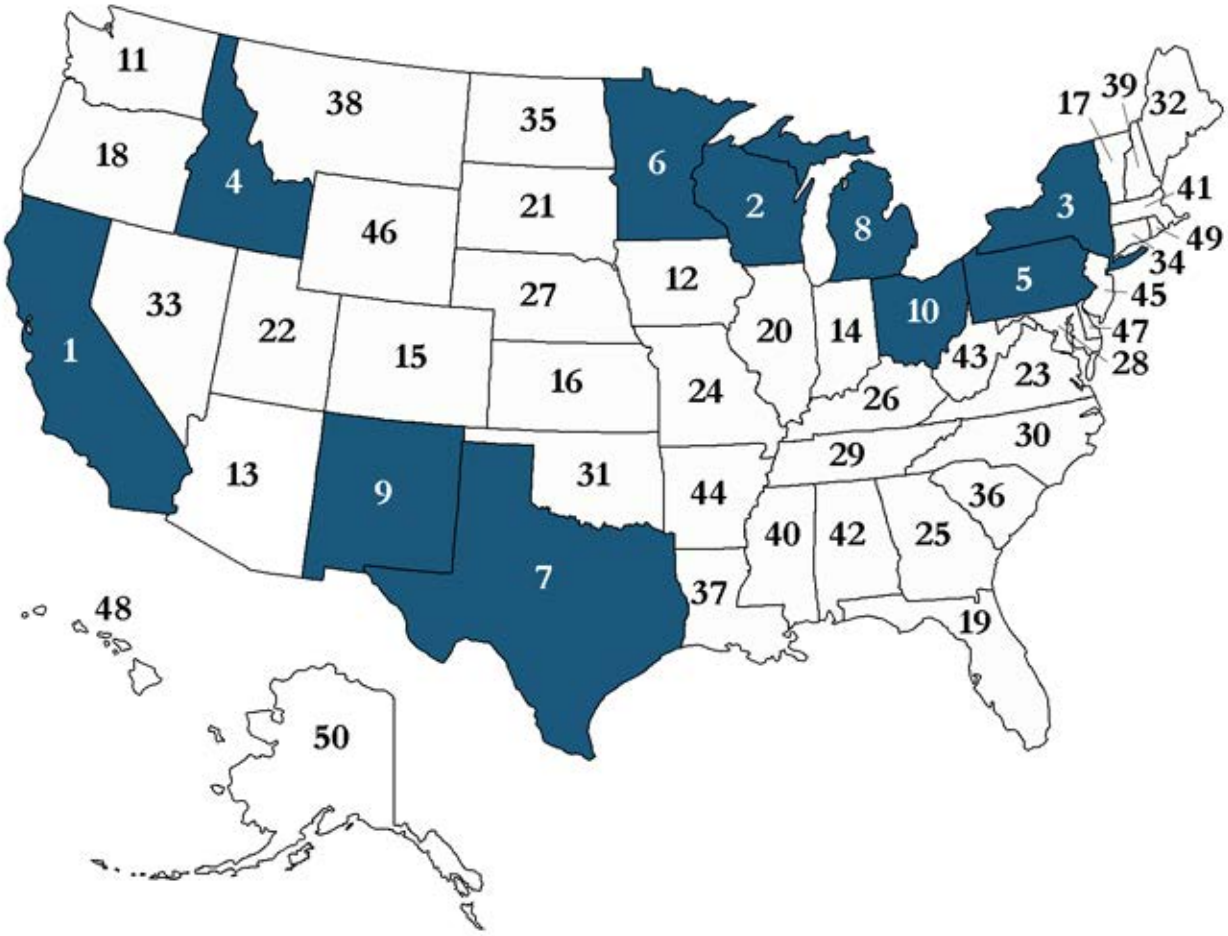
Exhibit 1.6 - Milk Cow Inventory for Selected States, Jan. 1, 1994, 2004 and 2014



Source: USDA, National Agricultural Statistics Service

Graphically, Exhibit 1.7 illustrates each state's rank for milk cow inventory on Jan. 1, 2014, and it highlights states ranked in the top 10 for milk cow inventory. The top 10 states concentrate in the West, Great Lakes, mid-Atlantic and Southwest regions. Missouri ranked as No. 24 for milk cow inventory. Of the states that neighbor Missouri, Iowa and Kansas had the higher rankings – No. 12 and No. 16, respectively – for dairy cow inventory on Jan. 1, 2014.

Exhibit 1.7 - Milk Cow Inventory, Jan. 1, 2014, Rankings by State and Top 10 States Highlighted



Source: USDA, National Agricultural Statistics Service

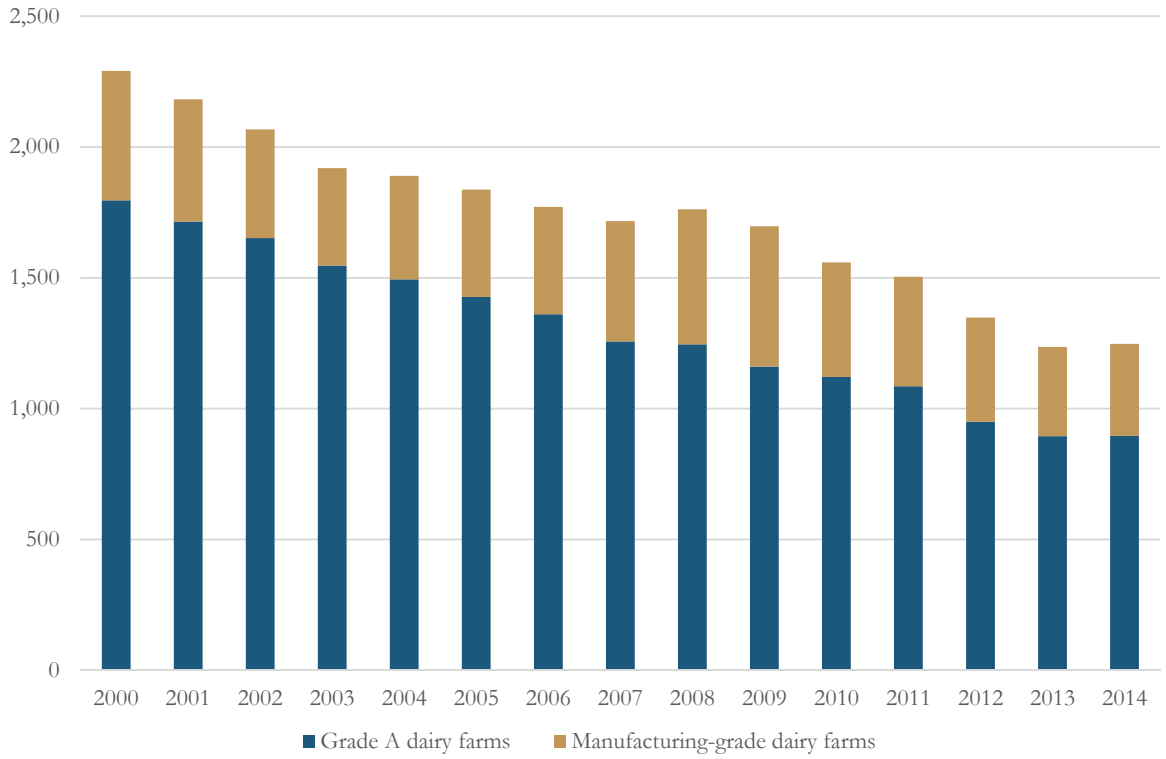
2. Dairy Farms

2.1 Number of Farms

In Missouri, commercial dairy farms either sell permitted "Grade A" milk or "manufacturing grade" milk. Grade A milk refers to milk produced under conditions to meet fluid milk consumption standards. Manufacturing grade milk refers to milk that does not meet the conditions for fluid milk consumption and can be used in cheese, butter and nonfat dry milk.

In December 2014, 1,248 permitted dairy farms operated in Missouri. Of these, 896 were Grade A dairy farms, and 352 were manufacturing-grade dairy farms, which mostly included Amish operations and some goat or sheep dairies. Since 2000, the number of commercial dairy farms operating in Missouri has consistently declined. See Exhibit 2.1.1. Between 2000 and 2014, the total number of Missouri commercial dairies decreased by 45.5 percent. Only three percent of the milk marketed in Missouri was from manufacturing-grade operations in the year 2013. As of December 2014, the closing of cheese plants in Missouri and nearby states casts doubts of the long-term marketability of Missouri manufacturing-grade milk.

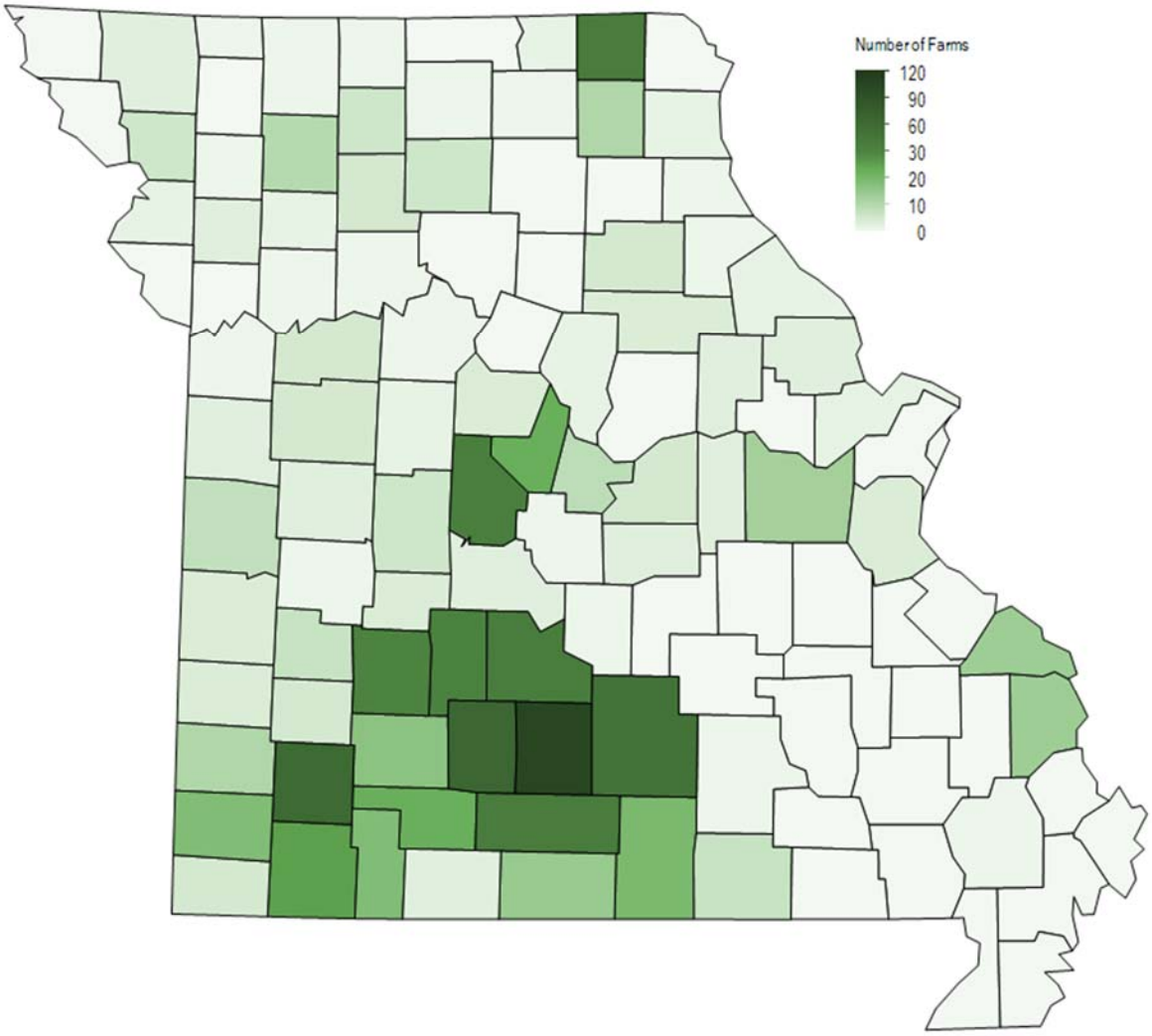
Exhibit 2.1.1 – Number of Missouri Commercial Dairy Operations in Missouri, 2000 to 2014



Source: Missouri State Milk Board

Exhibit 2.1.2 presents the number of Grade A dairy farms, which market milk within the federal order marketing system. During December 2012, the counties with the most farms marketing milk within the federal order system were Wright County, 108 farms; Webster County, 67 farms; Lawrence County, 64 farms; Texas County, 52 farms; Scotland County, 41 farms; and Douglas County, 41 farms. Missouri counties that have the most Grade A dairy farms also tend to rank highly in milk cow inventory. Of the six counties ranked highest for dairy farms with federal order milk marketings during December 2012, four ranked in the top five Missouri counties for milk cow inventory on Jan. 1, 2013. The appendix of this report lists the number of Grade A farms by county from 2000 to 2012.

Exhibit 2.1.2 –Missouri Farms with Federal Order Milk Marketings, December 2012



Source: Central Milk Market Administrator's Office

2.2 Farm and Herd Characteristics

For Missouri, the 2012 U.S. Census of Agriculture reported that 1,153 farms operated in the dairy cattle and milk production industry, designated by the North American Industry Classification System code 11212. Exhibit 2.2.1 summarizes some characteristics of the Missouri farms in this industry. In 2012, these farms maintained 407,812 acres, and they harvested 157,463 acres of cropland. On average, the market value of land and building capital assets per farm exceeded $815,000, and the machinery and equipment capital asset market value per farm was more than $131,000. The "Per Cow" column represents the "Total" column numbers divided by the milk cow inventory or average herd size in Missouri.

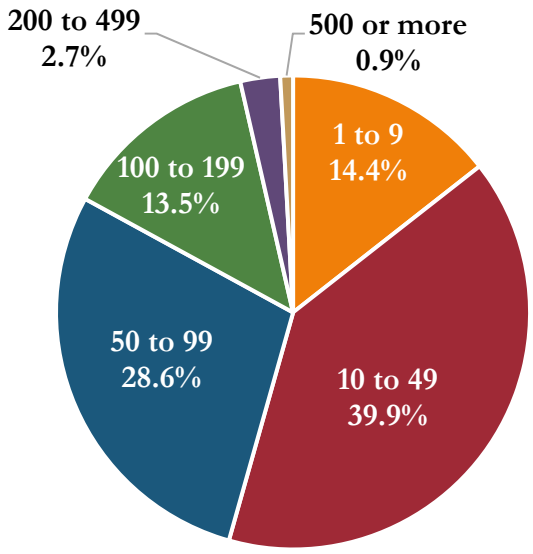
Exhibit 2.2.1 – Characteristics of Missouri Dairy Cattle and Milk Production Farms by NAICS Classification System (11212), 2012

	Total	Per Cow	Units
Farms	1,153		farms
Land in farms	407,812	4.86	acres
Harvested cropland	157,463	1.88	acres
Estimated average market value of land and buildings per farm	$815,062	$11,165	dollars
Estimated average market value of machinery and equipment per farm	$131,073	$1,796	dollars
Market value of agricultural products sold, total sales	$290,236	$3,976	thousand dollars

Source: Derived from USDA, National Agricultural Statistics Service, Census of Agriculture

Of the Missouri farms included in the dairy cattle and milk production NAICS category, the census found that 68.5 percent had operations with 10 milk cows to 99 milk cows. Exhibit 2.2.2 illustrates the distribution of Missouri dairy cattle and milk production farms by their milk cow inventory. Based on these data, 17.1 percent of farms had at least 100 milk cows, and 14.4 percent of farms had fewer than 10 milk cows. Most farms with one to nine cows are Amish operations, family operations producing milk for home consumption or operations with nurse cows for bottle calves.

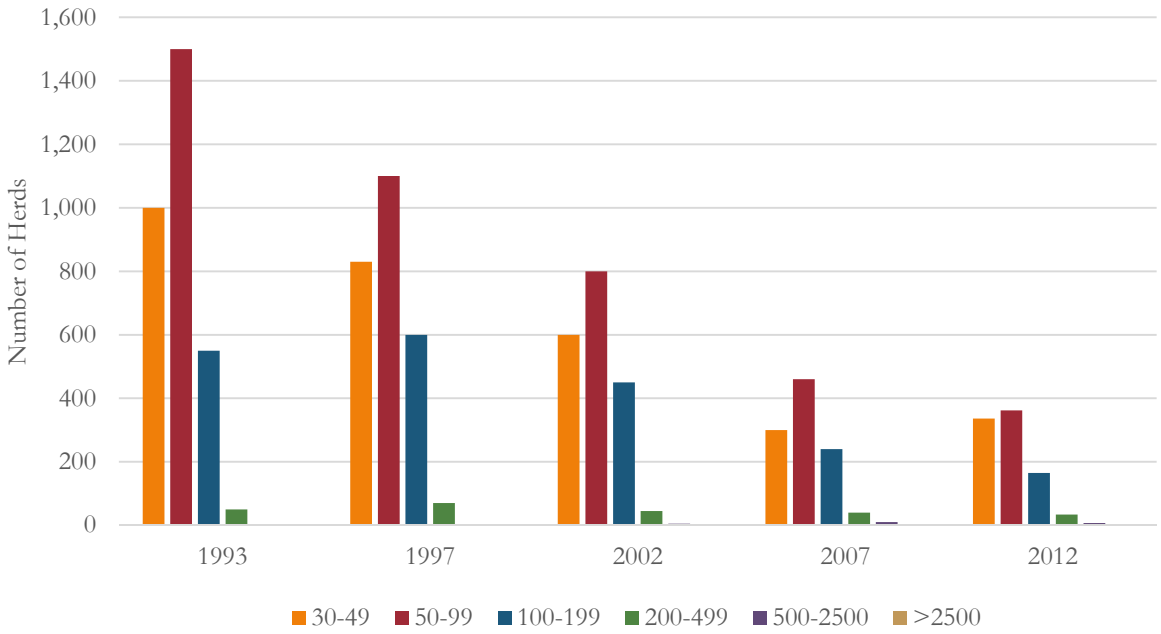
Exhibit 2.2.2 – Milk Cow Inventory Distribution of Missouri Dairy Cattle and Milk Production Farms by NAICS Classification System (Code 11212), 2012



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

Exhibit 2.2.3 illustrates changes in Missouri dairy farm herd size distribution from 1993 to 2012. In all years observed, Missouri herds were predominantly 50- to 99-cow operations. During the time period analyzed, however, the differences in number of herds with 50 to 99 cows and number of herds in other size categories have narrowed. In 2012, Missouri recorded 336 herds with 20 to 49 cows, 362 herds with 50 to 99 cows, 165 herds with 100 to 199 cows, 34 herds with 200 to 499 cows, seven herds with 500 to 2,500 cows and three herds with more than 2,500 cows.

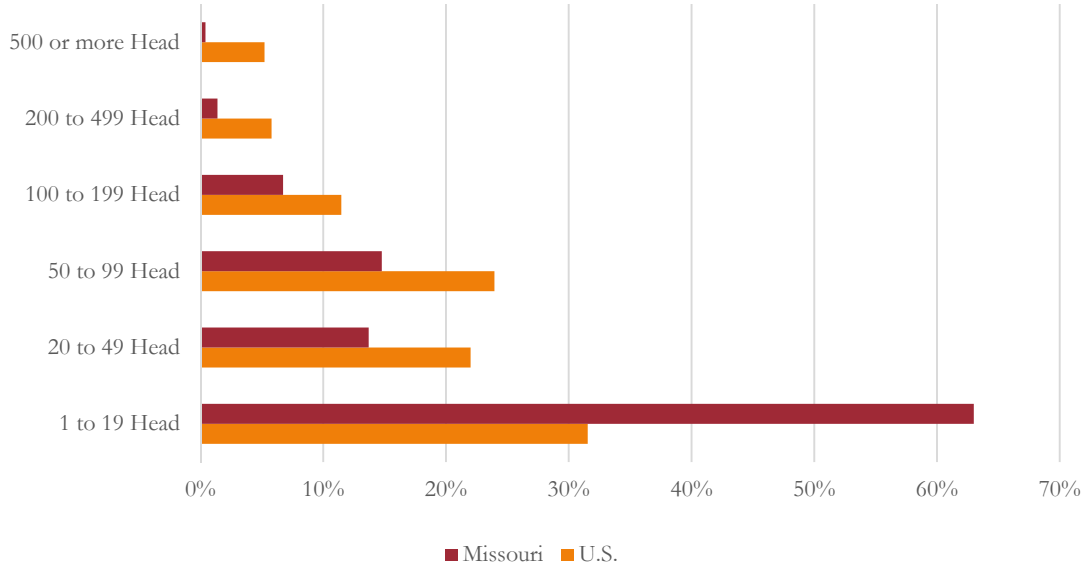
Exhibit 2.2.3 – Missouri Dairy Farm Herd Size Distribution, 1993 to 2012



Notes: Prior to 2000, 500 was the top herd size. Beginning in 2012, the 30-49 category shifted to 20-49 head category
Source: USDA, National Agricultural Statistics Service

To compare Missouri and U.S. dairy herds, Exhibit 2.2.4 evaluates the two based on the percent of operations that fit into various herd size categories during 2012. In all categories shown in Exhibit 2.2.4 – they range from 20 to 49 head to 500 or more head – the U.S. has a greater share of operations reporting the various herd sizes. Based on these data, relatively small shares of Missouri and U.S. dairy herds have more than 100 head. Instead, greater shares reported herd sizes in the smaller two categories. For example, 14.8 percent of Missouri operations and 23.9 percent of U.S. operations reported herd sizes that ranged from 50- to 99-head. In Missouri, 13.7 percent of operations shared that they have a 20- to 49-head herd size, and 22 percent of U.S. operations identified that their herd size was in this range. Missouri only has a few operations larger than 500 cows.

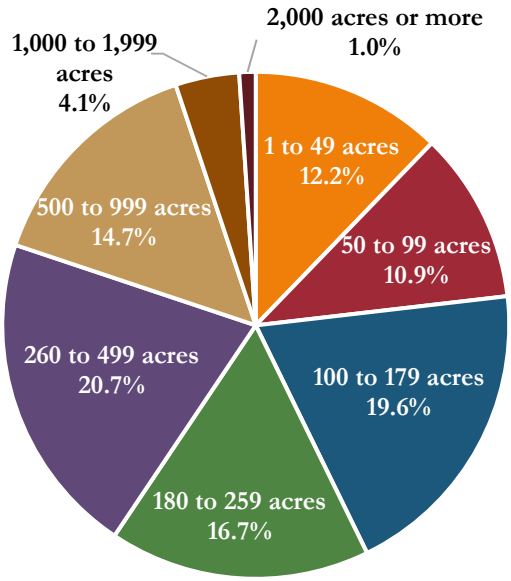
Exhibit 2.2.4 – Missouri and U.S Dairy Herd Size Distribution, Pct. of Operations, 2012



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

Missouri dairy cattle and milk production farms have diverse land holdings. Exhibit 2.2.5 shares the distribution of these farms by acreage category. In 2012, 57 percent of Missouri dairy cattle and milk production farms maintained between 100 acres and 499 acres, 23.1 percent maintained less than 100 acres and 19.8 percent maintained at least 500 acres in 2012.

Exhibit 2.2.5 – Acreage of Missouri Dairy Cattle and Milk Production Farms by NAICS Classification System (11212), 2012



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

2.3 Dairy Farm Operator Characteristics

Missouri dairy principal operators are predominantly white. Exhibit 2.3.1 shares Missouri principal operator race, gender, ethnicity and primary occupation data from 2012. Regarding race, three Missouri principal dairy operators reported having American Indian or Alaska Native heritage, and five principal operators reported more than one race. Otherwise, all others reported being white. Of the 1,153 principal dairy farm operators in Missouri during 2012, 7.5 percent were women. Just eight principal operators reported having Spanish, Hispanic or Latino origin. Of the Missouri principal operators in the dairy cattle and milk production farms industry, 79.4 percent indicated that farming was their primary occupation.

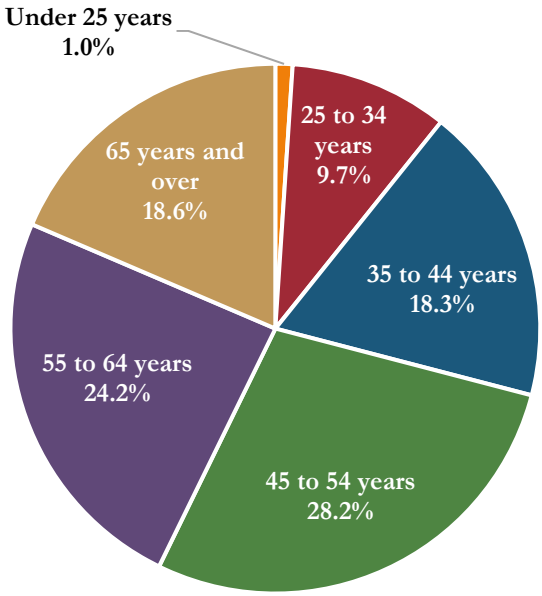
Exhibit 2.3.1 – Principal Operator Characteristics of Missouri Dairy Cattle and Milk Production Farms by NAICS Classification System (Code 11212), 2012

	Number	Percent
Race		
American Indian or Alaska Native	3	0.3%
Asian	--	0.0%
Black or African American	--	0.0%
Native Hawaiian or other Pacific Islander	--	0.0%
White	1,145	99.3%
Operators reporting more than one race	5	0.4%
Gender		
Male	1,066	92.5%
Women	87	7.5%
Ethnicity		
Spanish, Hispanic or Latino origin	8	0.7%
Primary Occupation		
Farming	916	79.4%
Other	237	20.6%
Total	**1,153**	

Source: USDA, National Agricultural Statistics Service, Census of Agriculture

Based on 2012 data from the U.S. Census of Agriculture, 42.8 percent of Missouri dairy cattle and milk production farm principal operators were at least 55 years old. See Exhibit 2.3.2. The 45- to 54-year-old segment represented 28.2 percent of all principal operators. Just 29 percent of the principal operators were younger than 45. These data indicate that Missouri dairy farm principal operators tend to be an older group. In the future, secession may become increasingly important to address.

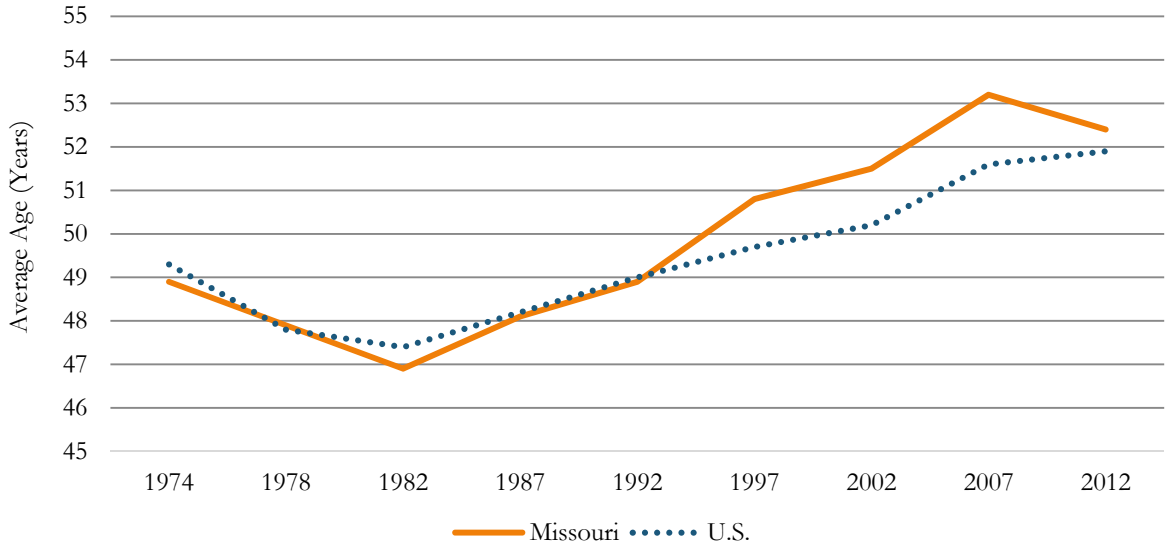
Exhibit 2.3.2 – Age Distribution of Missouri Dairy Cattle and Milk Production Farm Principal Operators by NAICS Classification System (Code 11212), 2012



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

Over time, the average age of Missouri and U.S. dairy cattle and milk production farm operators has increased. Until the late 1990s, Missouri and U.S. dairy cattle and milk production farm operators tended to have similar average ages. Exhibit 2.3.3 illustrates the trend in operator average age since 1974. In the late 1990s, however, the Missouri and U.S. operator average ages slightly increased their variance. Based on USDA Census of Agriculture data, the Missouri average operator age increased to be one year to 1.5 years older than the U.S. average. This difference in average age narrowed in the most recent census when the average Missouri dairy cattle and milk production farm operator was 52.4 years old, and the U.S. average was 51.9 years old.

Exhibit 2.3.3 – Trend in Missouri and U.S. Average Age of Dairy Cattle and Milk Production Farm Operators (NAICS Code 11212)



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

During 2012, 52.6 percent of Missouri dairy farms had Internet access. By comparison, 62 percent of all Missouri farms indicated having Internet access during 2013, based on a USDA National Agricultural Statistics Service report, and the U.S. Census Bureau reported that 74.8 percent of U.S. households had home Internet access during 2012. Thus, Missouri dairy farms tend to lag all U.S. households and all Missouri farms in connecting to the Internet. Exhibit 2.3.4 shares details about Missouri dairy cattle and milk production farms' access to the Internet. To connect to the Internet, DSL and satellite were the most popular service options that Missouri dairy cattle and milk production farms used in 2012. Mobile broadband and dial-up service were also relatively popular Internet access options for Missouri dairy farms.

Exhibit 2.3.4 – Internet Access of Missouri Dairy Cattle and Milk Production Farms by NAICS Classification System (Code 11212), 2012

Category	Total	% of All Dairy Farms
Internet Access	607	52.6%
Dial-up service	85	7.4%
DSL service	274	23.8%
Cable modem service	41	3.6%
Fiber-optic service	16	1.4%
Mobile broadband (computer or cell phone)	105	9.1%
Satellite service	145	12.6%
Broadband over power lines (BPL)	6	0.5%
Other Internet service	24	2.1%

Source: USDA, National Agricultural Statistics Service, Census of Agriculture

2.4 Dairy Farm Business Structure

Most Missouri farms categorized in the dairy cattle and milk production industry have organized as family or individual farms. Such family or individual farms represented 85.3 percent of all Missouri dairy cattle and milk production farms in 2012. See Exhibit 2.4.1. Other Missouri dairies have more formally organized as partnerships, 9.1 percent; corporations, 3.3 percent; and other structures, which include cooperatives, estates or trusts, institutions or other entities, 2.3 percent.

Exhibit 2.4.1 – Legal Status of Missouri Dairy Cattle and Milk Production Farms by NAICS Classification System (11212), 2012

	Farms	
	Number	**Percent**
Family or individual	984	85.3%
Partnership	105	9.1%
Registered under state law	60	5.2%
Corporation	38	3.3%
Family held	36	3.1%
10 or fewer stockholders	35	3.0%
More than 10 stockholders	1	0.1%
Other than family held	2	0.2%
10 or fewer stockholders	2	0.2%
Other	26	2.3%
Total	**1,153**	100%

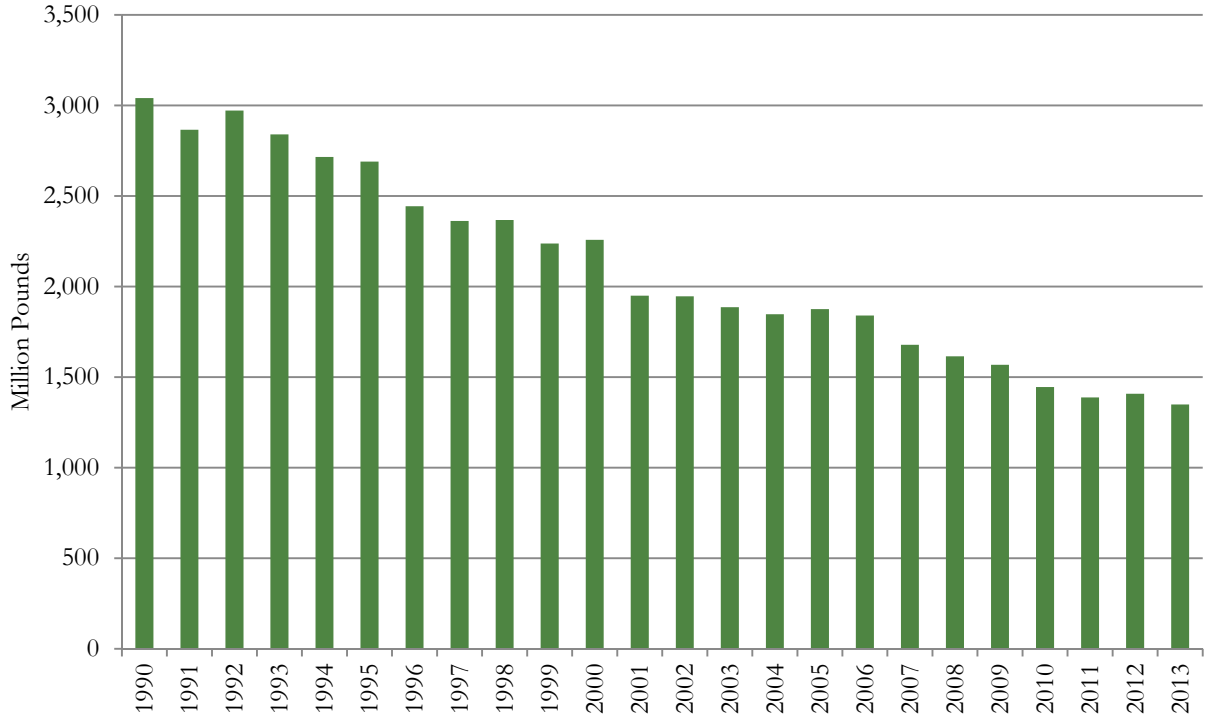
Source: USDA, National Agricultural Statistics Service, Census of Agriculture

3. Milk Production

3.1 Total Milk Production

Since 1990, Missouri milk production has trended downward. Exhibit 3.1.1 illustrates this milk production decline. Between 1990 and 2013, total Missouri milk production decreased by 55.6 percent, and milk yield per cow increased just 7.6 percent, compared with the national average of a 36.2 percent increase in milk production. A shrinking Missouri dairy herd and stagnant milk yield per cow are two factors contributing to the state's milk production decline. Lack of milk yield improvements may be attributed to pasture-based dairies gaining popularity in Missouri. Pasture-based dairies operate at lower milk production levels and contribute to lower milk yield per cow.

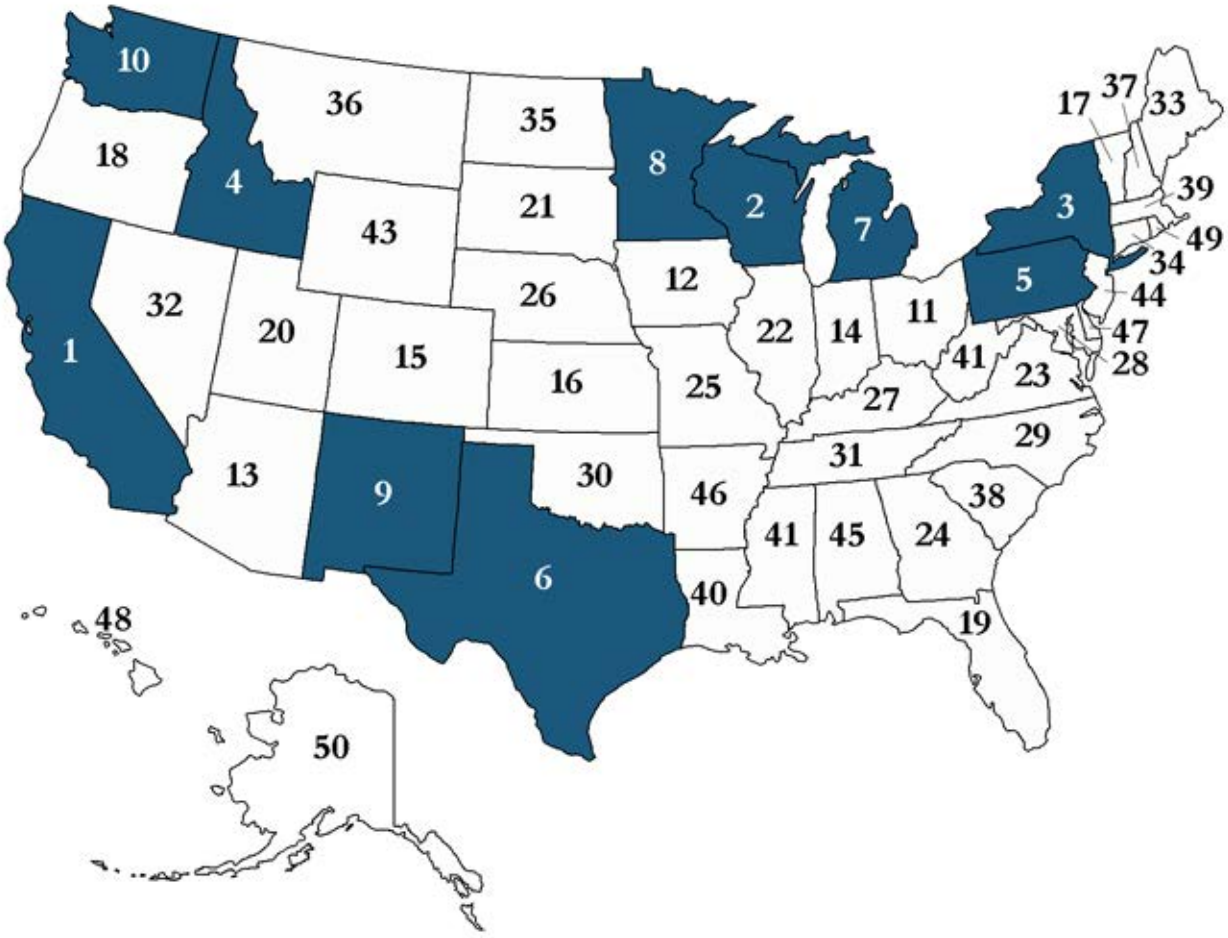
Exhibit 3.1.1 – Missouri Milk Production, 1990 to 2013



Source: USDA, National Agricultural Statistics Service

Relative to other states, Missouri ranked 25th for its milk production output during 2013. Exhibit 3.1.2 graphically depicts milk production rankings for all states, and it highlights states that rank in the top 10. States in the West, Southwest, Great Lakes and mid-Atlantic regions were represented for ranking in the top 10 for 2013 milk production. The three states that produced the most milk during 2013 were California, Wisconsin and New York.

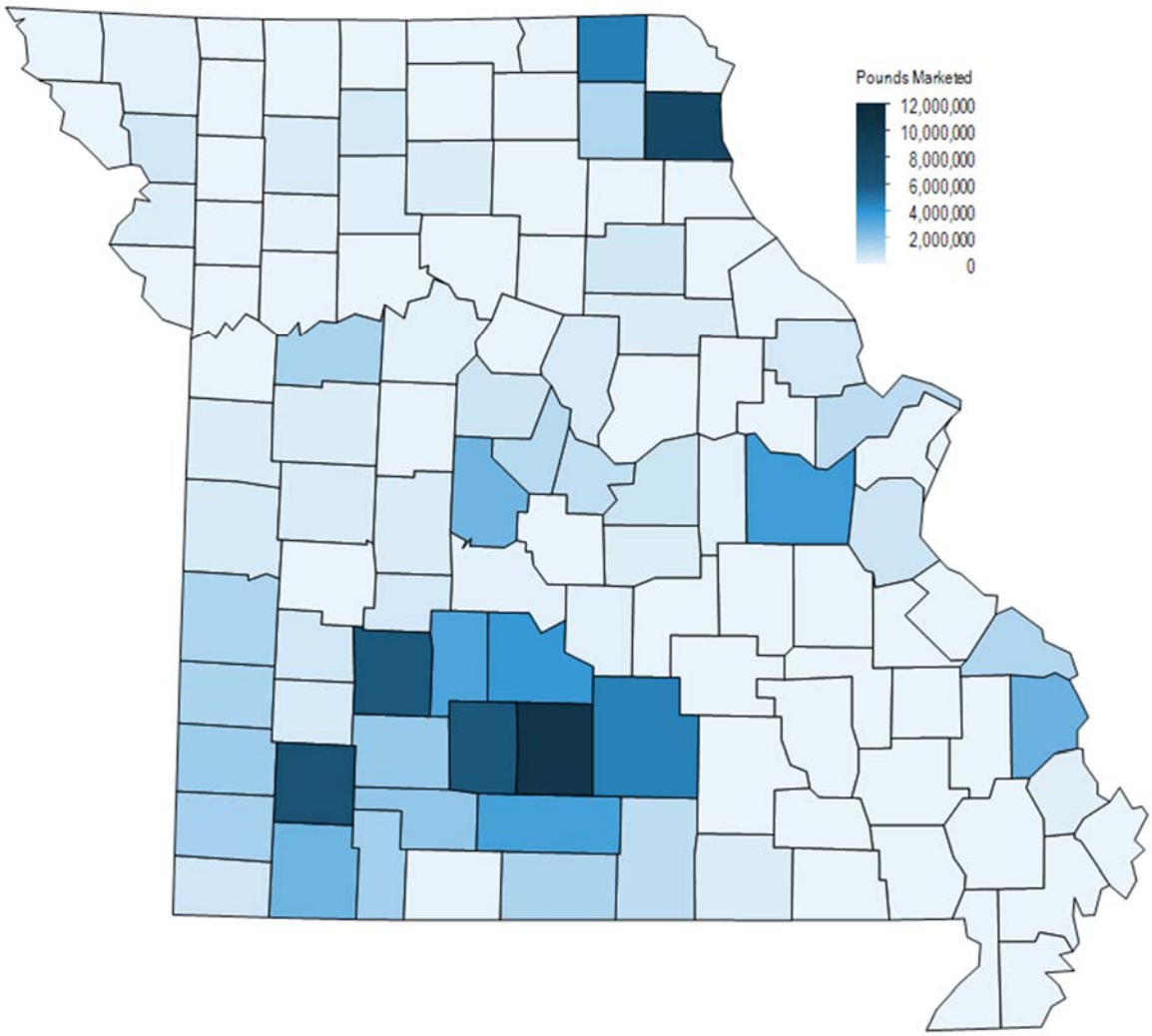
Exhibit 3.1.2 – Total Milk Production, 2013, Rankings by State and Top 10 States Highlighted



Source: USDA, National Agricultural Statistics Service

In Missouri, counties recognized for producing and marketing the greatest milk volumes in the federal order system tend to concentrate in the state's south central, southwest and northeast regions. Additionally, counties that neighbor the Missouri River to the south and Mississippi River also had more significant milk marketing volumes during December 2012 than counties in many other Missouri geographies. Exhibit 3.1.3 illustrates December 2012 federal order milk marketing volume data by county. Note that the data in Exhibit 3.1.3 represent milk marketed during December 2012. Because many seasonal pasture-based dairy operations dry off their herds in December, their production levels tend to be minimal in December compared with other months.

Exhibit 3.1.3 – Missouri Federal Order Milk Marketings, December 2012

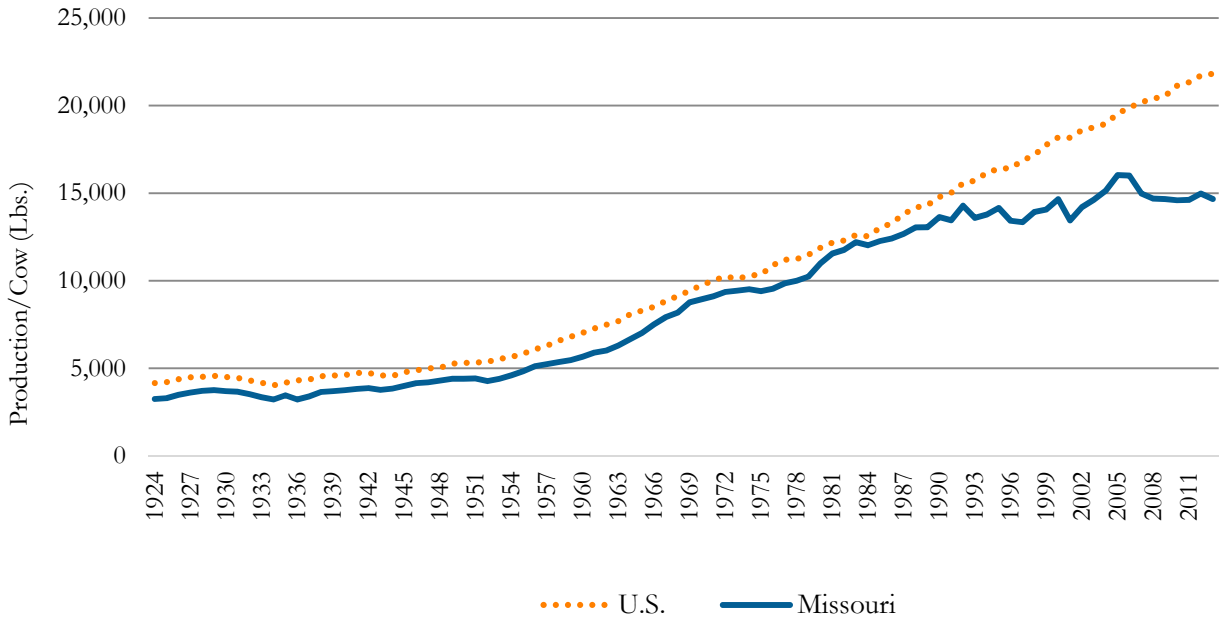


Source: Central Milk Market Administrator's Office

3.2 Milk Production per Cow

Since the 1920s, Missouri dairy cows have lagged U.S. dairy cows in average milk yield per cow. Exhibit 3.2.1 charts average milk yield per cow for Missouri and U.S. dairy cows. The graph indicates that the average U.S. dairy cow has consistently outperformed the average Missouri dairy cow based on milk yield per cow. Another trend noted in the milk yield data involves the recent widening deviation between the average U.S. and Missouri milk yield per cow. Since the 1990s, U.S. average milk yield per cow has continued a consistent growth trend. Growth in the average milk yield for Missouri cows began to slow during the 1990s and hasn't kept pace with the upward trend in average U.S. milk yield per cow. A common explanation for this Missouri deviation is the state's reliance upon pasture-based dairy systems rather than confinement systems. As national average milk production per cow surpassed 15,000 pounds in the early 1990s Missouri's lack of adoption of confinement systems restricted heat abatement and cow comfort technologies that enable higher milk production per cow.

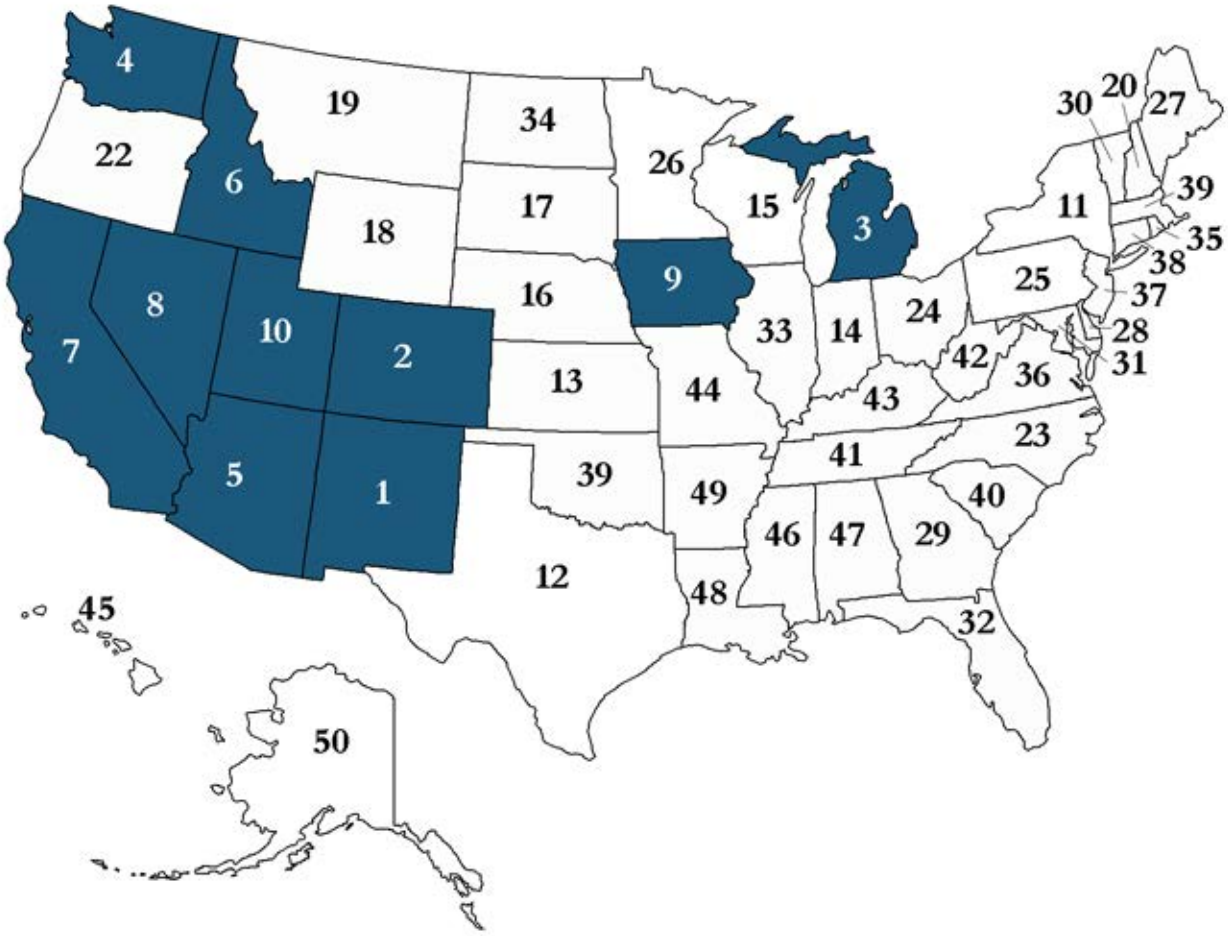
Exhibit 3.2.1 – U.S. and Missouri Milk Yield per Cow Trends, 1924 to 2013



Source: USDA, National Agricultural Statistics Service

Western states predominantly perform best from a milk production per cow perspective. Exhibit 3.2.2 depicts each state's rank in milk production per cow during 2013, and it highlights states ranked in the top 10. Although western states tend to rank higher for milk production per cow, Oregon notably lagged its neighboring states and ranked No. 22 during 2013. Two non-western states, Michigan and Iowa, were top-10 states for milk per cow during 2013. Compared with milk yield in other states, Missouri ranked 44th for milk production per cow. Since 2005, Missouri's large-scale adoption of low-input intensive rotational grazing dairying has decreased the state's average milk production per cow. Of its neighboring states, only Arkansas averaged lower milk output per cow than Missouri.

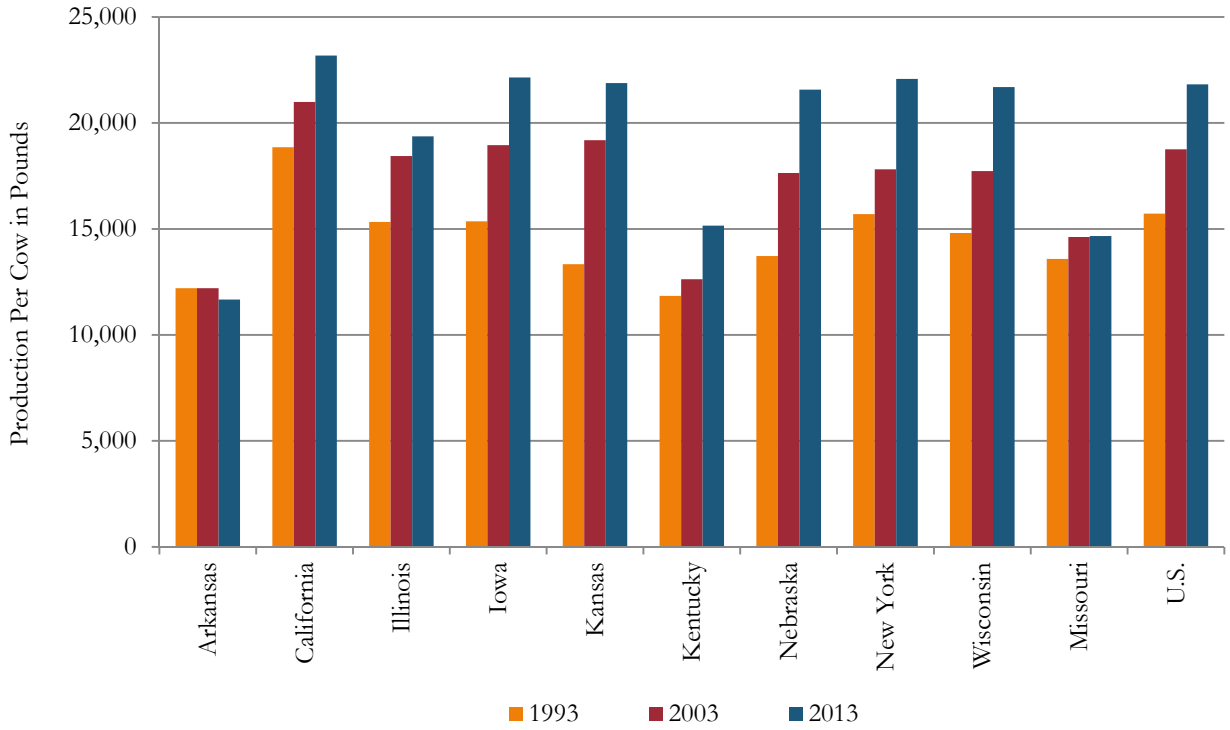
Exhibit 3.2.2 – Milk Production per Cow, 2013, Rankings by State and Top Ten States Highlighted



Source: USDA, National Agricultural Statistics Service

In 2013, U.S. milk production per cow averaged 21,822 pounds, which was 148.8 percent of Missouri's average of 14,663 pounds per cow. Exhibit 3.2.3 shows milk production per cow for the U.S., Missouri and selected states in 1993, 2003 and 2013. Between 1993 and 2013, milk production per cow accelerated in several states. Of the states shared in Exhibit 3.2.3, those with the greatest production output advances were Kansas, 64.1 percent; Nebraska, 57.2 percent; Wisconsin, 46.5 percent; and Iowa, 44.2 percent. By comparison, milk production per cow improvement has been less significant in Missouri. It gained just 7.9 percent between 1993 and 2013. Average U.S. milk production per cow increased 38.8 percent during the same period.

Exhibit 3.2.3 – Trends in Milk Yield per Cow for Selected States in 1993, 2003 and 2013

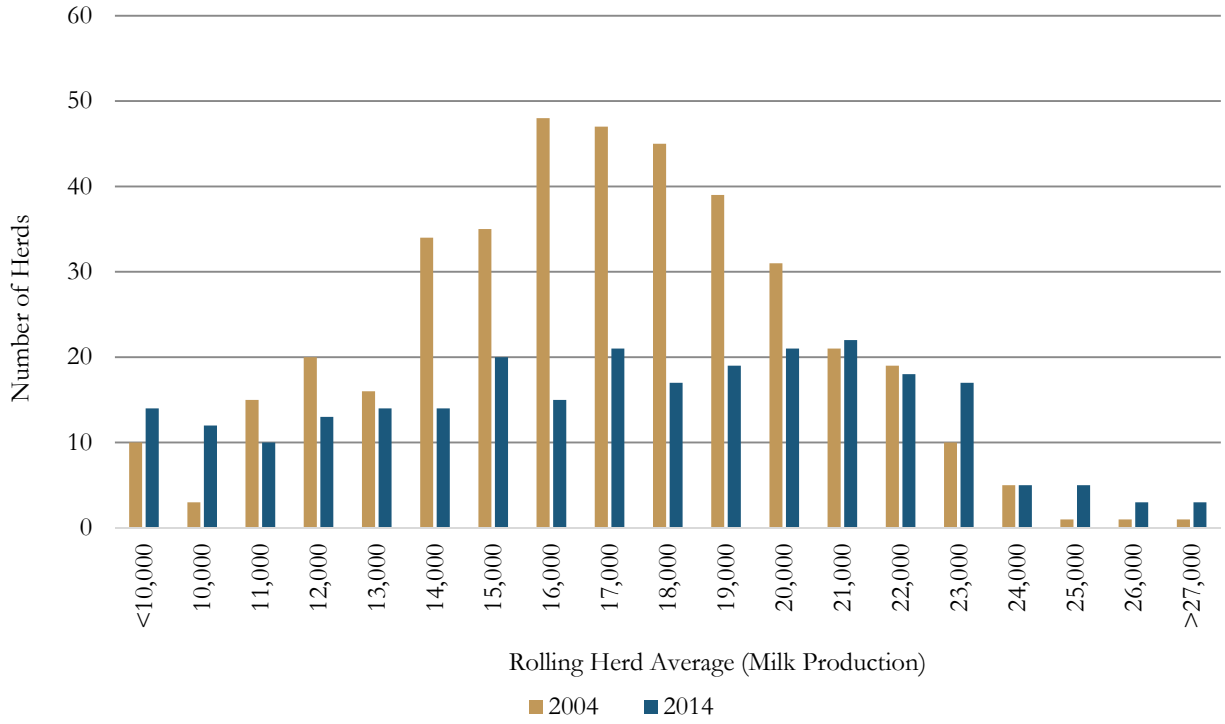


Source: USDA, National Agricultural Statistics Service

3.3 Rolling Herd Averages

Rolling herd averages estimate average milk production for an average Missouri milk cow during a particular year. Comparing the 2004 and 2014 rolling averages in Exhibit 3.3.1 communicates the extent to which average Missouri milk output per cow has changed during the past decade. These rolling average data suggest that Missouri dairy farmers have improved milk production per cow during the past decade. The dynamics have been interesting, though. For those Missouri dairy farms with DHIA records, more farms produced at the lowest and highest milk yield levels in 2014 than in 2004. In 2004, 2.5 percent of the Missouri rolling herd averages didn't reach 10,000 pounds, and in 2014, 5.3 percent of Missouri farm rolling herd averages failed to reach the 10,000-pound threshold. During 2004, just 0.2 percent of farms had rolling herd averages that exceeded 27,000 pounds, but that share increased to 1.1 percent in 2014.

Exhibit 3.3.1 – Missouri Rolling Herd Averages, 2004 and October 2014



Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

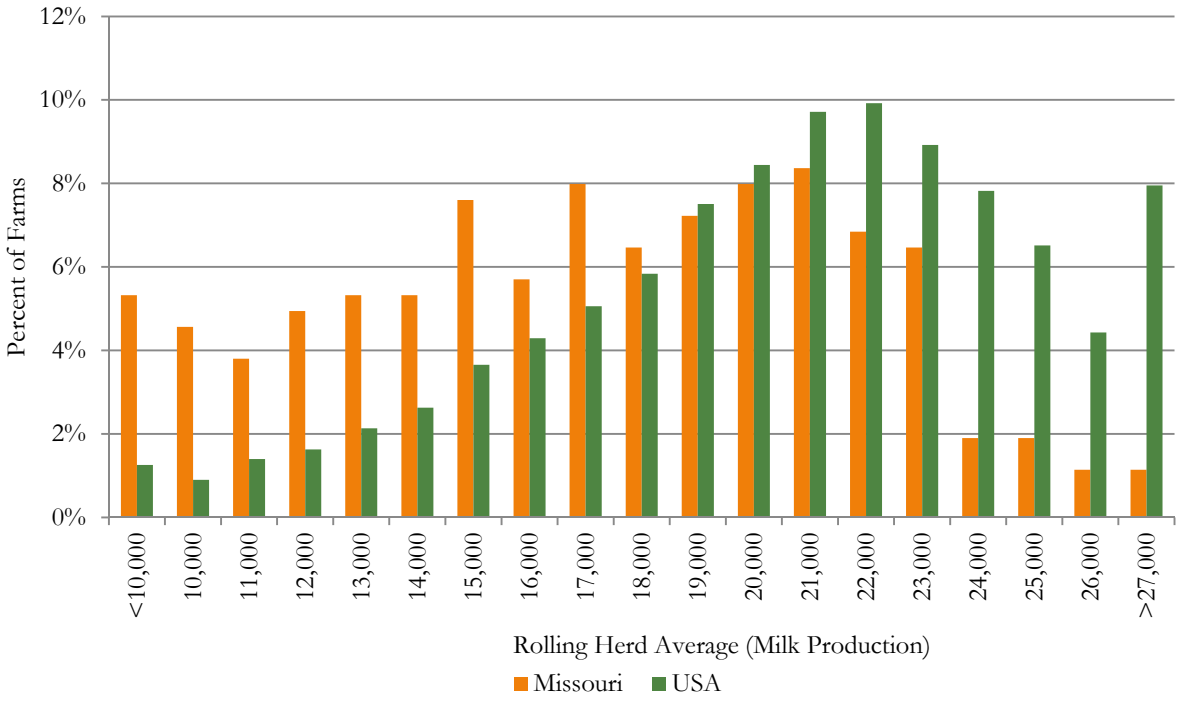
Within the mid-rolling average ranges, Missouri dairy farms have improved their averages. During 2004, 54.4 percent of Missouri rolling herd averages ranged from 10,000 pounds to 17,000, and that share decreased to 45.2 percent in 2014. Consequently, in the 18,000- to 26,000-pound range, 42.9 percent of Missouri rolling herd averages fit in this category during 2004, and that share increased to 48.3 percent of farms during 2014.

Expressed by an industry observer, one possible explanation of the Exhibit 3.3.1 trend is that Missouri has experienced an industry dividing into two dairy models. During the past decade, the number of minimalist grazing dairy producers with rolling herd averages below 14,000 pounds grew. Meanwhile,

a number of the state's higher producing confinement herds progressed beyond 20,000-pound rolling herd averages. Between those two production levels, as many as half of the DHIA herds disappeared due to producers retiring or leaving the industry.

During 2014, Missouri rolling herd averages tended to be lower than the U.S. average. Exhibit 3.3.2 displays the percent of Missouri and U.S. dairy farms by various rolling herd average categories in October 2014. At rolling averages less than 19,000 pounds, Missouri had a greater share of its farms reporting such averages at each 1,000-pound increment. At rolling averages that exceed 19,000 pounds, the U.S. had a greater share of its farms qualifying for these higher rolling herd average categories.

Exhibit 3.3.2 – Missouri and U.S. Rolling Herd Averages, October 2014



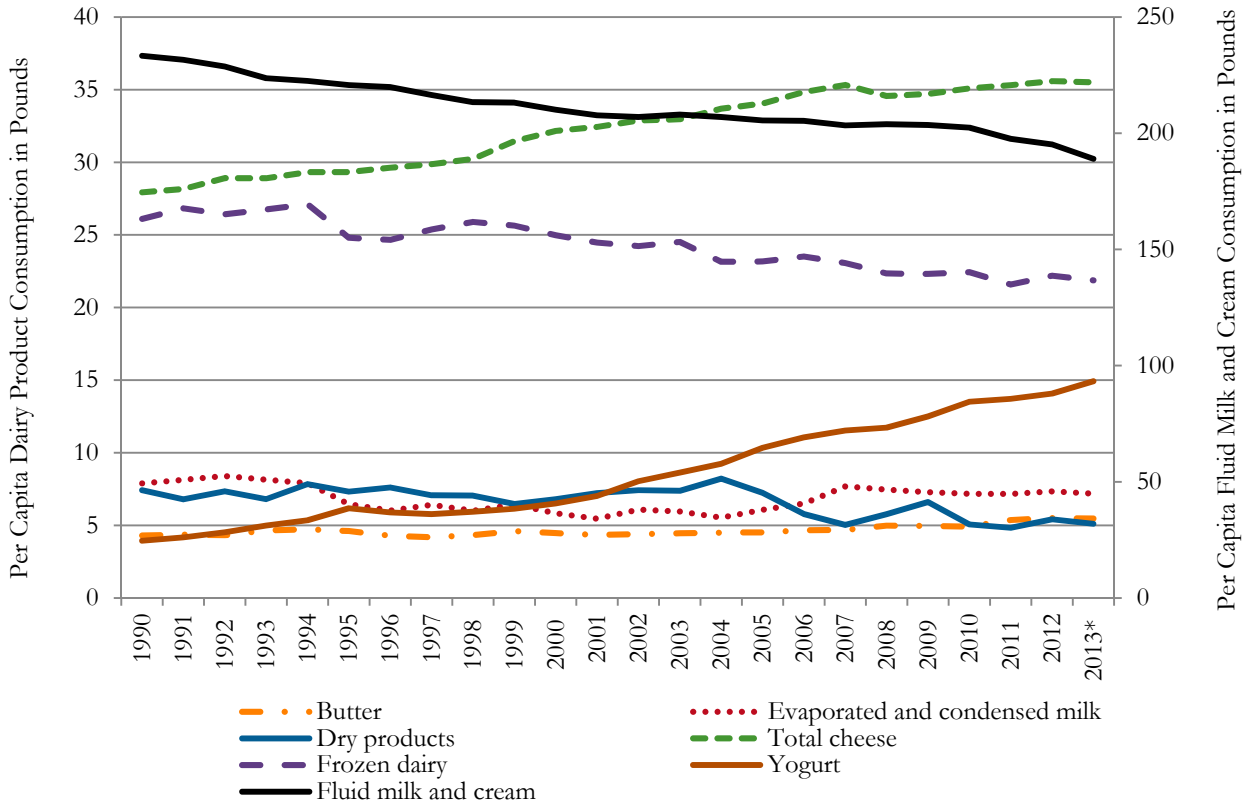
Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

3.4 Per Capita Milk Production and Consumption

The national per capita consumption rate for fluid milk and cream averaged 189 pounds in 2013, based on preliminary data. To satisfy a state's fluid milk consumption needs, dairies in a given state must have produced at least 189 pounds of milk per person or imported milk from outside the state. On a milk equivalent and milk fat basis, per capita consumption of all dairy products in the U.S. averaged 607 pounds during 2013. This indicates that any state that produced less than 607 pounds of milk per person must have imported milk or processed dairy products to satisfy consumer dairy needs in the given state.

Between 1990 and 2013, U.S. consumer demand for milk in all dairy products increased 6.8 percent. Exhibit 3.4.1 displays the consumption trend for various dairy products. Note that fluid milk and cream and frozen dairy consumption both clearly trended downward. Between 1990 and 2013, fluid milk and cream consumption decreased by 19 percent, and frozen dairy consumption dropped by 16.2 percent. During this same period, yogurt, cheese and butter gained popularity. In terms of percentage growth, yogurt led all products as consumption expanded by nearly 279 percent. The average American consumed just 3.9 pounds in 1990, but consumption grew to 14.9 pounds in 2013. Growth in the butter and cheese categories was more conservative. Between 1990 and 2013, consumption in these categories both grew 27.1 percent.

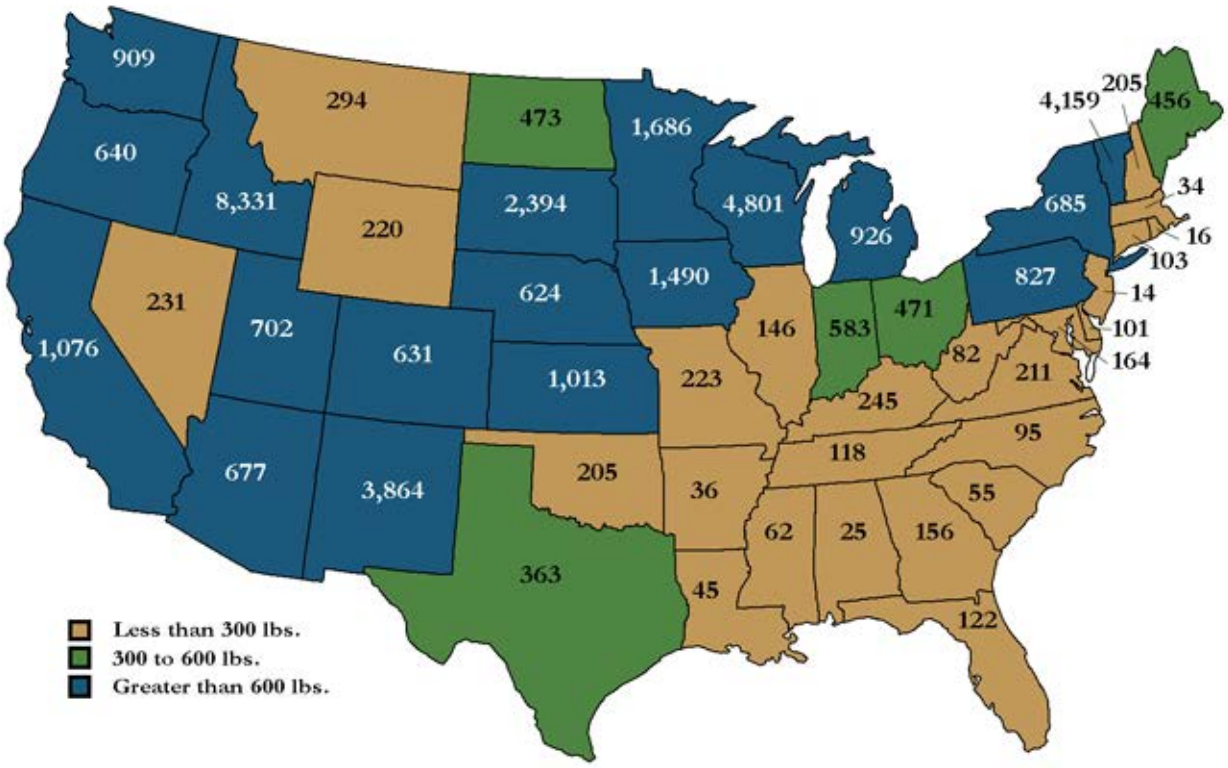
Exhibit 3.4.1 – U.S. per Capita Dairy Product Consumption Trends, Pounds



* 2013 data are preliminary.
Source: USDA, Economic Research Service

Missouri produced 223 pounds of milk per capita in 2013. Exhibit 3.4.2 shares milk production per capita data for all U.S. states. Values tend to be lowest in the southeast U.S. From 2008 to 2013, Missouri per capita milk production decreased by 18 percent. In 2013, Missouri's milk production would have supported 36.7 percent of the per capita consumption needs assumed for Missourians.

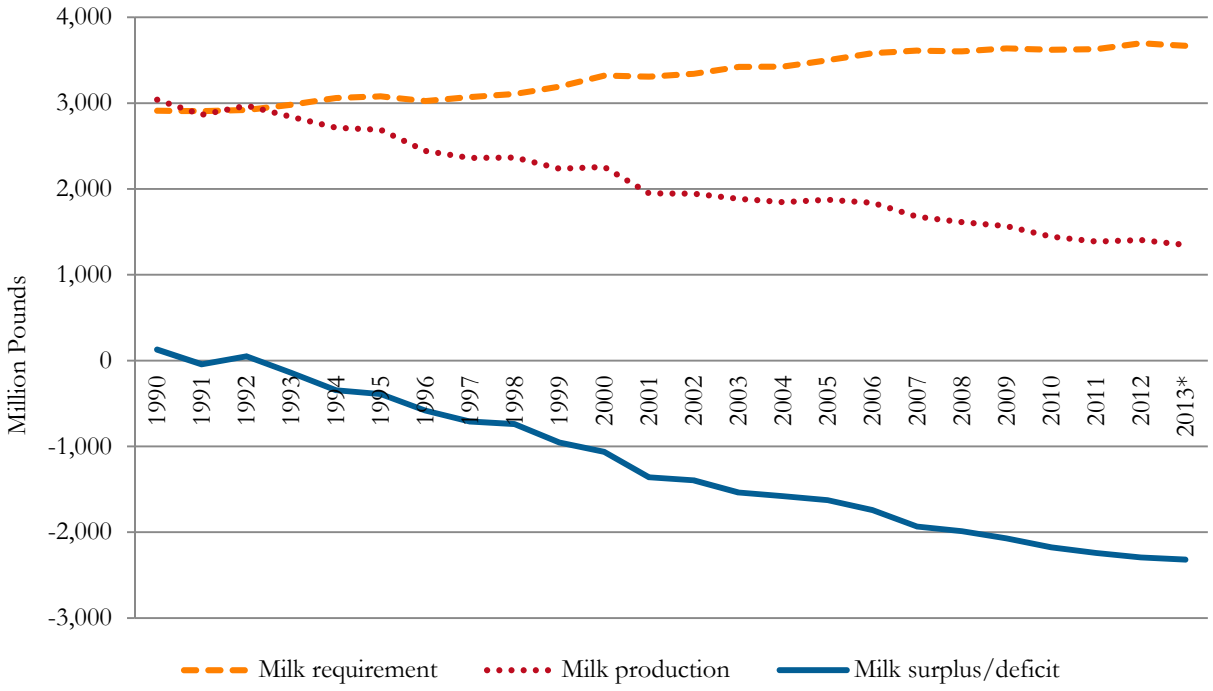
Exhibit 3.4.2 – Per Capita Milk Production by State, 2013



Source: Federal Milk Market Administrator, Central Order

Because milk production lags consumer needs, Missouri is considered a milk-deficit state. Exhibit 3.4.3 quantifies the milk deficit from 1990 to 2013; the 2013 milk deficient was approximated using preliminary per capita consumption data. The milk deficit value considers the state's milk production and the state's consumer milk needs for all dairy products on a milk-equivalent basis. Only twice since 1990 has Missouri recorded a milk surplus, and there was never a milk surplus since 1993. Recently, the state has consistently increased its milk deficit each year as production has declined and consumption needs have risen. In 2013, Missouri's estimated milk deficit exceeded 2.3 billion pounds.

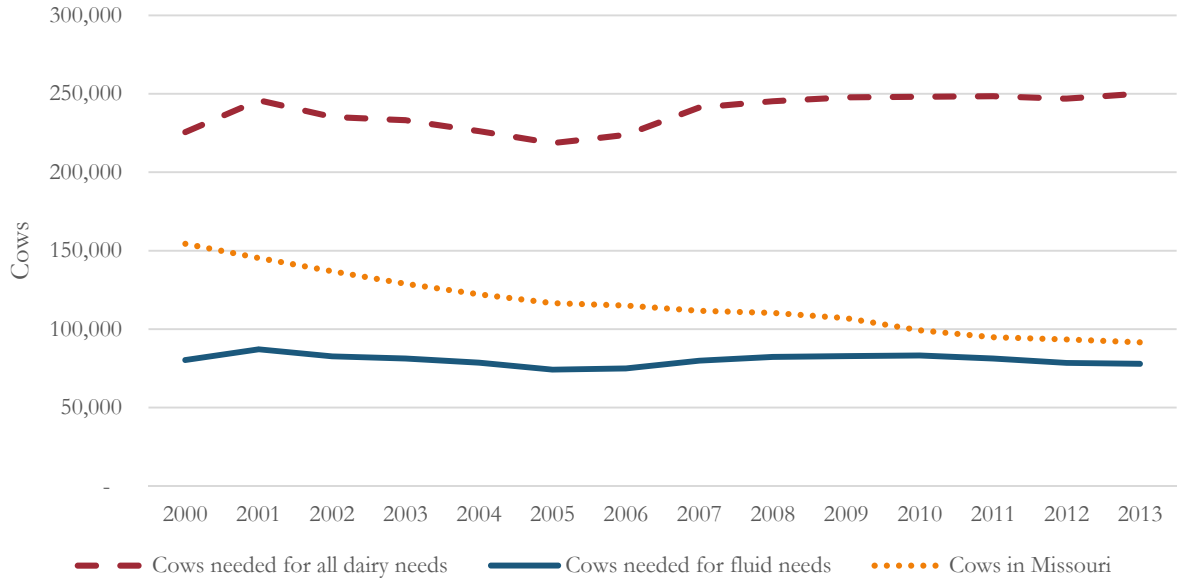
Exhibit 3.4.3 – Trend in Missouri Milk Surplus or Deficit, 1990 to 2013



* 2013 milk requirement and milk deficit based on preliminary per capita consumption data
Sources: U.S. Census Bureau and USDA, National Agricultural Statistics Service

Exhibit 3.4.4 illustrates the difference between milk needs and milk supply on a cow basis. The orange line illustrates the recorded change in Missouri milk cow inventory from 2000 to 2013. The blue line estimates the milk cow inventory (based on Missouri's average milk production per cow) needed to satisfy fluid milk needs in the state during each respective year. Based on these assumptions, Missouri milk cow inventory was adequate to serve the state's fluid milk needs between 2000 and 2013, but note that the gap between actual Missouri milk cow inventory and cows needed to satisfy fluid milk consumption has narrowed over time. The red line indicates that Missouri has needed about 250,000 milk cows in each of the past five years to produce enough milk to meet milk demand for all dairy needs. Considering that Missouri's actual milk cow inventory has recorded levels lower than 100,000 for the past three years, the state hasn't been close to maintaining enough cows to meet milk needs for all dairy products.

Exhibit 3.4.4 –Missouri's Evolution toward a Fluid-Only Milk Market, 2000 to 2013



Sources: Derived from U.S. Census Bureau and USDA, National Agricultural Statistics Service

4. Marketing and Prices

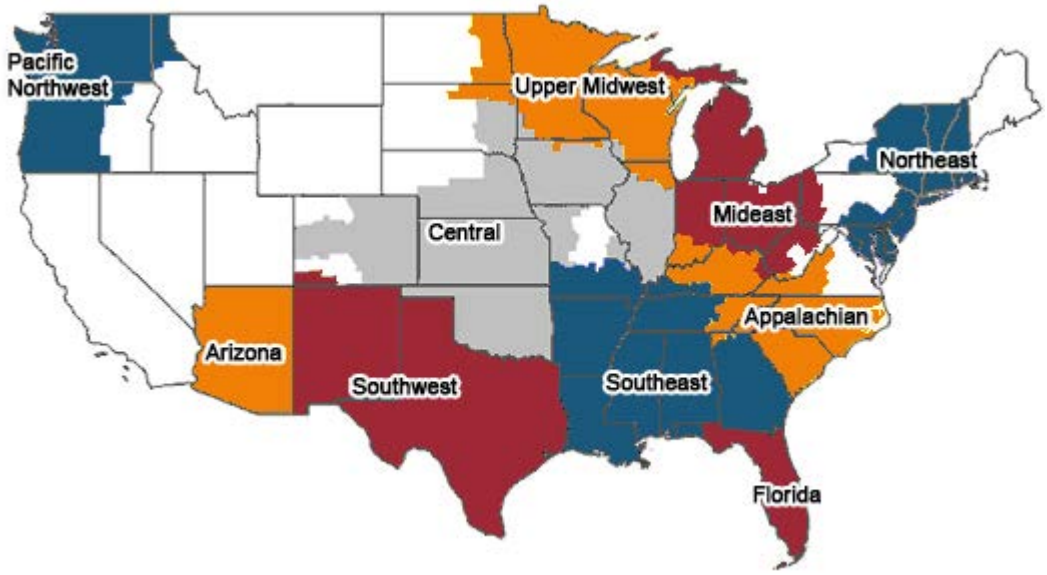
4.1 Milk Prices

Federal milk marketing orders set minimum prices for more than 60 percent of the Grade A milk produced in the U.S., and Grade A milk constitutes 99 percent of all U.S. milk produced. California uses a state pricing system similar to federal order pricing. The revised Agricultural Marketing Agreement Act of 1937 authorizes federal orders. USDA cites a few major benefits of the federal milk orders program:

1) It provides consumers with an adequate milk supply to meet needs throughout the year and helps to prevent extreme price fluctuations during heavy and light milk production periods.
2) It ensures a reasonable minimum milk price for dairy producers throughout the year.

Exhibit 4.1.1 highlights federal milk marketing order coverage areas.

Exhibit 4.1.1 – Federal Milk Marketing Order Areas



Source: USDA, Agricultural Marketing Service

The Southeast Order, which includes portions of southern Missouri, has a high Class I (fluid milk) utilization. The utilization rate averaged around 74 percent in 2014. As a comparison, the Central Order in northern Missouri had a Class I utilization rate that averaged 32 percent. Because Class I is the highest valued milk over time, orders with higher Class I utilization tend to have higher blend prices. Missouri is an increasingly milk-deficient area. Other states to the south and east of Missouri have experienced a similar phenomenon. It is expected that milk prices in this region will show relative increases compared with prices in other parts of the country, particularly as energy prices increase and milk transportation costs make local milk more valuable.

The national federal order mailbox milk price is a good measure of regional differences in U.S. milk prices received. Mailbox milk prices reflect the net pay price received by dairy farmers for milk. This includes all payments received for milk sold and all costs associated with marketing milk, including hauling. Price is a weighted average for the reporting area and is reported at the average butterfat test. Mailbox price does not include any Milk Income Loss Contract (MILC) payments. Exhibit 4.1.2 presents mailbox milk prices for various U.S. states and regions in 2011, 2012 and 2013. The southeast region of the U.S. tends to have higher milk prices received due to its high fluid milk demands and short supply. During the three years observed, the milk price in all federal order areas averaged $19.63 per hundredweight.

Exhibit 4.1.2 – Mailbox Milk Prices for Selected Reported Areas in Federal Orders and California

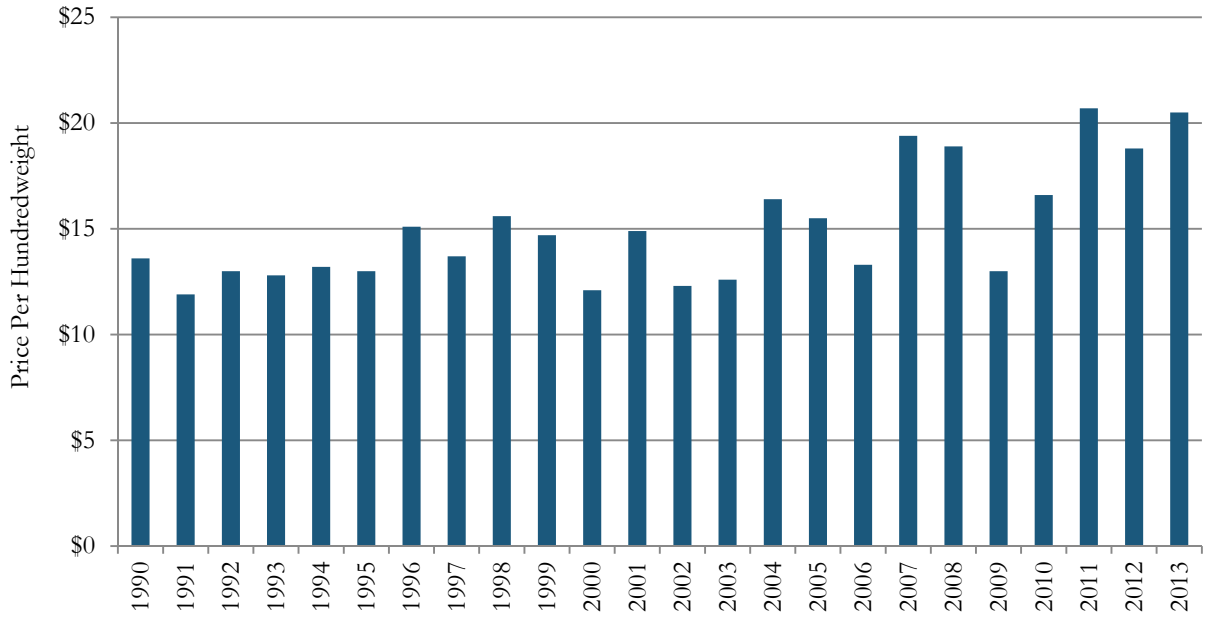
Reporting Area 1/	2011	2012	2013	Three-Year Simple Average
	Mailbox Milk Price Per Hundredweight 2/			
New England States 3/	$21.35	$19.63	$21.51	$20.83
New York	$20.00	$18.57	$20.50	$19.69
Eastern Pennsylvania 4/	$20.86	$18.95	$20.60	$20.14
Appalachian States 5/	$21.65	$19.47	$21.23	$20.78
Southeast States 6/	$22.11	$20.04	$21.61	$21.25
Southern Missouri 7/	$20.14	$18.05	$20.31	$19.50
Florida	$23.32	$21.26	$23.02	$22.53
Western Pennsylvania 8/	$20.93	$18.88	$20.45	$20.09
Ohio	$20.85	$18.68	$20.53	$20.02
Indiana	$20.44	$18.06	$19.97	$19.49
Michigan	$20.11	$17.91	$19.76	$19.26
Wisconsin	$20.06	$19.16	$20.07	$19.76
Minnesota	$19.99	$19.20	$19.93	$19.71
Iowa	$20.26	$18.94	$20.35	$19.85
Illinois	$20.63	$19.08	$20.35	$20.02
Corn Belt States 9/	$19.83	$18.11	$19.28	$19.07
Western Texas 10/	$19.35	$17.60	$19.00	$18.65
New Mexico	$18.31	$16.67	$17.96	$17.65
Northwest States 11/	$19.86	$18.05	$19.75	$19.22
All Federal Order Areas 12/	$20.20	$18.63	$20.07	$19.63
California 13/	$18.14	$16.29	$18.26	$17.56

1/ Information is shown for those areas for which prices are reported for at least 75% of the milk marketed under Federal milk orders. The price shown is the weighted average of the prices reported for all orders that received milk from the area. As applicable, includes milk not-pooled due to disadvantageous intra-order price relationships. 2/ Net pay price received by dairy farmers for milk. Includes all payments received for milk sold and all costs associated with marketing the milk. Price is a weighted average for the reporting area and is reported at the average butterfat test. Mailbox price does not include any Milk Income Loss Contract (MILC) payments. Mailbox price does include, for the most part, the $0.05 per cwt. assessment under the Cooperatives Working Together (CWT) program. 3/ Includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. 4/ All the counties to the east of those listed in 8/. 5/ Includes Kentucky, North Carolina, South Carolina, Tennessee and Virginia. 6/ Includes Alabama, Arkansas, Georgia, Louisiana and Mississippi. 7/ The counties of Vernon, Cedar, Polk, Dallas, Laclede, Texas, Dent, Crawford, Washington, St. Francois and Perry and all those to the south of these. 8/ The counties of Warren, Elk, Clearfield, Indiana, Westmoreland and Fayette, and all those to the west of these. 9/ Includes Kansas, Nebraska and the Missouri counties to the north of those listed in 7/. 10/ All counties to the west of Fanin, Hunt, Van Zandt, Henderson, Houston, Cherokee, Nacogdoches and Shelby. 11/ Includes Oregon and Washington. 12/ Weighted average of the information for all selected reporting areas in Federal milk orders. Previous year figures have not been revised for new reporting areas. 13/ California is not part of the Federal Order program. Calculated by California Department of Food and Agriculture Dairy Marketing Board, and published in "California Dairy Information Bulletin."

Source: USDA, Federal Milk Market Administrator, Upper Midwest Order

Since 1990, Missouri milk prices have experienced volatility, but the price has maintained an upward trend. Exhibit 4.1.3 tracks the change in the average price received for Missouri milk. The exhibit illustrates that milk prices tend to be cyclical, meaning that prices cycle every few years. From 2011 to 2013, the Missouri milk price received averaged $20 per hundredweight. The longer term average price received from 1990 to 2013 was $15.07 per hundredweight.

Exhibit 4.1.3 – Average Returns for Missouri Milk, 1990 to 2013

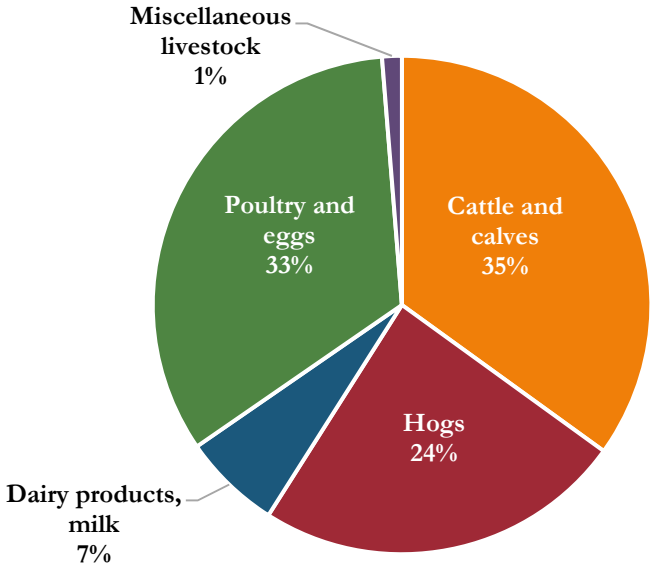


Source: USDA, National Agricultural Statistics Service

4.2 Farm Cash Receipts

The dairy industry is an important contributor to Missouri's economy. During 2013, the state's dairy industry generated $272.2 million in milk cash receipts. Of all Missouri livestock cash receipts in 2013, milk cash receipts represented 7 percent of the total. See Exhibit 4.2.1. Cattle and calves, poultry and eggs and hogs sales generated greater cash receipts totals than the milk production sector. Their shares were 35 percent, 33 percent and 24 percent, respectively.

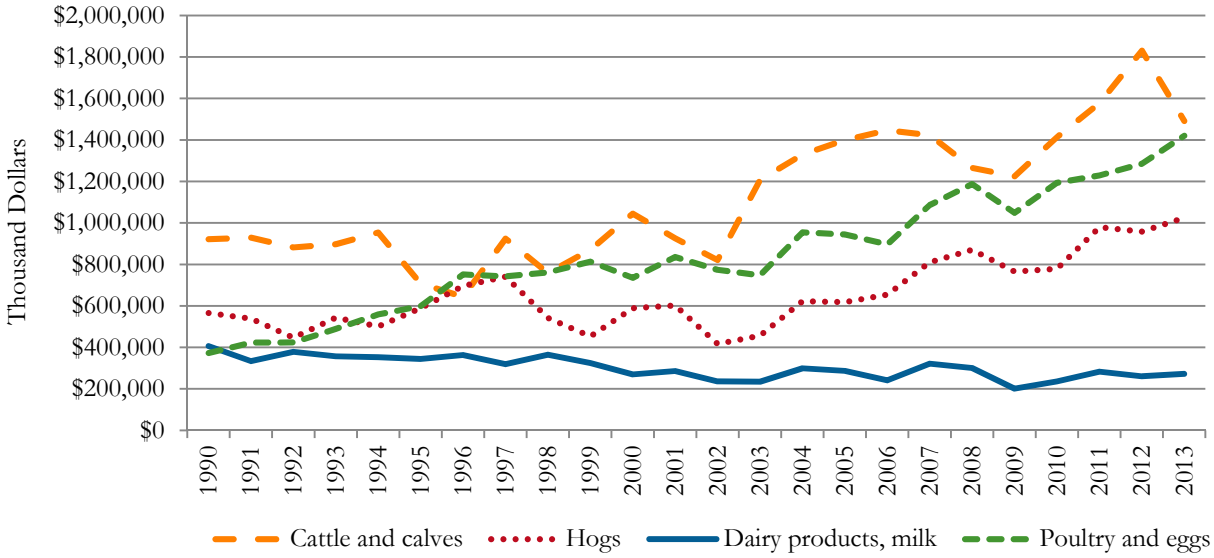
Exhibit 4.2.1 – Missouri Livestock Cash Receipts by Sector, 2013



Source: USDA, Economic Research Service

Missouri milk cash receipts have declined over time as dairy cows and farms maintained in the state have decreased. Exhibit 4.2.2 charts Missouri cash receipts for various livestock production sectors from 1990 to 2013. Missouri milk cash receipts decreased 32.9 percent between 1990 and 2013. Unlike the milk cash receipts values, receipts for cattle and calves, hogs and poultry and eggs have generally increased since 1990. Between 1990 and 2013, cash receipts for these categories grew by 61.8 percent for cattle and calves, 81.1 percent for hogs and 280.4 percent for poultry and eggs.

Exhibit 4.2.2 – Missouri Livestock Cash Receipts, 1990 to 2013



Source: USDA, Economic Research Service

4.3 Milk Use and Marketings

In 2013, Missouri produced 1.349 billion pounds of milk. Exhibit 4.3.1 shares the use distribution for that Missouri-produced milk. Missouri dairies market most of their milk. During 2013, producers marketed 98 percent of their total production. Milk marketed by producers represents milk sold to plants and dealers as whole milk and equivalent amounts of milk for cream. It also includes milk sold directly to consumers. Approximately 97 percent of all Missouri-produced milk was eligible for fluid use, meaning it was Grade A. The "fed to calves" and "used for milk, cream and butter" categories include milk that's used where it's produced. In 2013, Missouri dairies used a small share of total milk production for feeding calves and directing it toward on-farm milk, cream and butter consumption.

Exhibit 4.3.1 – Missouri Milk Use Distribution, 2013

Milk Use Category	Quantity of Milk (million pounds)
Milk marketed by producers	1,328
Fed to calves	17
Used for milk cream and butter	4
Total	**1,349**

Source: USDA, National Agricultural Statistics Service

During 2013, Missouri-produced milk contained 3.74 percent fat on average. Given that the state produced 1.349 billion pounds of milk that year, the state generated 50.5 million pounds of milk fat. Per cow, milk fat production totaled 548 pounds. By comparison, U.S. milk fat content averaged 3.76 percent, and the average U.S. dairy cow produced 821 pounds of milk fat in 2013. U.S. milk fat production exceeded 7.5 billion pounds during 2013.

5. Production Economics and Practices

5.1 Cost of Production

The USDA Economic Research Service estimates regional shifts in competitiveness by surveying producers and collecting costs and return information. Using 2010 data from the Agricultural Resource Management Survey as a base and other data, the agency prepared these estimates. Annually, USDA updates the estimates with new prices and production information. Exhibit 5.1.1 presents the 2013 results of these milk production cost estimates for various states and the U.S. Relative to the average for all states, Missouri producers incurred higher feed costs, total operating costs, allocated overhead costs and total costs. Missouri's small herd size contributed to its high opportunity cost of unpaid labor. Of the eight states evaluated, Missouri ranked second for the highest total costs. Only production costs in Kentucky were greater of the states observed in Exhibit 5.1.1. Missouri's total milk production costs were 36.6 percent higher than the all-state average total production cost. Per milk hundredweight sold, Missouri dairies incurred $10.03 more in production costs than the U.S. average. Of the states evaluated below, production costs were least expensive in Idaho and California.

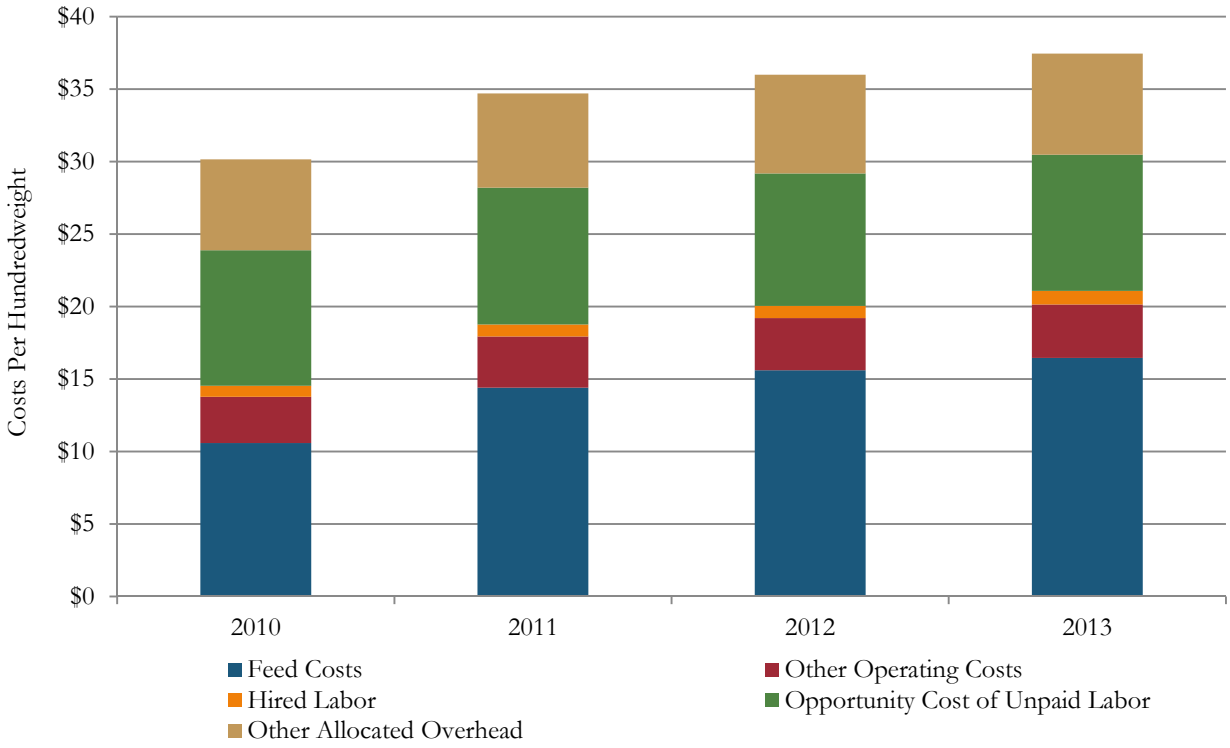
Exhibit 5.1.1 – Milk Cost of Production in Dollars per Hundredweight Sold, 2013

Item	CA	GA	ID	IA	KY	MO	TX	WI	All States
Operating costs:									
Feed--									
Purchased feed	11.15	9.21	8.59	8.58	8.41	10.27	11.57	6.19	9.48
Homegrown harvested feed	3.50	2.17	2.14	10.16	8.99	5.51	3.32	13.96	6.33
Grazed feed	0.03	0.28	0.03	0.13	0.45	0.68	0.29	0.11	0.10
Total, feed costs	14.68	11.66	10.76	18.87	17.85	16.46	15.18	20.26	15.91
Other--									
Veterinary and medicine	0.61	0.63	0.59	0.96	0.74	0.72	0.51	1.05	0.82
Bedding and litter	0.09	0.02	0.25	0.45	0.26	0.11	0.04	0.34	0.25
Marketing	0.30	0.21	0.28	0.16	0.33	0.16	0.13	0.23	0.24
Custom services	0.45	0.76	0.28	0.65	0.73	0.56	1.15	0.37	0.57
Fuel, lube, and electricity	0.67	1.03	0.52	1.03	1.34	1.30	0.83	1.02	0.82
Repairs	0.42	0.59	0.37	0.72	0.71	0.83	0.35	0.64	0.60
Other operating costs*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Interest on operating capital	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total feed and other operating costs	17.23	14.91	13.06	22.85	21.97	20.15	18.20	23.93	19.22
Allocated overhead:									
Hired labor	1.53	1.99	1.47	1.50	1.56	0.93	1.62	1.77	1.58
Opportunity cost of unpaid labor	0.42	3.82	0.32	2.90	7.74	9.40	2.29	3.18	2.22
Capital recovery of mach. and equip.	2.79	4.19	1.55	4.17	8.73	5.65	2.97	4.54	3.58
Opportunity cost of land (rental rate)	0.00	0.10	0.00	0.03	0.11	0.22	0.03	0.03	0.02
Taxes and insurance	0.14	0.18	0.08	0.24	0.28	0.47	0.16	0.27	0.19
General farm overhead	0.44	0.44	0.29	0.63	0.50	0.63	0.27	0.80	0.61
Total, allocated overhead	5.32	10.72	3.71	9.47	18.92	17.30	7.34	10.59	8.20
Total costs listed	**22.55**	**25.63**	**16.77**	**32.32**	**40.89**	**37.45**	**25.54**	**34.52**	**27.42**

* Costs for third-party organic certification.
Source: USDA, Economic Research Service

For 2010 to 2013, Exhibit 5.1.2 shares Missouri milk production costs, which include whole-herd feed costs. Total costs have grown gradually to total $37.45 per hundredweight in 2013. Between 2010 and 2013, total costs increased by 24.2 percent. Of the five cost categories, feed costs increased most. Feed expense grew 55.4 percent between 2010 and 2013. The other costs grew more gradually. Opportunity cost of unpaid labor grew the least during the observed period.

Exhibit 5.1.2 – Missouri Milk Cost of Production per Hundredweight Sold, 2010 to 2013



Source: USDA, Economic Research Service

5.2 Income over Feed Cost

From 2005 to 2013, feed costs to produce a hundredweight of milk in Missouri more than doubled, and this has pressured the milk income over feed cost indicator. Exhibit 5.2.1 quantifies the income per hundredweight of milk produced that remains after dairy producers account for the feed cost investment to produce the milk. This income over feed cost value has fluctuated from 2005 to 2013; however, the value trended downward during the observed period. It reached its highest level, $8.02 per hundredweight, during 2007 and its lowest level, $1.80 per hundredweight, during 2009. In 2013, income over feed cost for Missouri averaged $3.32 per hundredweight.

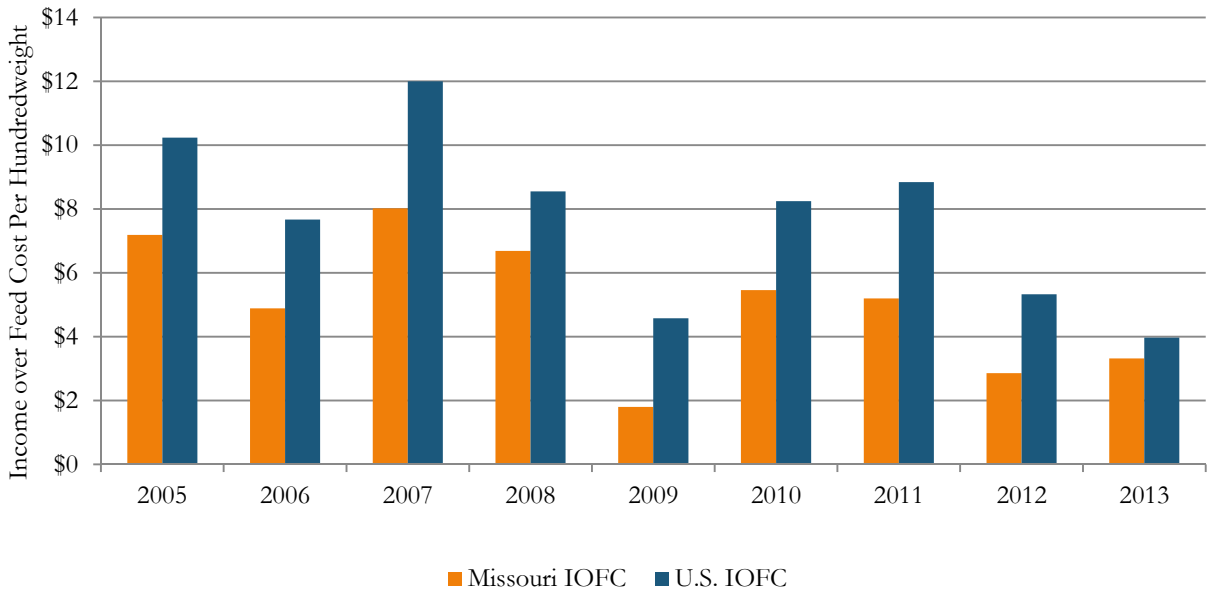
Exhibit 5.2.1 – Missouri Income over Feed Cost per Hundredweight Milk, 2005 to 2013

Item	2005	2006	2007	2008	2009	2010	2011	2012	2013
Missouri milk price ($/cwt.)	$14.59	$12.50	$18.19	$17.63	$11.65	$16.05	$19.61	$18.47	$19.78
Purchased feed	$5.13	$5.07	$6.52	$7.43	$6.97	$6.57	$9.53	$9.77	$10.27
Homegrown harvested feed	$1.98	$2.26	$3.44	$3.30	$2.68	$3.46	$4.28	$5.18	$5.51
Grazed feed	$0.29	$0.28	$0.21	$0.21	$0.20	$0.56	$0.60	$0.66	$0.68
Total feed $/cwt. milk	$7.40	$7.61	$10.17	$10.94	$9.85	$10.59	$14.51	$15.61	$16.46
Missouri income over feed cost/cwt. milk	**$7.19**	**$4.89**	**$8.02**	**$6.69**	**$1.80**	**$5.46**	**$5.20**	**$2.86**	**$3.32**

Source: USDA, Economic Research Service

Relative to the U.S. average, Missouri averaged a less desirable income over feed cost value from 2005 to 2013. Exhibit 5.2.2 shares income over feed cost values from 2005 to 2013 for Missouri and the U.S. In 2013, the Missouri income over feed cost value was just 83.6 percent of the U.S. value. Although the U.S. income over feed cost value tends to be higher than Missouri's value, note that the two values tend to move in similar directions from year to year.

Exhibit 5.2.2 – Missouri Income over Feed Cost per Hundredweight Milk, 2005 to 2013



Source: USDA, Economic Research Service

5.3 Farm Financial Statements and Analysis

The USDA Agricultural Resource Management Survey (ARMS) collects dairy farm structural and financial data for 15 states. States represented in the survey are Arkansas, California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Carolina, Texas, Washington and Wisconsin. Exhibit 5.3.1 shares structural characteristic data captured in the 2012 ARMS report. Keep in mind that a major drought impacted Missouri during this year, so it has some influence on the financial data. Missouri dairy farms represented just 3.7 percent of the dairy farms represented in all surveyed states, 2.9 percent of acres operated by dairy farms in the surveyed states and 0.7 percent of dairy farm production value in the surveyed states.

Exhibit 5.3.1 – Dairy Farm Business Structural Characteristics, 2012

Category	Units	All Surveyed States	Missouri
Number of farms	Farms	47,569	1,750
Total value of production	1,000 dollars	39,862,837	278,673
Total acres operated	1,000 acres	19,835	572
Acres operated per farm	Acres	417	327
Farms by tenure: Full owner	Percent	30	67
Farms by tenure: Part owner	Percent	58	33
Farms by tenure: Tenant	Percent	12	0
Operator occupation: Farming	Percent	93	58
Operator occupation: Something else	Percent	2*	21*
Operator occupation: Retired	Percent	*	21*
Operator education: Less than high school	Percent	20	30
Operator education: Completed high school	Percent	47	46
Operator education: Some college	Percent	25	15*
Operator education: Completed 4 years college or more	Percent	*	*
Operator hours worked annually on farm: Less than 500	Percent	2*	2*
Operator hours worked annually on farm: 500 to 999	Percent	1	0
Operator hours worked annually on farm: 1,000 to 1,999	Percent	6*	33
Operator hours worked annually on farm: 2,000 or more	Percent	91	65

* The estimate is statistically unreliable due to the combination of a low sample size and high sampling error.
Source: USDA, Economic Research Service, Agricultural Resource Management Survey (ARMS)

Missouri dairy farm operator characteristics vary somewhat from those of all dairy farm operators in the selected states. Full-owners operate a majority (67 percent) of Missouri dairy farms. However, among dairy farms in all surveyed states, part-owners operate a majority (58 percent) of dairy farms. Operators in all surveyed states are more likely to identify farming as their occupation. Ninety-three percent of operators in all surveyed states noted farming as their occupation, but just 58 percent of Missouri dairy farm operators shared that farming was their occupation. Twenty-one percent of Missouri dairy farmers noted being retired, and 21 percent identified their occupation as something else. USDA noted that both of these estimates were statistically unreliable, however.

Likely a reflection of Missouri dairy operators splitting time between dairy farming and other occupations, a smaller share of Missouri dairy farmers identified annually working at least 2,000 hours on the farm than dairy operators in all surveyed states. Of the dairy operators in all surveyed states, 91

percent indicated working on the farm at least 2,000 hours per year. In Missouri, about two-thirds of dairy operators worked on the farm at least 2,000 hours per year.

Regarding operator education level, about half of the Missouri dairy operators and dairy operators in all surveyed states at least have a high school diploma. One-quarter of those in all surveyed states had completed some college, but just 15 percent of Missouri dairy operators had some college, though USDA reported that the Missouri estimate was statistically unreliable. Due to low statistical reliability, ARMS didn't report about dairy operators who had attended at least four years of college.

A dairy farm's income statement summarizes the farm's revenue, expenses and net income during a given year. Exhibit 5.3.2 presents the average dairy farm business income statement for Missouri dairy farms and all farms in the ARMS study states. From a revenue perspective, Missouri dairy farm gross cash income averaged just one-fifth the gross cash income collected by an average farm in all surveyed states. Livestock income was the primary income source. Among Missouri dairy farms, livestock income represented nearly 85 percent of total gross cash income. Non-livestock-related income sources included crop sales, government payments and other farm-related income.

Regarding dairy farm business expenses, variable expenses were more significant than fixed expenses during 2012 for Missouri dairy farm businesses. Among the variable costs, feed, labor and fertilizer and chemicals were the most significant. For dairy farm businesses in all surveyed states, the most significant variable expenses during 2012 were feed, labor, repairs and maintenance and other livestock-related costs. In Missouri, the largest fixed expense for dairy farm businesses during 2012 was interest, and for dairy farms in all surveyed states, the most significant fixed expense was rent and lease payments. During 2012, net cash income per farm averaged $194,940 for dairies in all surveyed states and $39,688 for those in Missouri. After accounting for depreciation, non-cash labor benefits, inventory changes and nonmoney income, net farm income for dairy businesses averaged $164,224 per farm for dairies in all surveyed states and $15,406 for Missouri dairy farm businesses.

Exhibit 5.3.2 – Dairy Farm Business Income Statement, 2012

Category	Units	All Surveyed States	% of Gross Cash Income	Missouri	% of Gross Cash Income
Farms	Number	47,569		1,750	
Gross cash income	Dollars per farm	866,736	100.0%	178,007	100.0%
Livestock income	Dollars per farm	795,422	91.8%	150,731	84.7%
Crop sales	Dollars per farm	30,032	3.5%	8,900*	5.0%
Government payments	Dollars per farm	11,827	1.4%	3,772	2.1%
Other farm-related income /1	Dollars per farm	29,455	3.4%	14,604*	8.2%
Total cash expenses	Dollars per farm	671,796	77.6%	138,320	77.7%
Variable expenses	Dollars per farm	615,497	71.0%	126,900	71.3%
Livestock purchases	Dollars per farm	1,215	0.1%	1,047*	0.6%
Feed	Dollars per farm	329,736	38.0%	67,941	38.2%
Other livestock-related /2	Dollars per farm	33,403	3.9%	3,935	2.2%
Seed and plants	Dollars per farm	14,833	1.7%	3,766	2.1%
Fertilizer and chemicals	Dollars per farm	28,434	3.3%	9,626	5.4%
Utilities	Dollars per farm	18,979	2.2%	3,546	2.0%
Labor	Dollars per farm	73,567	8.5%	12,112	6.8%
Fuels and oils	Dollars per farm	26,176	3.0%	7,805	4.4%
Repairs and maintenance	Dollars per farm	33,732	3.9%	7,866	4.4%
Machine-hire and custom work	Dollars per farm	31,656	3.7%	5,090	2.9%
Other variable expenses /3	Dollars per farm	23,767	2.7%	4,165	2.3%
Fixed expenses	Dollars per farm	56,299	6.5%	11,420	6.4%
Real estate and property taxes	Dollars per farm	7,907	0.9%	2,250	1.3%
Interest	Dollars per farm	18,307	2.1%	4,937	2.8%
Insurance premiums	Dollars per farm	10,060	1.2%	1,901	1.1%
Rent and lease payments	Dollars per farm	20,025	2.3%	2,332*	1.3%
Net cash farm income	Dollars per farm	194,940	22.5%	39,688	22.3%
Depreciation	Dollars per farm	52,480	6.1%	13,843	7.8%
Labor, non-cash benefits	Dollars per farm	1,482	0.2%	90*	0.1%
Value of inventory change	Dollars per farm	16,256	1.9%	*	-
Nonmoney income /4	Dollars per farm	8,614	1.0%	8,205	4.6%
Net farm income	Dollars per farm	164,224	18.9%	15,406*	8.7%

* - The estimate is statistically unreliable due to the combination of a low sample size and high sampling error.
1 - Includes income from machine-hire, custom work, livestock grazing, land rental, contract production fees, outdoor recreation and other farm-related sources.
2 - Includes livestock leasing, custom feed processing, bedding and grazing.
3 - Includes supplies, registration fees, transportation, storage and general business expenses.
4 - Defined as home consumption and imputed rental value of farm dwellings owned by the farm operation.
Source: USDA, Economic Research Service, Agricultural Resource Management Survey (ARMS)

A dairy farm's balance sheet provides a snapshot of the farm's assets, liabilities and equity on a given date. Exhibit 5.3.3 presents 2012 balance sheet data collected from dairy farm businesses in Missouri and all surveyed states represented in the ARMS data set. In 2012, Missouri dairy farm assets totaled more than $1.03 million per farm. Relative to Missouri dairy farms, dairies in all surveyed states held more assets, nearly $2.27 million per farm on average, during 2012. Assets may be classified as current, which are assets used with a one-year period, or noncurrent assets, which are long-term assets. Among Missouri dairy farms and those in all surveyed states, noncurrent assets represent a greater share of total assets, and land and buildings are the greatest noncurrent assets.

Exhibit 5.3.3 – Dairy Farm Business Balance Sheet, 2012

Category	Units	All Surveyed States	% of Farm Assets	Missouri	% of Farm Assets
Farms	Number	47,569		1,750	
Farm assets	Dollars per farm	2,269,085	100.0%	1,034,292	100.0%
Assets: Current	Dollars per farm	303,613	13.4%	76,240	7.4%
Assets: Livestock inventory	Dollars per farm	60,670	2.7%	11,794	1.1%
Assets: Crop inventory	Dollars per farm	114,717	5.1%	28,569*	2.8%
Assets: Purchased inputs	Dollars per farm	21,399	0.9%	3,215	0.3%
Assets: Cash invested in growing crops	Dollars per farm	3,904	0.2%	16*	0.0%
Assets: Prepaid insurance	Dollars per farm	2,515	0.1%	475	0.0%
Assets: Other /1	Dollars per farm	100,408	4.4%	32,172	3.1%
Assets: Non-current	Dollars per farm	1,965,472	86.6%	958,052	92.6%
Assets: Investment in cooperatives	Dollars per farm	19,989	0.9%	8,905*	0.9%
Assets: Land and buildings /2	Dollars per farm	1,386,908	61.1%	771,297	74.6%
Assets: Operators dwelling	Dollars per farm	105,845	4.7%	104,530	10.1%
Assets: Farm equipment	Dollars per farm	248,575	11.0%	104,704	10.1%
Assets: Breeding animals	Dollars per farm	310,001	13.7%	73,145	7.1%
Farm liabilities	Dollars per farm	382,529	16.9%	85,394	8.3%
Liabilities: Current	Dollars per farm	103,945	4.6%	15,559	1.5%
Liabilities: Notes payable within one year	Dollars per farm	48,832	2.2%	4,443	0.4%
Liabilities: Current portion of term debt	Dollars per farm	36,779	1.6%	7,128	0.7%
Liabilities: Accrued interest	Dollars per farm	10,926	0.5%	2,442	0.2%
Liabilities: Accounts payable	Dollars per farm	7,408	0.3%	1,545	0.2%
Liabilities: Noncurrent	Dollars per farm	278,585	12.3%	69,836	6.8%
Liabilities: Nonreal estate	Dollars per farm	57,027	2.5%	5,692	0.6%
Liabilities: Real estate	Dollars per farm	221,558	9.8%	64,144	6.2%
Farm equity	Dollars per farm	1,886,555	83.1%	948,898	91.7%

* - The estimate is statistically unreliable due to the combination of a low sample size and high sampling error.
1 - Includes accounts receivable, certificates of deposit, checking and saving balances, and any other financial assets of the farm business.
2 - The value of the operators' dwelling and any associated liabilities were included if the dwelling was owned by the farm business.
Source: USDA, Economic Research Service, Agricultural Resource Management Survey (ARMS)

Liabilities and equity finance a dairy farm's assets. For both Missouri dairy farms and those in all surveyed states, assets are more significantly financed with equity than liabilities. Like assets, liabilities are categorized as current liabilities, which are those paid within a one-year period, and noncurrent liabilities, which are held for longer terms than one year. For Missouri dairy farms in 2012, the largest current liabilities maintained on their balance sheets was the current portion of term debt. For dairy

farms in all surveyed states, the largest current liabilities were notes payable within one year. Real estate was the most significant noncurrent liability for dairy farm business in Missouri and all surveyed states.

Financial ratios summarize financial performance. Exhibit 5.3.4 shares several 2012 financial ratios for dairy farm businesses in Missouri and all surveyed states. The current ratio conveys whether a farm can pay current liabilities with current assets. Although the average current ratios for farms in Missouri and all surveyed states indicate that both could repay current liabilities, Missouri farms on average had a stronger current ratio. The debt-to-asset ratio indicates a farm's reliance on debt to finance its assets. The ratio is low for both groups – dairy farms in Missouri and those from all 15 surveyed states – but it's lowest for Missouri dairies. The term debt coverage ratio also suggests that both groups produce adequate net income to repay term debt principal and interest. The return on assets and return on equity values suggest that Missouri dairy farms are less efficient at using assets and equity to generate return, though both ratios were statistically reliable. The negative operating profit margin for Missouri dairy farm businesses in 2012 indicates that the average dairy struggled to efficiently earn a return from its sales. Note, however, that the value was statistically unreliable.

Exhibit 5.3.4 – Dairy Farm Business Financial Ratios, 2012

Category	Units	All Surveyed States	Missouri
Farms	Number	47,569	1,750
Current ratio	Ratio	2.9	4.9
Working capital-to-expense ratio	Percent	29.7	43.9
Debt/asset	Percent	16.9	8.3
Rate of return on assets	Percent	4*	-2.1*
Rate of return on equity	Percent	3.9*	-2.4*
Operating profit margin	Percent	10.9*	-21.3*
Term debt coverage ratio	Number of times	6.3	5.6*
Asset turnover ratio	Number of times	0.4	0.2
Operating expense ratio	Percent	77.5	77.7
Economic cost-to-output ratio	Percent	96.8	125.7

* - The estimate is statistically unreliable due to the combination of a low sample size and high sampling error.
Source: USDA, Economic Research Service, Agricultural Resource Management Survey (ARMS)

Based on a percent of all dairy farms, fewer Missouri dairy farms carried debt than dairy farms in all surveyed states in 2012, and of the farms reporting debt, those in Missouri indicated that they have less debt per farm than dairy businesses in all surveyed states. Exhibit 5.3.5 presents data about the capacity for dairies to repay their debt. On average, Missouri dairy farms reported less gross cash farm income, net farm income and income for debt coverage in 2012 than farms in all surveyed states. However, these lower income levels may not preclude them from repaying their debt because they also reported having less debt and less maximum feasible debt. On average, repayment capacity use indicators were higher for Missouri dairy farms than they were for dairy farms in all surveyed states.

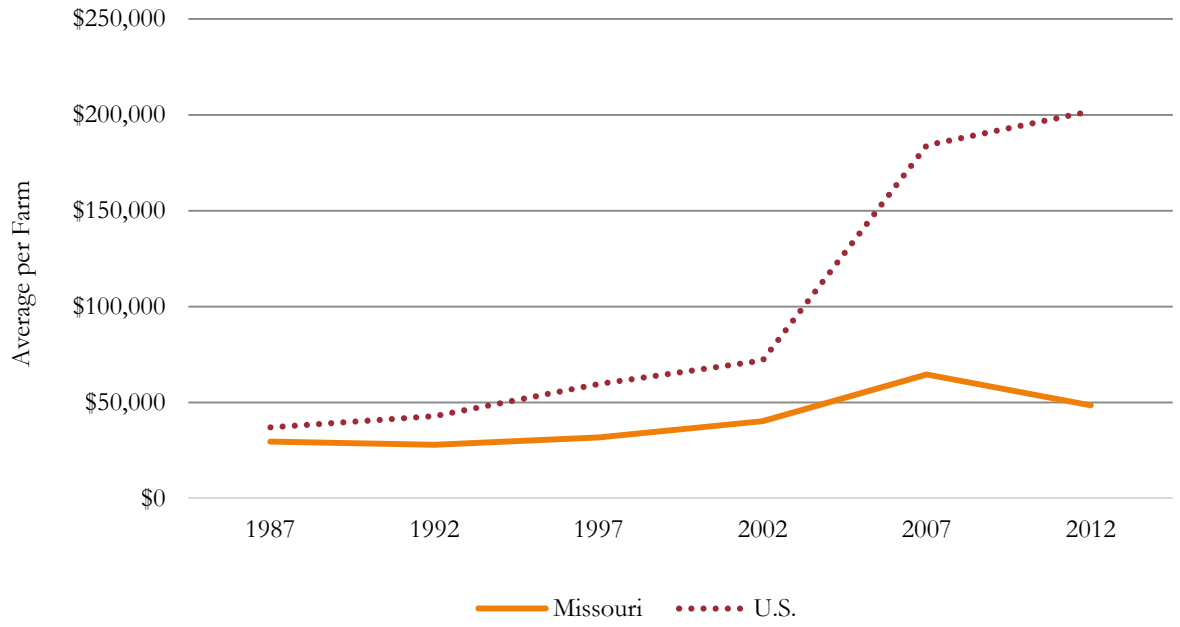
Exhibit 5.3.5 – Dairy Farm Business Debt Repayment Capacity, 2012

Category	Units	All Surveyed States	Missouri
Farms	Number	47,569	1,750
Number of farms with debt	Number	31,384	1,025
Gross cash farm income	Dollars per farm	866,736	178,007
Net farm income	Dollars per farm	164,224	15,406*
Income for debt coverage	Dollars per farm	224,866	21,965
Principal/interest payments	Dollars per farm	53,177	11,367
Debt coverage margin	Dollars per farm	185,269	17,642*
Maximum loan payment	Dollars per farm	85,445	9,782
Total reported debt	Dollars per farm	382,529	85,394
Max feasible debt (7.5%)	Dollars per farm	555,394	116,023
Max feasible debt (10%)	Dollars per farm	519,011	111,835
Repayment capacity use (7.5%)	Percent	68.9	73.6
Repayment capacity use (10%)	Percent	73.7	76.4

* - The estimate is statistically unreliable due to the combination of a low sample size and high sampling error.
Source: USDA, Economic Research Service, Agricultural Resource Management Survey (ARMS)

Since 1987, U.S. dairy farms on average have improved their capacity to generate net cash farm income of operations. For the average U.S. dairy cattle and milk production farm, net cash farm income of operations grew from $37,110 in 1987 to $201,930 in 2012. See Exhibit 5.3.6. For Missouri dairy cattle and milk production farms, net cash farm income of operations has improved; however, the growth hasn't been as strong. The average Missouri dairy cattle and milk production farm generated $29,571 in net cash farm income of operations during 1987. That value increased to $48,569 during 2012, though it had been higher in 2007.

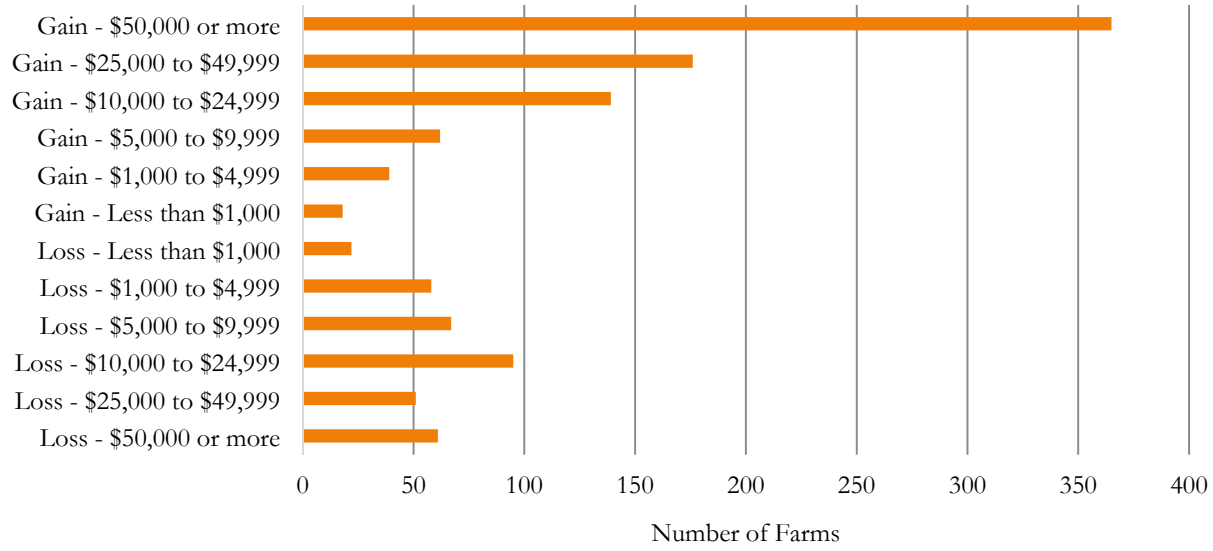
Exhibit 5.3.6 – Missouri and U.S. Average Net Cash Farm Income of Operations on Dairy Cattle and Milk Production Farms, 1987 to 2012



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

During 2012, Missouri dairy cattle and milk production farms predominantly recorded net cash farm income that exceeded a $50,000 gain. Exhibit 5.3.7 illustrates that more than 350 farms indicated that their net cash farm income was more than $50,000. Although most Missouri dairy cattle and milk production farms reported net cash farm income gains during 2012, note that several farms recorded losses. Keep in mind that 2012 was a major drought year, so results will be biased in Missouri. More than 50 farms lost at least $50,000 in net cash farm income in 2012. For these dairy cattle and milk production farms to maintain their long-term viability, they'll need to improve their annual net cash farm income performance.

Exhibit 5.3.7 – Missouri Dairy Cattle and Milk Production Farms, Distribution of Net Cash Farm Income, Gains and Losses, 2012

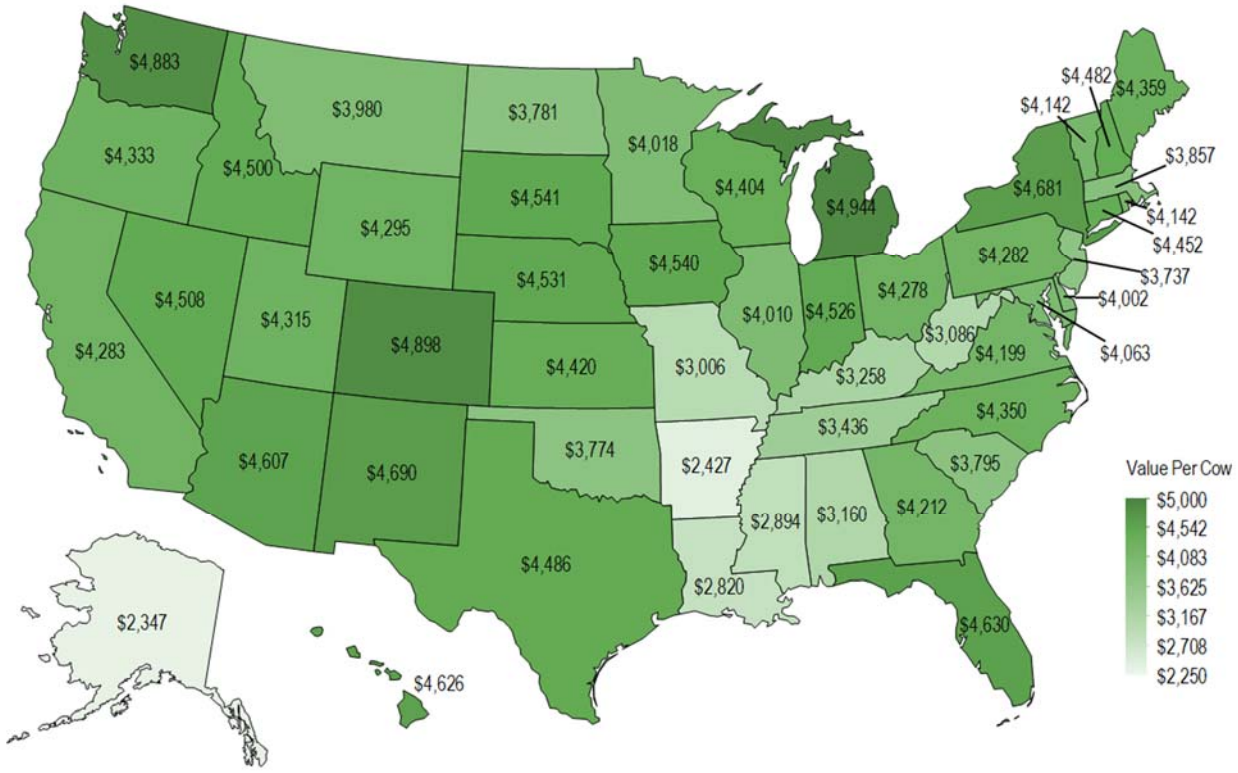


Source: USDA, National Agricultural Statistics Service, Census of Agriculture

5.4 Value of Production

Missouri noticeably averaged less value of milk produced per cow in 2013 than most other states. Only four states had lower values: Alaska, Arkansas, Louisiana and Mississippi. Mid-South states also tended to generate less value of milk per cow than states in other regions. Exhibit 5.4.1 illustrates milk value produced per cow on an average operation. States highlighted in darker colors averaged a higher value of milk per cow than states highlighted in lighter colors. The value of milk includes cash receipts from milk marketing, home consumption and milk fed to calves. States with cows that yielded the greatest value of milk on average were Michigan, Colorado and Washington.

Exhibit 5.4.1 - Value of Milk per Cow, 2013



Source: USDA, National Agricultural Statistics Service

5.5 Land

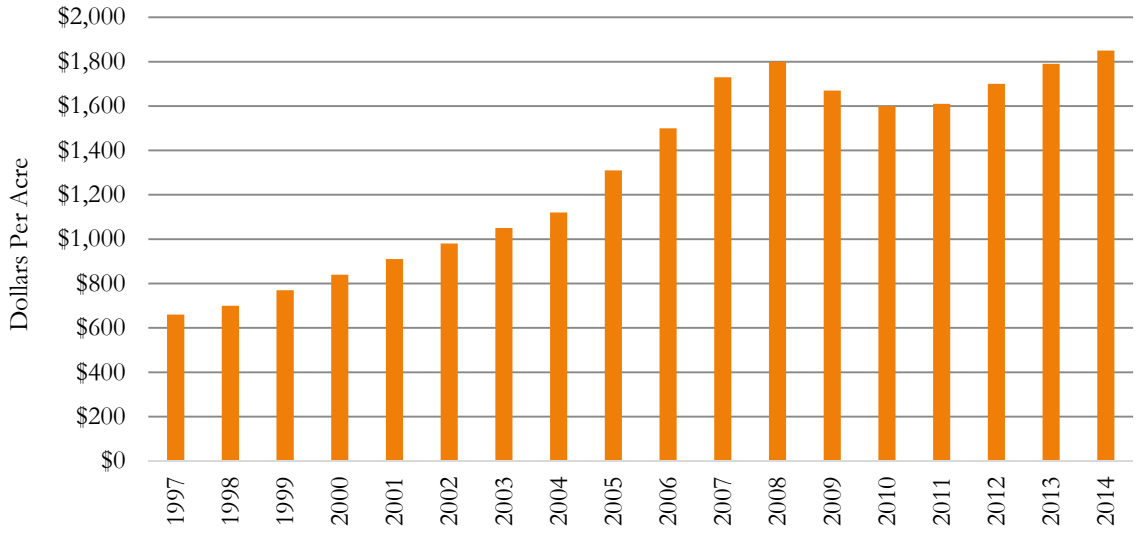
For pasture, Exhibit 5.5.1 shares average values by state for 2014. Pastureland values for each state vary, mainly due to location, land productivity and pressure from alternative uses. In 2014, Missouri pastureland values averaged $1,850 per acre, which is significantly more than pastureland values in many western states and 42.3 percent more than the U.S. average. Between 2013 and 2014, Missouri pasture values increased 3.4 percent, and U.S. pasture value growth averaged 11.1 percent.

Exhibit 5.5.1 – Average Pastureland Values by State, 2014, Dollars per Acre

Source: USDA, National Agricultural Statistics Service

Since 1997, Missouri pasture values have maintained an increasing trend. Exhibit 5.5.2 charts pastureland values from 1997 to 2014. Note that pastureland values steadily increased until 2004. Then, they began to increase quickly. Values recessed somewhat after 2008. However, they've since gained momentum, and they reached their highest point of the observed period during 2014. Between 1997 and 2014, Missouri pastureland values increased 180 percent.

Exhibit 5.5.2 – Missouri Average Pastureland Value, 1997 to 2014, Dollars per Acre



Source: USDA, National Agricultural Statistics Service

Within Missouri, pasture cash rental rates by county vary significantly. See Exhibit 5.5.3. Pasture rental rates ranged from $9.40 per acre in Taney County to $54.00 per acre in Nodaway County. The rental rate averaged $29 per acre in Missouri. These rates reflect rental pasture's relative scarcity and pastureland's productivity and its value to the lessee.

Exhibit 5.5.3 – Average Missouri Pastureland Cash Rent Per Acre, By County, 2014

County	Average Cash Rent		County	Average Cash Rent		County	Average Cash Rent
Adair	$28.50		Gentry	$40.00		Pettis	$33.00
Andrew	$45.00		Grundy	$35.50		Phelps	$18.50
Atchison	$49.50		Harrison	$35.00		Pike	$33.50
Audrain	$32.50		Henry	$37.00		Platte	$30.00
Barry	$21.50		Hickory	$19.00		Polk	$24.00
Barton	$16.50		Holt	$43.50		Pulaski	$21.50
Bates	$37.00		Howard	$32.50		Putnam	$32.00
Benton	$22.00		Howell	$21.50		Ralls	$24.00
Bollinger	$15.50		Iron	$19.00		Randolph	$35.50
Boone	$18.50		Jackson	$34.50		Ray	$43.00
Buchanan	$36.00		Jasper	$34.50		Reynolds	$13.50
Caldwell	$36.00		Jefferson	$13.00		Ripley	$13.50
Callaway	$28.00		Knox	$31.00		Saline	$33.50
Camden	$13.50		Laclede	$18.00		Schuyler	$35.50
Cape Girardeau	$26.50		Lewis	$33.00		Scotland	$32.00
Carroll	$37.00		Lincoln	$24.00		Shannon	$22.00
Carter	$12.50		Linn	$40.00		Shelby	$34.50
Cass	$32.00		Livingston	$23.50		St. Charles	$45.50
Cedar	$29.00		Macon	$31.00		St. Clair	$27.50
Chariton	$38.50		Maries	$20.50		St. Francois	$18.50
Christian	$25.50		Marion	$35.00		Ste Genevieve	$25.00
Clark	$32.00		McDonald	$26.00		Stoddard	$35.50
Clay	$42.00		Mercer	$35.50		Stone	$21.00
Clinton	$45.50		Miller	$22.00		Sullivan	$28.50
Cole	$20.50		Moniteau	$28.00		Taney	$9.40
Cooper	$29.50		Monroe	$28.50		Texas	$28.00
Crawford	$12.50		Montgomery	$24.50		Vernon	$32.00
Dade	$28.00		Morgan	$23.00		Warren	$31.00
Dallas	$22.50		Newton	$29.50		Washington	$11.50
Daviess	$51.50		Nodaway	$54.00		Wayne	$21.00
DeKalb	$35.00		Oregon	$14.50		Webster	$24.00
Dent	$14.50		Osage	$20.00		Worth	$45.50
Franklin	$26.50		Ozark	$15.50		Wright	$21.50
Gasconade	$17.50		Perry	$36.50			

Source: USDA, National Agricultural Statistics Service

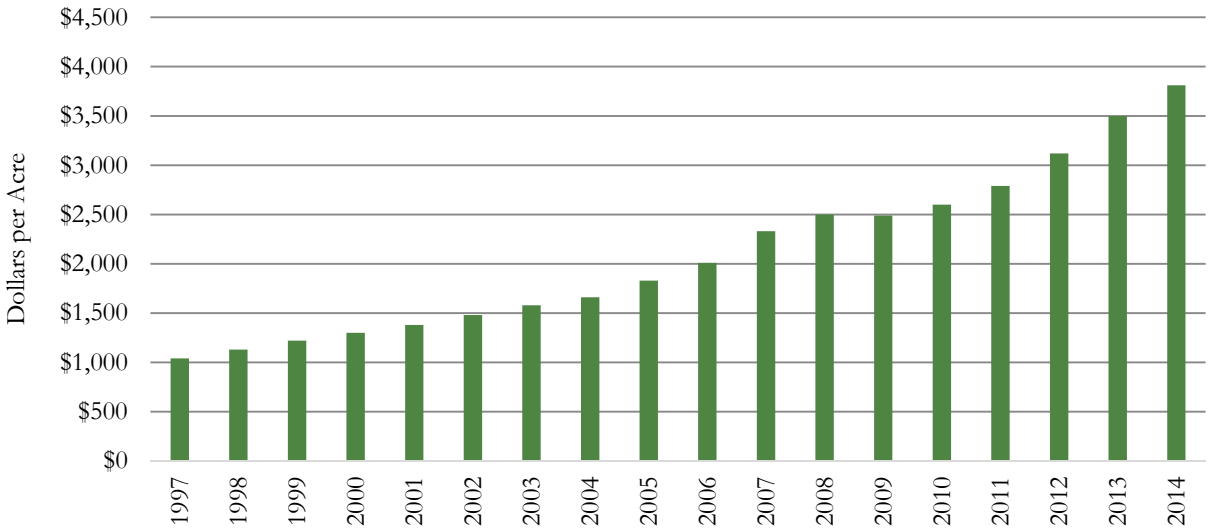
Cropland land values represent critical overhead costs associated with raising dairy cattle because producers typically need land for feed production, such as raising corn silage, and manure application. Relative to other states, Missouri farmland is less expensive than land in most of the states to the east and directly north, and it's more expensive than land in many states west of Missouri. Exhibit 5.5.4 shares average cropland values by state for 2014. The Missouri cropland value averaged $3,810 per acre, which is 7 percent lower than the U.S. average value per acre of $4,100. Between 2013 and 2014, Missouri cropland values increased an estimated 8.9 percent, which was faster growth than U.S. cropland value growth, which averaged 7.6 percent.

Exhibit 5.5.4 – Cropland Value by State, 2014, Dollars per Acre

Source: USDA, National Agricultural Statistics Service

Like pastureland values, Missouri cropland values have also increased since 1997. Exhibit 5.5.5 charts cropland value growth from 1997 to 2014. Relative to Missouri pastureland values, Missouri cropland values increased more during the observed period. Between 1997 and 2014, Missouri cropland values grew more than 266 percent. Just within the past five years, cropland values grew 46.5 percent. In the chart, note that in all but one year prices maintained the increasing trend. From 2008 to 2009, cropland values dropped slightly, but they quickly rebounded in 2010.

Exhibit 5.5.5 – Average Missouri Cropland Value, 1997 to 2014, Dollars per Acre

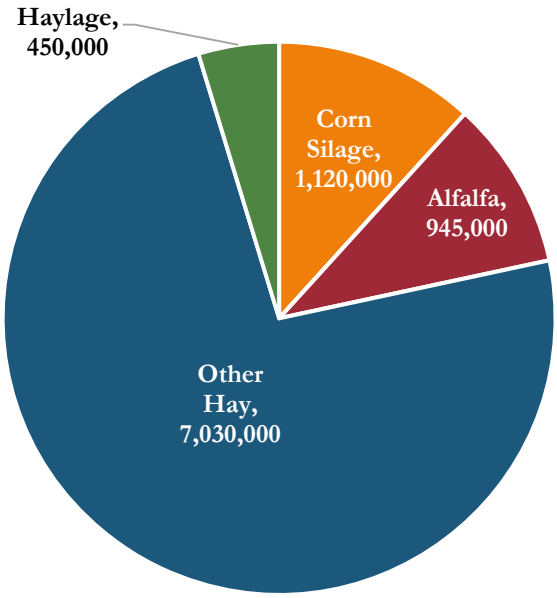


Source: USDA, National Agricultural Statistics Service

5.6 Forages

Missouri produces several types of forage: hay, haylage, grass silage and greenchop. Exhibit 5.6.1 shares 2013 forage production data for Missouri in tons. The state's total forage production exceeded 9.5 million tons. As illustrated, "other hay" was the predominant forage produced during 2013. It represented nearly three-fourths of the state's total forage production. Corn silage, alfalfa and haylage followed "other hay" as the most popular forages produced.

Exhibit 5.6.1 – Missouri Forage Production in Tons, 2013



Source: USDA, National Agricultural Statistics Service

Relative to other states, Missouri ranked 11th for total forage production during 2013. Exhibit 5.6.2 lists states ranked in the top 15 for their 2013 total forage production. Of these states, Texas was the largest "other hay" producer during 2013, and Missouri produced the second most "other hay." Of the states observed, California led in alfalfa hay production, and Wisconsin led in both haylage and corn silage production. The three states that produced the most forage during 2013 – Wisconsin, California and New York – raised more corn silage than any other forage. These states also led the U.S. as the three states that produced the most milk during 2013.

Exhibit 5.6.2 – Top 15 States in Forage Production in Tons, 2013

State	Alfalfa Hay	Other Hay	Haylage	Corn Silage	Total
	tons	*tons*	*tons*	*tons*	*tons*
Wisconsin	2,860,000	900,000	6,600,000	16,170,000	26,530,000
California	6,120,000	1,836,000	3,472,000	10,997,500	22,425,500
New York	770,000	2,160,000	4,184,000	8,500,000	15,614,000
Texas	630,000	8,250,000	940,000	3,800,000	13,620,000
Pennsylvania	986,000	1,932,000	2,783,000	7,790,000	13,491,000
Minnesota	2,470,000	1,425,000	1,996,000	6,270,000	12,161,000
Idaho	4,256,000	720,000	1,051,000	5,850,000	11,877,000
Iowa	2,409,000	968,000	749,000	7,410,000	11,536,000
Michigan	1,891,000	627,000	2,123,000	5,950,000	10,591,000
South Dakota	3,780,000	2,125,000	380,000	3,640,000	9,925,000
Missouri	945,000	7,030,000	450,000	1,120,000	9,545,000
Nebraska	2,415,000	2,520,000	258,000	4,160,000	9,353,000
Kansas	1,925,000	4,620,000	228,000	1,950,000	8,723,000
Kentucky	660,000	5,280,000	0	1,680,000	7,620,000
North Dakota	3,240,000	1,850,000	0	1,680,000	6,770,000

Source: USDA, National Agricultural Statistics Service

On a tons per cow basis, North Dakota led other states in both alfalfa hay and corn silage production as it produced 180 tons per cow and 93.3 tons per cow, respectively, during 2013. Exhibit 5.6.3 shares alfalfa hay and corn silage production in tons per cow for several U.S. states. Based on tons of production per cow, Nebraska and South Dakota ranked second and third, respectively, for alfalfa hay and corn silage production in 2013.

Exhibit 5.6.3 – Top 15 States in Forage Production, Alfalfa and Corn Silage, Tons/Cow, 2013

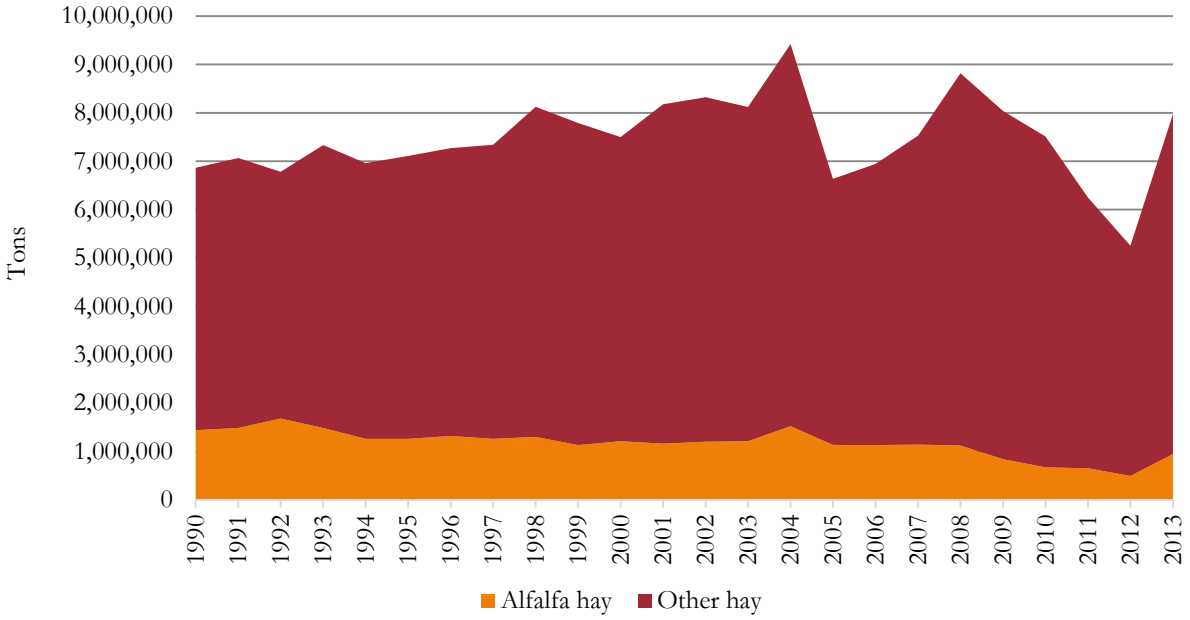
State	Alfalfa Hay *Tons/cow*	Corn Silage *Tons/cow*
Wisconsin	2.3	12.7
California	3.4	6.2
New York	1.3	13.9
Texas	1.4	8.7
Pennsylvania	1.8	14.6
Minnesota	5.3	13.5
Idaho	7.4	10.2
Iowa	11.6	35.6
Michigan	5.0	15.7
South Dakota	40.2	38.7
Missouri	10.3	12.2
Nebraska	44.7	77.0
Kansas	14.4	14.6
Kentucky	9.3	23.7
North Dakota	180.0	93.3

Source: Derived from USDA, National Agricultural Statistics Service

Missouri is a major hay-producing state. On average, the state produced just more than 7 million tons of hay per year between 2009 and 2013. Exhibit 5.6.4 illustrates the trend in Missouri alfalfa and all other hay production from 1990 to 2013. Missouri steadily increased its hay production from 1990 to the early 2000s. Since then, production has been more volatile. Note that total hay production was lowest in 2012, when severe drought limited hay growth and production potential.

From 2009 to 2013, alfalfa production on average represented 10.2 percent of all Missouri-produced hay. "Other hay" usually is tall fescue or a grass-legume hay mix that contains fescue. Missouri farmers do not sell most hay they produce. Instead, they typically use it for on-farm animal feeding.

Exhibit 5.6.4 – Trend in Missouri Hay Production, 1990 to 2013

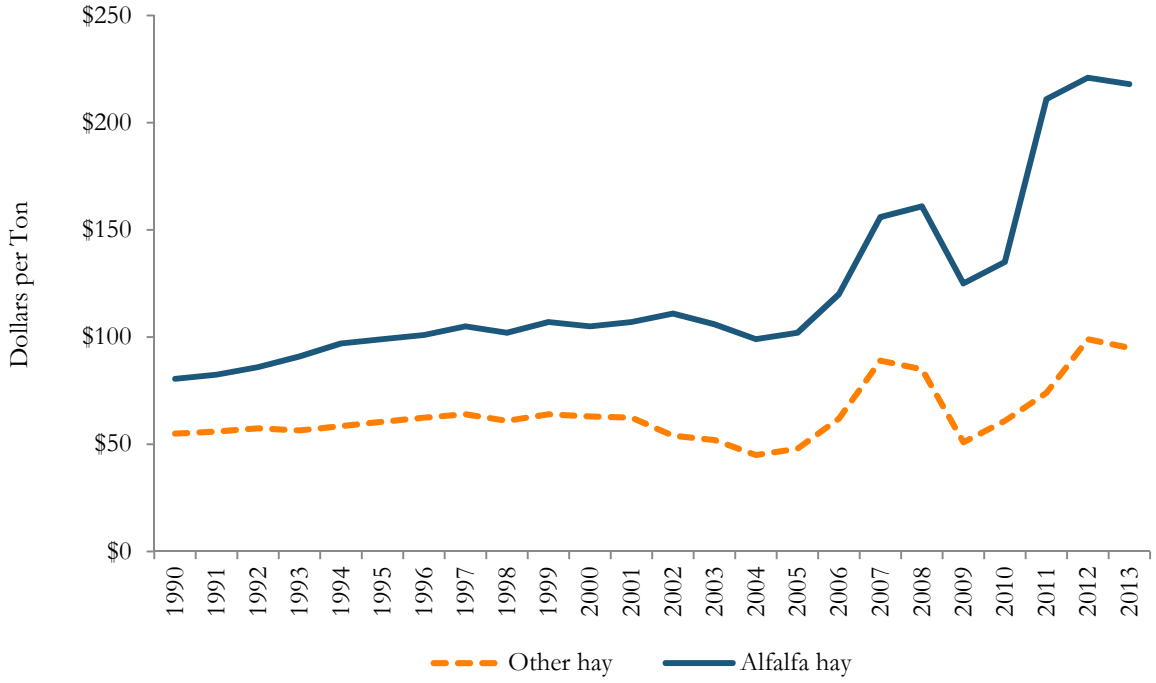


Source: USDA National Agricultural Statistics Service

Hay prices are a function of hay demand and supply. Exhibit 5.6.5 charts Missouri alfalfa and other hay prices from 1990 to 2013. During the observed period, prices noticeably jumped two different times. The first occurred in the mid-2000s, and the second occurred from 2010 to 2012. Production output influenced both price movements, as noted when correlating production data from the previous exhibit and the price trends shown in Exhibit 5.6.5.

Exhibit 5.6.5 also highlights the difference between alfalfa hay and other hay prices. Both prices move in a similar pattern. However, note the premium paid for alfalfa hay. From 2009 to 2013, alfalfa hay prices averaged being 2.4 times more than other hay prices in Missouri.

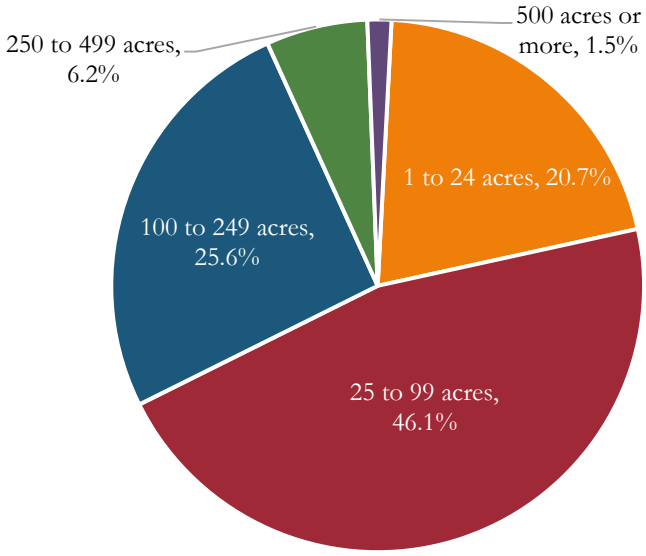
Exhibit 5.6.5 – Missouri Average Hay Price Received by Farmers, 1990 to 2013



Source: USDA, National Agricultural Statistics Service

In Missouri, 46.1 percent of dairy cattle and milk production farms harvested between 25 acres and 99 acres of forage during 2012. See Exhibit 5.6.6. Slightly more than one-quarter harvested 100 forage acres to 249 forage acres in 2012. Very few Missouri dairy cattle and milk production farms – 7.7 percent of those reporting forage production – harvested at least 250 forage acres in 2012, and about one-fifth harvested less than 25 acres of forage.

Exhibit 5.6.6 –Number of Dairy Farms by Forage Acres Harvested, 2012



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

5.7 Co-Products

Ethanol facilities, soy crush plants, biodiesel facilities and cotton gins generate co-products that Missouri dairy farmers may use when formulating rations for their herds. At ethanol production facilities, a plant's outputs include not only ethanol but also dried distillers grains that have feed value. Within Missouri, the Renewable Fuels Association reports that six ethanol facilities operate. The proximity of these Missouri-based plants and other nearby plants in surrounding states provides Missouri cattle producers with several outlets from which they could source co-product feeds. Exhibit 5.7.1 lists Missouri ethanol facilities and further outlines details about these plants.

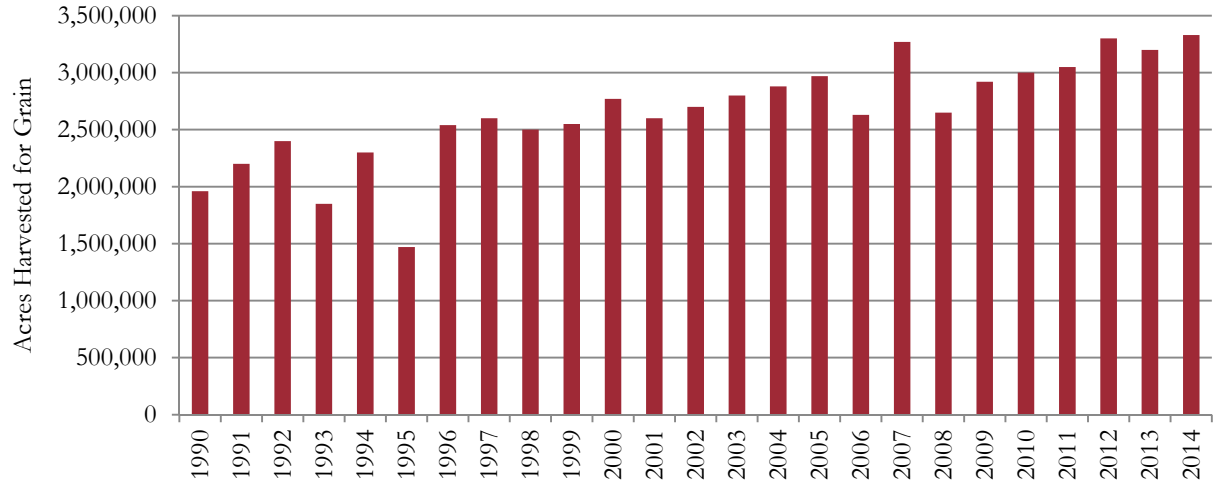
Exhibit 5.7.1 – Missouri Corn Ethanol Production Facilities

Facility	Location	Nameplate Capacity (mgy)	Operating Production (mgy)	DDG Capacity (tons)*
Golden Triangle Energy, LLC	Craig, MO	20	5	15,179
Lifeline Foods	St. Joseph, MO	50	50	151,786
Mid-Missouri Energy, Inc.	Malta Bend, MO	50	50	151,786
POET Biorefining – Laddonia	Laddonia, MO	50	50	151,786
POET Biorefining – Macon	Macon, MO	46	46	139,643
Show Me Ethanol	Carrollton, MO	55	55	166,964

*Based on 17 lbs of DDG per bushel used and 2.8 gallons of ethanol per bushel.
Source: Renewable Fuels Association

Since 1990, Missouri farmers have sharply increased their corn production output. Exhibit 5.7.2 illustrates the change in Missouri corn acreage harvested for grain production. In 1990, Missouri harvested 1.96 million corn acres for grain production. Total corn acreage harvested for grain increased to 3.33 million acres by 2014. Between these two periods, acreage harvested grew 69.9 percent. Increasing corn production signals a possible increase in co-products available for feed.

Exhibit 5.7.2 – Missouri Corn Acreage Harvested for Grain, 1990 to 2014



Source: USDA, National Agricultural Statistics Service

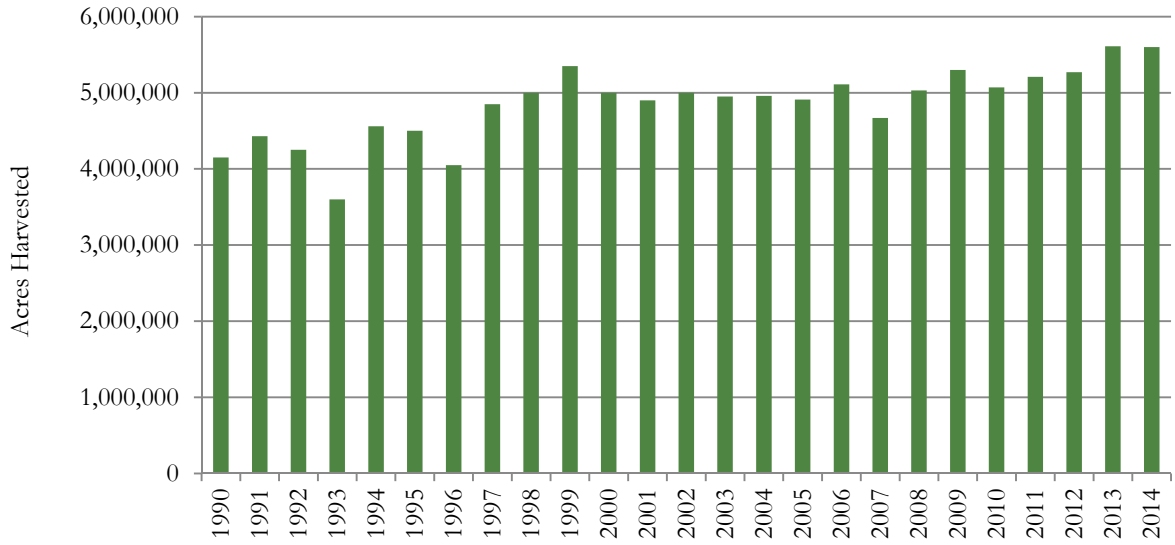
At soy crushing facilities, meal and hulls are two outputs that have feed value in livestock rations. In Missouri, four soybean crushing facilities operate. Exhibit 5.7.3 lists these facilities and their locations. Three facilities operate in western Missouri, and one operates in eastern Missouri. In addition to these facilities buying Missouri soybeans and supplying processed products to Missouri buyers, two Illinois facilities – one in Quincy and one in Cairo – also serve eastern Missouri, and one Kansas facility in Emporia serves western Missouri.

Exhibit 5.7.3 – Missouri Soybean Crushing Facilities

Facility	Location
Ag Processing, Inc.	St. Joseph, MO
Cargill	Kansas City, MO
ADM	Deerfield, MO
ADM	Mexico, MO

Like corn acreage harvested, soybean acreage harvested has also grown since 1990. During 1990, Missouri producers harvested 4.15 million acres, and harvested acreage increased to 5.6 million acres in 2014. Exhibit 5.7.4 illustrates the increase in harvested soybean acreage. The 34.9 percent growth indicates that more soybean products may be available for incorporating into livestock feed rations.

Exhibit 5.7.4 – Missouri Soybean Acreage Harvested for Grain, 1990 to 2014



Source: USDA, National Agricultural Statistics Service

Like soybean crushing plants, cotton gins also yield meal and hulls that have potential application in animal feeds. The Cotton Board reports active gins in its gin code list for 2014. According to that list, 29 active cotton gins operate in Missouri, and these facilities are concentrated in five southeastern counties: Dunklin, New Madrid, Pemiscot, Scott and Stoddard. Exhibit 5.7.6 lists these facilities by name and county. Dunklin County has more facilities than any other county. For dairies located in Missouri, cotton gin byproducts may be viable feed ingredients.

Exhibit 5.7.6 – Missouri Cotton Gins

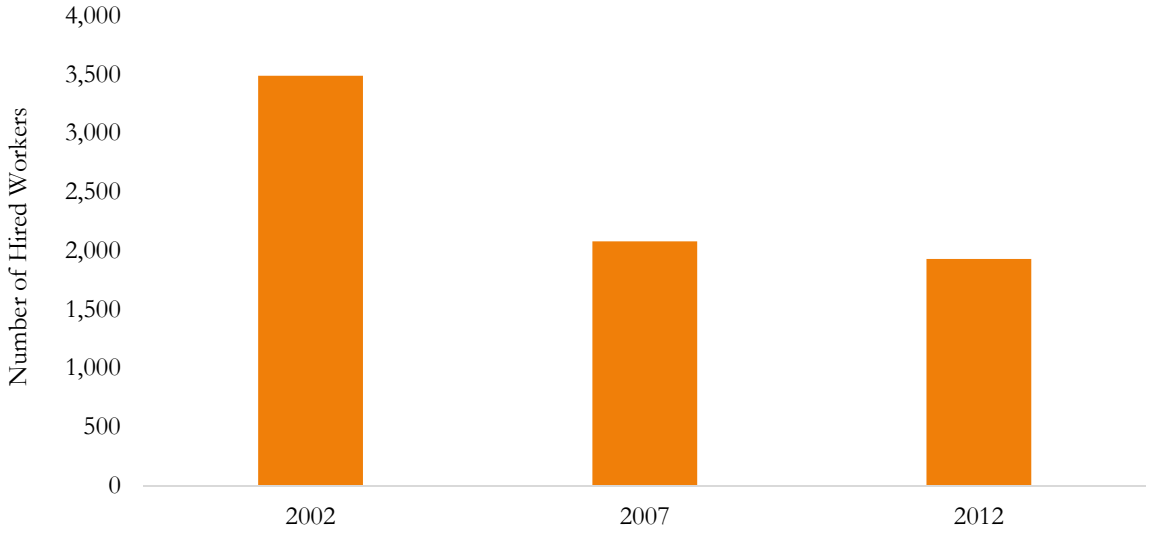
Facility	City	County
B&B Cotton Company	Campbell, MO	Dunklin
Cardwell Coop Gin #1	Cardwell, MO	Dunklin
Little River Gin, Inc.	Hornersville, MO	Dunklin
Dunklin Graves Kennett Gin	Kennett, MO	Dunklin
Stephens Gin Company	Kennett, MO	Dunklin
Stokes-Mayberry Gin Co., Inc.	Malden, MO	Dunklin
Bernie Farmers Gin, LLC	Malden, MO	Dunklin
Farmers Union Gin Company	Senath, MO	Dunklin
Four Way Gin Company	Senath, MO	Dunklin
Sandy Ridge Cotton Co.	Malden, MO	Dunklin
Whiteoak Gin Company, Inc.	Whiteoak, MO	Dunklin
Dalton Cotton Company, Inc.	Senath, MO	Dunklin
McCord Gin Company, Inc.	Gideon, MO	New Madrid
Richardson Gin, Inc.	Marston, MO	New Madrid
Bootheel Cotton Company	Matthews, MO	New Madrid
A.C. Riley Cotton Company	New Madrid, MO	New Madrid
Mahan Gin Company	Parma, MO	New Madrid
Portageville Farmers Gin, Inc.	Portageville, MO	New Madrid
D. G. & G., Inc.	Matthews, MO	New Madrid
Caruthersville Gin, Inc.	Caruthersville, MO	Pemiscot
Cooter Cotton Gin, Inc.	Cooter, MO	Pemiscot
L. Berry Gin Company	Holland, MO	Pemiscot
Peach Orchard Gin Company, Inc.	Gideon, MO	Pemiscot
Still Gin Company	Steele, MO	Pemiscot
Crowder Gin Company	Sikeston, MO	Scott
Vanduser Gin Co., Inc.	Vanduser, MO	Scott
J. P. Ross Cotton Co., Inc.	Essex, MO	Stoddard
D. G. & G. Cotton Gin, Inc.	Sikeston, MO	Stoddard
Stoddard County Cotton Co.	Bernie, MO	Stoddard

Source: The Cotton Board

5.8 Labor

As the Missouri dairy industry has constricted, it has decreased the number of hired workers needed to facilitate operations. Based on data reported in the last three agriculture censuses, Exhibit 5.8.1 charts the number of workers hired by dairy cattle and milk production farms. In 2012, Missouri dairy cattle and milk production farms employed just 55 percent of the workers that it had employed in 2002. Although the industry's hired worker total has decreased, the dairy cattle and milk production farms industry still supported 1,931 hired workers in 2012.

Exhibit 5.8.1 – Missouri Hired Farm Labor on Dairy Cattle and Milk Production Farms (NAICS Code 11212), 2002, 2007 and 2012



Source: USDA, National Agricultural Statistics Service, Census of Agriculture

Farm labor wages in Missouri have risen strongly in recent years, and this reflects a national trend. In the 10-year period presented in Exhibit 5.8.2, the price of field and livestock labor in Missouri and Iowa increased from $9.28 per hour in 2003 to $12.22 an hour in 2013. The $2.94 per hour increase equates to 31.7 percent growth in labor costs. At an annual compound rate, field and livestock hired worker wage rates increased 2.53 percent.

Exhibit 5.8.2 - Farm Labor Wage Rates, Missouri and Iowa (Cornbelt II), 2003 to 2013

Year	All Hired Workers	Field Hired Worker	Field and Livestock Hired Worker
	(Dollars per hour)		
2003	$9.75	$9.21	$9.28
2004	$9.45	$8.79	$8.95
2005	$10.17	$9.01	$9.50
2006	$10.65	$9.39	$9.95
2007	$11.10	$9.89	$10.44
2008	$11.24	$10.57	$10.77
2009	$11.22	$10.64	$10.86
2010	$11.18	$10.96	$11.03
2011	$11.67	$11.84	$11.50
2012	$11.85	$11.80	$11.41
2013	$13.07	$12.19	$12.22

Source: USDA, National Agricultural Statistics Service, Farm Labor Summary

5.9 Herd Management

The Dairy Herd Information Association (DHIA) records several data indicators that may help dairy producers make management decisions. The charts in this section share data downloaded from the DHIA database. Note that the southeast category shared in these exhibits represents South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Kentucky and Tennessee. Missouri had 264 farms on DHI in October 2014, reflecting 29.5% of all Grade A Dairies or 21.2% of all dairy farms.

Missouri herds tend to average fewer lactating cows than average herds in the other three areas. Feed costs and income were two other factors that varied for Missouri and the other geographic areas. In Missouri and the southeast U.S. states, feed costs tend to be higher when evaluated on a milk production basis. See Exhibit 5.9.1. During October 2014, Missouri dairy farms incurred $9.10 in feed costs per 100 pounds of milk produced. The average U.S. dairy farm, however, spent $1.50 less per hundredweight produced for feed. Missouri and the southeast U.S. region both performed poorly from a milk production value perspective during October 2014. The U.S. average for days in milk is lower than the averages for Missouri, surrounding states and the southeast U.S. Age of first lactation and mortality rate are similar for the four geographic areas reported.

Exhibit 5.9.1 – General DHIA Statistics, Missouri vs. Other Areas, October 2014

Category	Unit	Missouri		Surrounding States		Southeast U.S.		U.S.	
		Herds	Avg.	Herds	Avg.	Herds	Avg.	Herds	Avg.
Number of Cows-All Lact	Number	264	135.6	1,424	162.1	611	234.0	12,545	172.3
Number of Cows-1st Lact	Number	264	44.4	1,418	63.5	605	93.3	12,530	66.2
Number of Cows-2nd Lact	Number	263	38.6	1,422	45.0	610	62.6	12,531	47.9
Number of Cows-3rd Lact	Number	263	52.9	1,417	54.2	604	80.1	12,506	58.5
Days in Milk	Days	264	194.6	1,424	192.7	611	199.6	12,545	184.8
Age of 1st Lact Cows	Months	263	26.8	1,418	26.2	606	26.5	12,519	26.0
Cows Left Herd-All Lact	Percent	248	35.0	1,368	38.3	573	37.6	12,040	36.7
Cows Died-All Lact	Percent	264	5.7	1,424	5.8	611	5.7	12,545	5.0
Daily Val Prod-Milk Cows	Dollars	264	$13.3	1,424	$14.9	611	$13.30	12,543	$15.5
Daily Feedcost-Milk Cows	Dollars	115	$4.9	421	$5.3	164	$5.70	2,118	$4.9
Daily Feedcost/Cwt Milk	Dollars	121	$9.1	438	$8.5	164	$10.30	2,285	$7.6
Daily Inc/Feed-Milk Cows	Dollars	121	$9.0	440	$9.8	165	$8.80	2,295	$11.1

Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

Of the four geographic areas evaluated, Missouri herds averaged the lowest rolling milk production, daily milk production, rolling fat content and rolling protein content. Exhibit 5.9.2 further describes production-related statistics. The peak milk data indicates that the peak production difference between the total U.S. and Missouri increases between the first lactation period and the second to third lactation periods. Production output measured in the rolling milk value is important because production output greatly influences a producer's income potential. The daily milk production, projected milk production and standardized milk production data sets all suggest that Missouri lags the averages for surrounding states, the southeast U.S. and the U.S. as a whole.

Exhibit 5.9.2 – Production DHIA Statistics, Missouri vs. Other Areas, October 2014

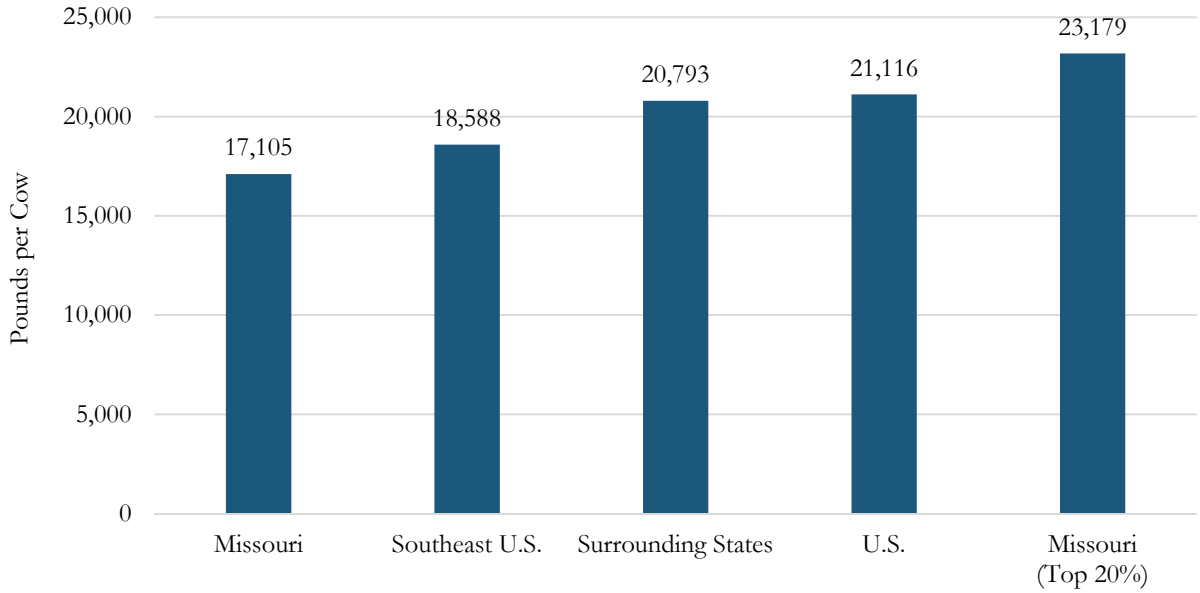
Category	Unit	Missouri		Surrounding States		Southeast U.S.		U.S.	
		Herds	Avg.	Herds	Avg.	Herds	Avg.	Herds	Avg.
Rolling Milk	Pounds	249	17,105.0	1,377	20,792.6	576	18,587.5	12,077	21,115.9
Rolling Fat	Pounds	249	660.5	1,363	787.9	537	688.7	11,980	807.8
Rolling Protein	Pounds	249	546.7	1,363	654.9	537	576.2	11,973	655.3
Daily Milk-Milk cows	Pounds	260	53.1	1,415	63.8	601	55.2	12,412	65.7
Daily Fat	Percent	264	3.9	1,412	3.8	579	3.7	12,455	3.8
Daily Protein	Percent	264	3.2	1,412	3.2	579	3.2	12,451	3.1
Peak Milk 1st Lact	Pounds	259	60.9	1,402	73.0	595	66.8	12,415	73.7
Peak Milk 2nd Lact	Pounds	259	75.8	1,407	91.1	597	82.5	12,418	92.4
Peak Milk 3rd+ Lact	Pounds	259	83.6	1,404	98.6	597	89.4	12,406	100.1
Proj 305 Day ME Milk	Pounds	262	18,481.5	1,417	22,389.4	605	20,434.6	12,508	22,904.1
Standardized 150 Day Milk	Pounds	262	59.7	1,421	71.4	607	63.6	12,473	72.1

Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

Although production output is important, compositional data related to fat and protein also matter because they too affect income. Fat and protein are two components to prioritize. Again, on a rolling basis, Missouri lags the other three geographic areas in delivering high fat and protein levels. Note that the daily component data indicate that Missouri milk performs better than the average U.S. milk. During October 2014, daily fat content averaged 3.9 percent in Missouri relative to 3.8 percent for the U.S., and daily protein content averaged 3.2 percent in Missouri relative to 3.1 percent for the U.S. Missouri dairies would benefit from optimizing fat and protein components on a rolling basis.

It is also important to consider, however, that some producers in Missouri are exceeding rolling herd averages from the four geographic regions. Exhibit 5.9.3 shows the rolling herd averages from regions noted in the previous exhibit, and it includes the average from Missouri producers that were in the top 20 percent for rolling herd averages. Missouri's top 20 percent producers averaged 23,179 pounds per cow during October 2014, which is nearly 10 percent higher than the U.S. average.

Exhibit 5.9.3 – Rolling Herd Average, October 2014



Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

To improve udder health, producers target reducing somatic cell counts. A somatic cell count reading indicates the extent to which a cow's udder is experiencing inflammation and mastitis. Exhibit 5.9.4 shares four somatic cell count measures for Missouri, its surrounding states, the southeastern U.S. and the U.S. average. For the actual somatic cell count and the somatic cell count score, only the southeast U.S. scored higher than Missouri. During October 2014, 62.4 percent of Missouri milk cows scored between zero and three for somatic cell count.

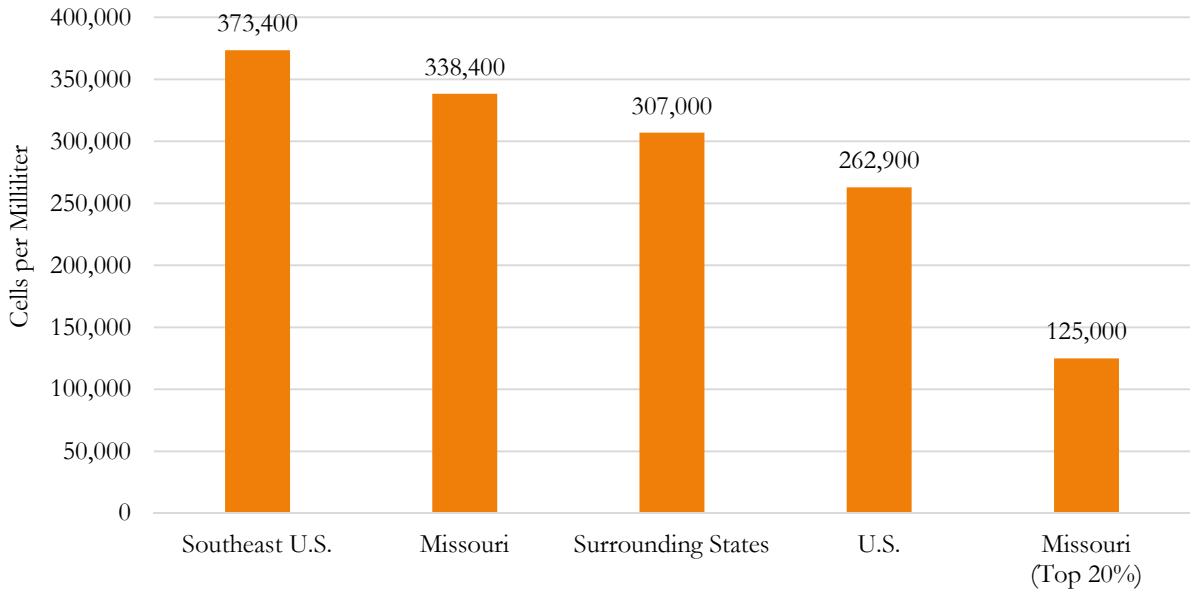
Exhibit 5.9.4 – Udder Health DHIA Statistics, Missouri vs. Other Areas, October 2014

Category	Unit	Missouri		Surrounding States		Southeast U.S.		U.S.	
		Herds	Avg.	Herds	Avg.	Herds	Avg.	Herds	Avg.
SCC Actual	x thousands	262	338.4	1,383	307.0	543	373.4	11,866	262.9
SCC Score	Linear or log	264	3.0	1,405	2.9	546	3.2	12,275	2.7
Cows (SCC of 0-3)	Percent	264	62.4	1,405	64.3	546	57.9	12,280	68.5
Cows (<41D with SCC>4)	Percent	242	32.8	1,394	29.0	595	32.8	12,281	24.2

Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

Exhibit 5.9.5 demonstrates the somatic cell count averages for the four geographic regions along with Missouri producers that were in the top 20 percent in milk quality. Note that Missouri's top 20 percent averaged 125,000 cells per milliliter, under half the size of the U.S. average of 262,900. This indicates that some Missouri milk producers have had success in managing somatic cell counts.

Exhibit 5.9.5 – Somatic Cell Counts, October 2014



Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

Compared with the U.S. average, Missouri dairy cows had a lower pregnancy rate, more days open, longer time span to first service and a lower share for heats observed per year based on October 2014 DHIA data. These data indicate several reproduction-related improvement needs for Missouri dairy herds. Exhibit 5.9.6 provides these data points and other 2014 reproduction-related DHIA statistics for Missouri, its surrounding states, the southeastern U.S. and the U.S. as a whole. Although Missouri dairy cows did not perform as well on several reproduction measures during 2014, they did well on a few measures. Relative to the U.S. average, Missouri dairy cows had a better first service conception rate and fewer abortions for the year, based on the October 2014 data.

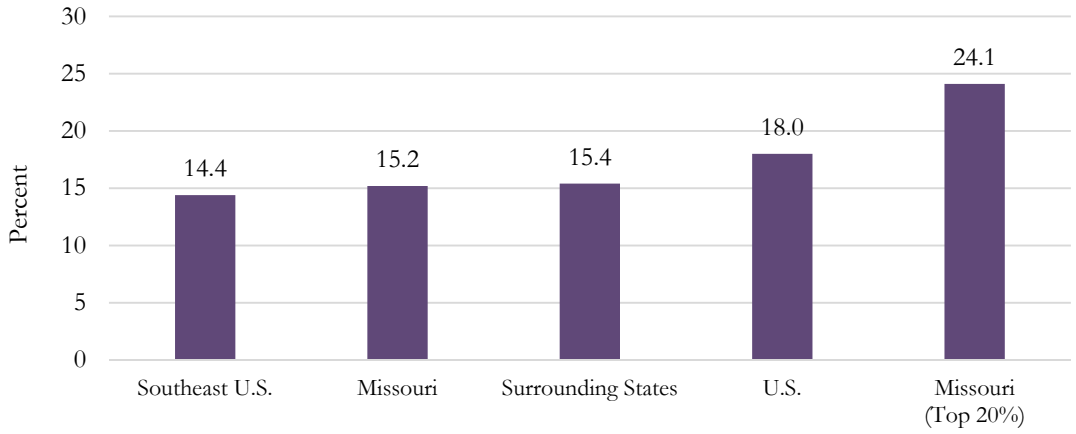
Exhibit 5.9.6 – Reproduction DHIA Statistics, Missouri vs. Other Areas, October 2014

Category	Unit	Missouri		Surrounding States		Southeast U.S.		U.S.	
		Herds	Avg.	Herds	Avg.	Herds	Avg.	Herds	Avg.
Preg Rate-Year Ave	Percent	156	15.2	876	15.4	388	14.4	10,218	18.0
Days Open-Proj Min-Total Herd	Days	262	177.6	1,414	171.1	604	177	12,499	152.6
Proj Calving Interval	Months	263	15.1	1,421	14.9	608	15.1	12,536	14.3
Actual Calving Interval	Months	260	13.9	1,421	14.1	606	14	12,526	13.7
Voluntary Waiting Period	Days	264	57.5	1,424	55.3	611	57.6	12,545	58.7
Days to 1st Serv-Total Herd	Days	240	98.6	1,334	100.2	579	102.8	12,172	93.1
Con Rate for Past 12M-1st Serv	Percent	264	45.7	1,424	43.5	611	48.4	12,545	41.3
Serv per Preg-All Lact	Number	240	2.6	1,334	2.7	581	2.5	12,172	2.8
Heats Observed for Year	Percent	222	36.3	1,267	37.9	524	34.9	11,795	44.4
Abortions in Past Year	Number	264	0.4	1,424	0.8	611	1.6	12,545	2.4

Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

Based on the reproduction-related discussion from the previous exhibit, Exhibit 5.9.7 adds Missouri's top 20 percent operations based on reproduction to evaluate their pregnancy rates relative to rates recorded in the other four geographic areas. The chart illustrates that the pregnancy rate recorded by the top 20 percent of Missouri producers, which averaged 24.1 percent, clearly exceeds the U.S. average of 18 percent.

Exhibit 5.9.7 – Pregnancy Rates, October 2014



Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

5.10 Organic Milk Production

Organic has become an alternative dairy production method and marketing niche. During the 2009 recession, a Missouri organic milk marketing cooperative lost its organic milk supply contract. This loss of marketing channel caused several certified organic dairies to permanently shift back to conventional production. Nine farms in Missouri with milk cows had organic certification in 2011, based on the USDA 2011 Certified Organic Production Survey. On Dec. 31, 2011, Missouri certified organic farms had 608 milk cows. See Exhibit 5.10.1. All Missouri organic dairy farms sell their milk as certified organic. In 2011, Missouri organic milk sales exceeded 6.95 million pounds. In value, those sales totaled $1.75 million, or an estimated $25.25 per hundredweight. Considering that the Missouri milk price received averaged $20.70 per hundredweight in 2011, the organic premium was an estimated 22 percent.

Exhibit 5.10.1 – Missouri Organic Dairy Sector, 2011

	2011 Survey
Certified organic dairy farms	9
Milk cow inventory (Dec. 31, 2011)	608
Farms selling organic products	9
Certified organic milk sales (pounds)	6,957,000
Certified organic milk sales (dollars)	$1,756,921
Estimated average milk price per cwt.	$25.25

Source: USDA, National Agricultural Statistics Service

Thirty-eight states had at least one organic farm with milk cows, and 1,848 organic farms with milk cows operated in the U.S. during 2011. U.S. organic farms had 199,737 milk cows on Dec. 31, 2011. During that year, Missouri ranked 18th for organic dairy farms and 20th for organic milk cow inventory. Exhibit 5.10.2 shares the top 10 states and Missouri based on their 2011 organic cow inventory. Note that the average estimated organic dairy farm size tended to be largest in Texas, California and Oregon. In Missouri, the average organic dairy farm maintained an estimated 67.6 organic dairy cows during 2011.

Exhibit 5.10.2 – Top 10 States and Missouri for Organic Milk Cow Inventory, Dec. 31, 2011

State	Inventory	% of U.S. Inventory	Estimated Average Cows Per Farm
California	32,939	16.5%	451.2
Texas	26,225	13.1%	3,278.1
Wisconsin	23,115	11.6%	57.9
New York	17,471	8.7%	72.5
Oregon	16,256	8.1%	378.0
Pennsylvania	11,996	6.0%	50.6
Vermont	11,813	5.9%	64.2
Minnesota	9,381	4.7%	81.6
Ohio	6,721	3.4%	49.8
Washington	6,570	3.3%	187.7
Missouri	608	0.3%	67.6

Source: USDA, National Agricultural Statistics Service

From a U.S. perspective, 1,823 certified organic dairy farms sold milk during 2011. Of those sales, the farms sold most milk as a certified organic product; however, not all milk sales from these farms were certified organic. By quantity, certified organic milk sales represented 99.8 percent of milk sales made by organic farms in 2011. Farms sold the remaining milk as conventional milk. In terms of organic milk sales, Missouri ranked 14th for sales value during 2011. Exhibit 5.10.3 lists the top 10 states by organic milk sales; note that these are certified organic farms making organic milk sales. Texas, Wisconsin and Oregon had the highest organic milk sales values in 2011. The table also approximates price per hundredweight given the organic milk sales volume and value. The U.S. estimated price per hundredweight averaged $27.35.

Exhibit 5.10.3 – Organic Milk Sales Value and Volume from Certified Organic Farms in Top 10 States and U.S., 2011

State	Sales Value	Sales Volume (pounds)	Estimated Price Per cwt.
Texas	$120,232,218	423,558,952	$28.39
Wisconsin	$82,151,746	313,298,106	$26.22
Oregon	$69,140,278	259,213,324	$26.67
New York	$60,058,757	218,121,034	$27.53
Pennsylvania	$42,579,601	148,440,277	$28.68
Vermont	$41,702,950	149,649,913	$27.87
Minnesota	$33,020,397	124,134,301	$26.60
Idaho	$25,310,940	93,922,456	$26.95
Maine	$11,264,907	39,770,451	$28.32
Iowa	$10,983,672	41,353,802	$26.56
U.S.	$763,381,231	2,791,430,858	$27.35

Source: USDA, National Agricultural Statistics Service

Production costs are significantly higher for producing organic milk compared with producing conventional milk. Exhibit 5.10.4 lists organic and conventional milk production costs for 2010. Note that USDA doesn't report costs for Missouri, so this budget presents costs for the Corn Belt region, which is composed of Missouri, Iowa, Illinois and Indiana. Relative to the conventional dairies, organic dairies incur significantly more for feed; bedding and litter; repairs; other operating costs, which include the third-party organic certification; opportunity cost of unpaid labor; capital recovery of machinery and equipment; and general farm overhead. In total, these production cost budgets suggest that organic milk production in Missouri required a 43.2 percent greater investment to produce one hundredweight of milk during 2010. On average, U.S. milk production costs were 80.3 percent higher for organic producers than conventional producers during 2010.

Exhibit 5.10.4 – Organic Milk Cost of Production per Cwt. Sold, 2010

	Conventional		Organic	
Item	**MO**	**U.S.**	**Corn Belt***	**U.S.**
	Dollars per hundredweight sold			
Operating costs:				
Feed--				
Purchased feed	6.57	6.09	5.37	7.08
Homegrown harvested feed	3.46	3.97	10.35	7.36
Grazed feed	0.56	0.10	0.73	0.80
Total, feed costs	10.59	10.16	16.45	15.24
Other--				
Veterinary and medicine	0.66	0.76	0.50	0.68
Bedding and litter	0.10	0.23	1.06	0.59
Marketing	0.14	0.22	0.20	0.25
Custom services	0.51	0.53	0.57	0.50
Fuel, lube, and electricity	1.03	0.66	1.50	1.20
Repairs	0.74	0.54	1.56	1.33
Other operating costs**	0.00	0.00	0.15	0.12
Interest on operating capital	0.01	0.01	0.02	0.02
Total, operating cost	13.78	13.11	22.01	19.93
Allocated overhead:				
Hired labor	0.76	1.46	0.77	2.60
Opportunity cost of unpaid labor	9.35	2.19	9.54	6.65
Capital recovery of mach. and equip.	5.07	3.28	9.22	6.71
Opportunity cost of land (rental rate)	0.19	0.02	0.20	0.10
Taxes and insurance	0.43	0.18	0.24	0.37
General farm overhead	0.58	0.58	1.22	1.17
Total, allocated overhead	16.38	7.71	21.19	17.60
Total costs listed	30.16	20.82	43.20	37.53

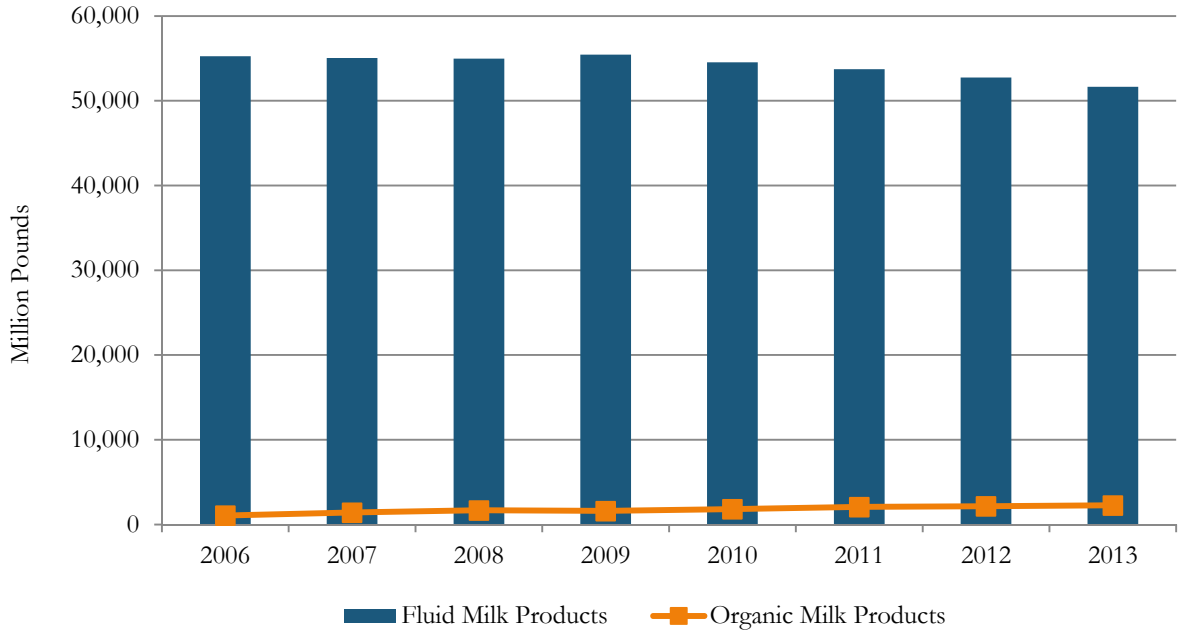
* Corn Belt region includes Iowa, Indiana, Illinois and Missouri.

** Costs for third-party organic certification.

Source: USDA, Economic Research Service

As indicated earlier, U.S. consumers have gradually consumed less fluid milk and cream over time. Organic milk sales, however, have grown. Exhibit 5.10.5 charts total U.S. organic fluid milk and total fluid milk product sales data from the USDA Agricultural Marketing Service. Organic milk sales represent a relatively small portion of total fluid milk product sales; however, organic's share of total fluid milk sales increased from 1.9 percent in 2006 to 4.4 percent in 2013.

Exhibit 5.10.5 – U.S. Organic and All Fluid Milk Sales, 2006 to 2013*



* These figures are based on the consumption of fluid milk products in Federal milk order marketing areas and California, which represents approximately 92 percent of total fluid milk sales in the U.S.; an estimate of total U.S. fluid milk sales is derived by interpolating the remaining 8 percent of sales from the Federal milk order and California data. Total fluid milk products include the products listed plus miscellaneous products and eggnog. Note that total fluid milk products sales volume is adjusted for calendar composition for all years but 2013.

Source: USDA, Agricultural Marketing Service and Economic Research Service

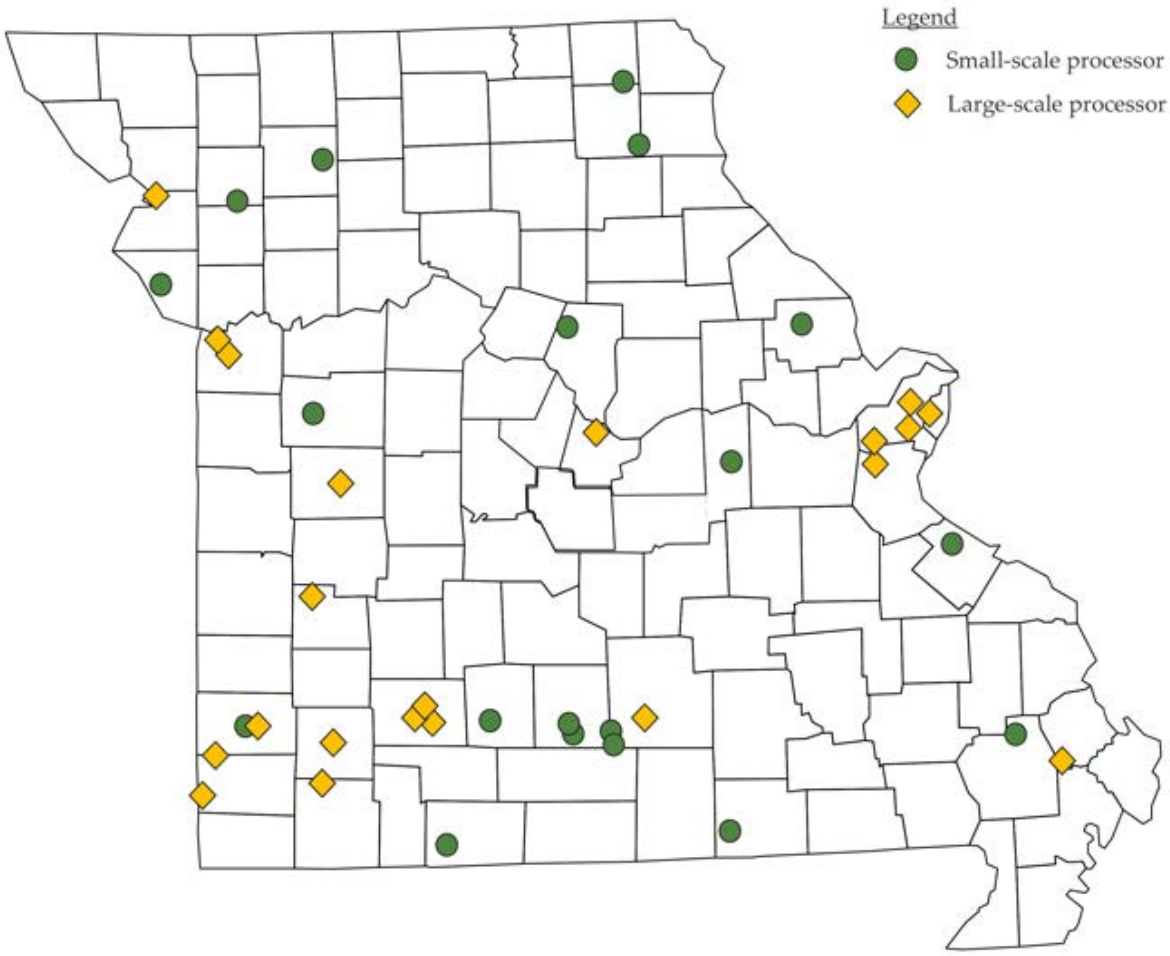
6. Dairy Product Manufacturing

6.1 Number of Plants and Location

Missouri's dairy product manufacturing industry processes dairy products from raw milk, processed milk and dairy substitutes. This industry can be divided into subsectors, which include fluid milk; creamery butter; cheese; dry, condensed and evaporated milk; and ice cream and frozen desserts.

Exhibit 6.1.1 maps the locations of Missouri dairy manufacturers. For the most part, the state's large-scale processors are located south of the Missouri River. Several plants concentrate in the southwest and south central regions. The appendix of this report includes a table with each respective plant, location, products and website. Several farmer-processors operate throughout the state. Within the past few years, Missouri dairy farmers have started such small-scale processing ventures to pursue niche marketing and directly capture more value from their milk.

Exhibit 6.1.1 –Missouri Dairy Product Plants, 2014

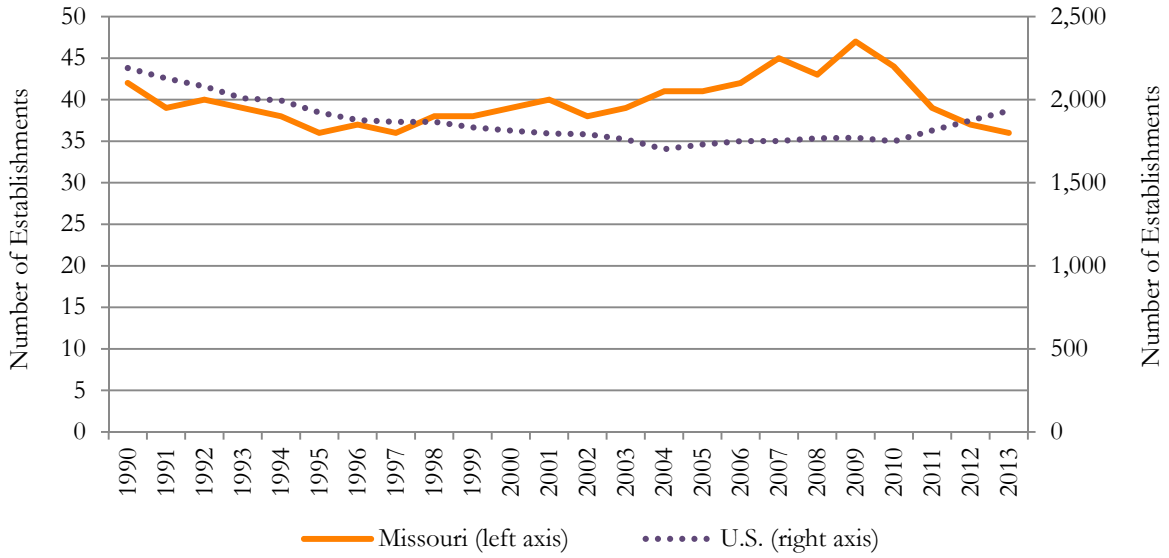


Source: Missouri State Milk Board

Fluid milk bottlers, ice cream and yogurt manufacturers tend to locate in Missouri population centers. Through dairy cooperatives, dairy farmers own the state's large milk bottling plants. These bottling plants operate under various well-known brands such Hiland in Springfield and Kansas City and Central Dairy (Prairie Farms) in Jefferson City. The Prairie Farms cooperative runs its bottling plants either directly or in joint ventures with the Dairy Farmers of America (DFA) cooperative. These same two dairy cooperatives also own additional dairy processing plants that make soft products, specialty drinks and other custom dairy products.

During the past five years, the number of dairy product manufacturing establishments increased in the U.S. but decreased in Missouri. Exhibit 6.1.2 charts the trend in dairy product establishments operating from 1990 to 2013. Dairy product manufacturing establishments in Missouri peaked at 47 establishments in 2009. By 2013, the number of Missouri dairy product manufacturing locations had dropped to 36 establishments. The number of U.S. dairy product manufacturing establishments reached its lowest level, 1,703 establishments, during 2004 and grew to 1,934 establishments by 2013. An establishment refers to a physical location that produces dairy or related products that fit within an industrial classification. A single company may own multiple establishments.

Exhibit 6.1.2 – Missouri and U.S. Dairy Product Manufacturing Establishments

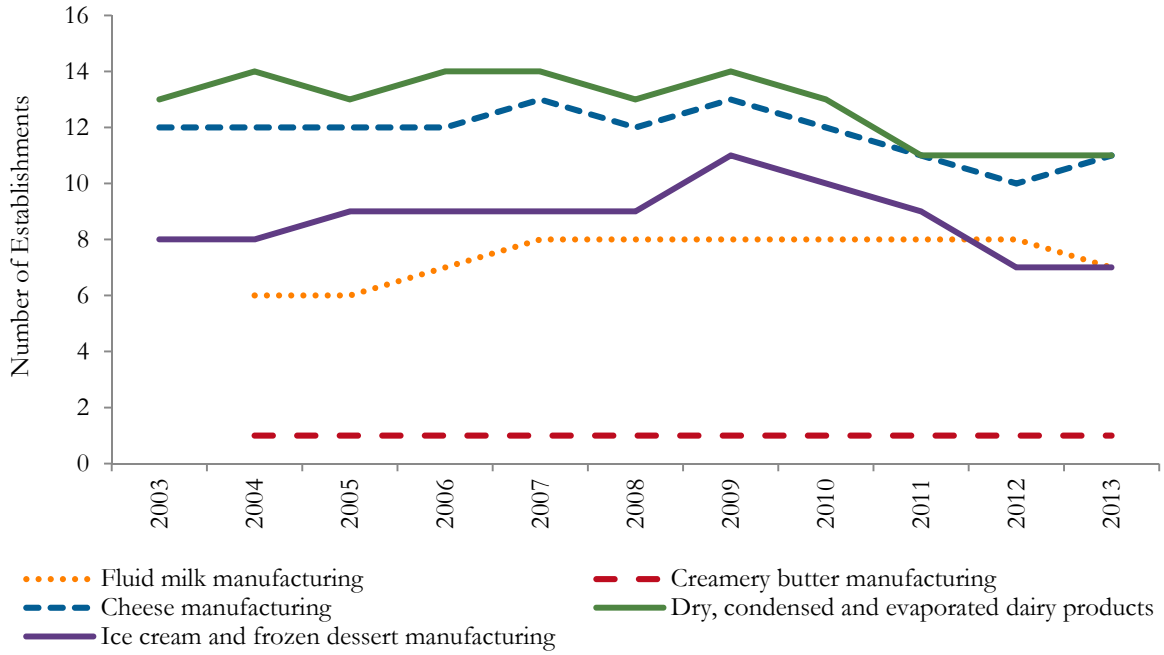


Source: U.S. Department of Labor, Bureau of Labor Statistics, Quarterly Census of Employment and Wages

The trend in the number of dairy manufacturing facilities that operate may reflect the overall food industry trend of continual concentration into fewer, larger plants that operate at higher volumes with lower cost structures. As fewer large plants represent a greater share of the packaged food market, however, smaller firms proliferate to fill market niches vacated by the expanding firms.

Several dairy product manufacturing subsectors operate in Missouri: fluid milk manufacturing; creamery butter manufacturing; cheese manufacturing; dry, condensed and evaporated dairy products; and ice cream and frozen dessert manufacturing. Exhibit 6.1.3 illustrates the trend in number of establishments for these subsectors. During the past 10 years, fewer cheese; ice cream and frozen dessert; and dry, condensed and evaporated dairy product manufacturers have operated. In 2013, the greatest number of Missouri dairy product manufacturing establishments were those who made dry, condensed and evaporated dairy products or cheese, and the fewest establishments made butter.

Exhibit 6.1.3 – Missouri Dairy Product Manufacturing Establishments by Sector

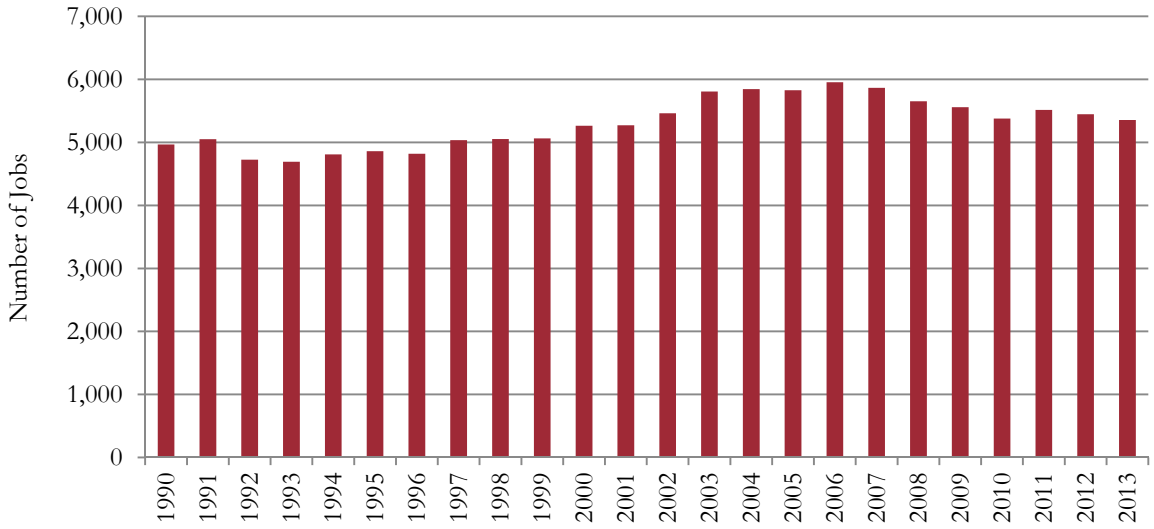


Source: U.S. Department of Labor, Bureau of Labor Statistics, Quarterly Census of Employment and Wages

6.2 Employment and Wages

The U.S. Bureau of Labor Statistics reports statistics on establishments, employee numbers and wages for Missouri dairy manufacturing sectors. Since 1990, the dairy product manufacturing industry in Missouri has experienced some changes in terms of annual employment. Exhibit 6.2.1 illustrates that the state's dairy manufacturing employment grew through the 1990s and peaked at 5,955 employees during 2006. Since then, the Missouri dairy product manufacturing industry has constricted. In 2013, Missouri's dairy product manufacturing industry employed 5,354 people.

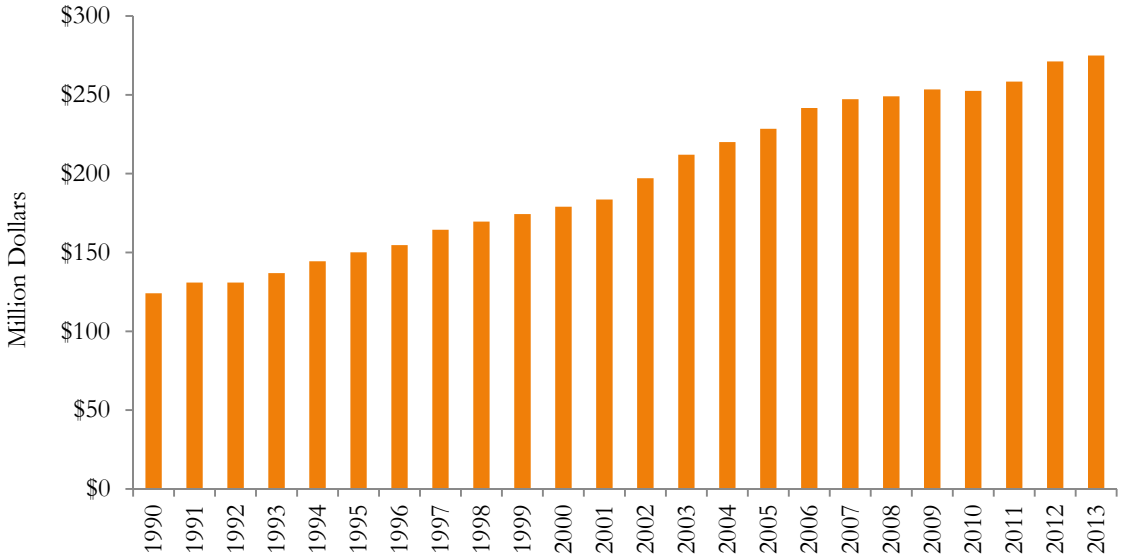
Exhibit 6.2.1 – Annual Employment for the Missouri Dairy Product Manufacturing Industry



Source: U.S. Department of Labor, Bureau of Labor Statistics, Quarterly Census of Employment and Wages

The Missouri dairy product manufacturing industry has gradually increased the wages paid to its employees. Exhibit 6.2.2 depicts the growth in annual total wages. From 1990 to 2013, total wages increased by 121.5 percent to reach $274.89 million in 2013. As an average, annual pay in the Missouri dairy product manufacturing industry totaled $51,340 in 2013.

Exhibit 6.2.2 – Annual Wages for the Missouri Dairy Product Manufacturing Industry



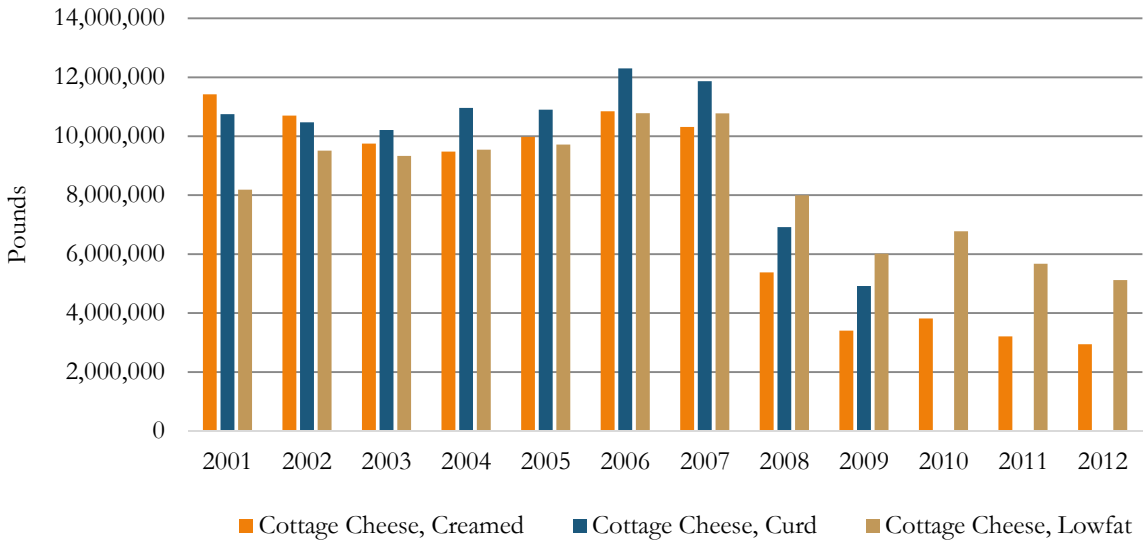
Source: U.S. Department of Labor, Bureau of Labor Statistics, Quarterly Census of Employment and Wages

6.3 Dairy Product Production

Missouri produces a variety of dairy products. This section explores the state's role in producing cottage cheese, ice cream, sherbet, cheese and butter. Relative to other states that produced dairy products in 2013, Missouri ranked third in the country for hard regular ice cream production and sixth in the country for ice cream mix production. Later discussion in this section will explain the dynamics of producing these dairy products.

Since the early 2000s, Missouri dairy cottage cheese production has declined. Exhibit 6.3.1 presents cottage cheese production data from 2001 to 2012. Between those two years, the number of Missouri plants producing cottage cheese decreased from four plants in 2001 to two plants in 2012. In the last six years analyzed, Missouri cottage cheese production facilities began to consistently produce more low-fat cottage cheese than creamed cottage cheese. During 2012, Missouri manufacturing facilities produced more than 8 million pounds of cottage cheese.

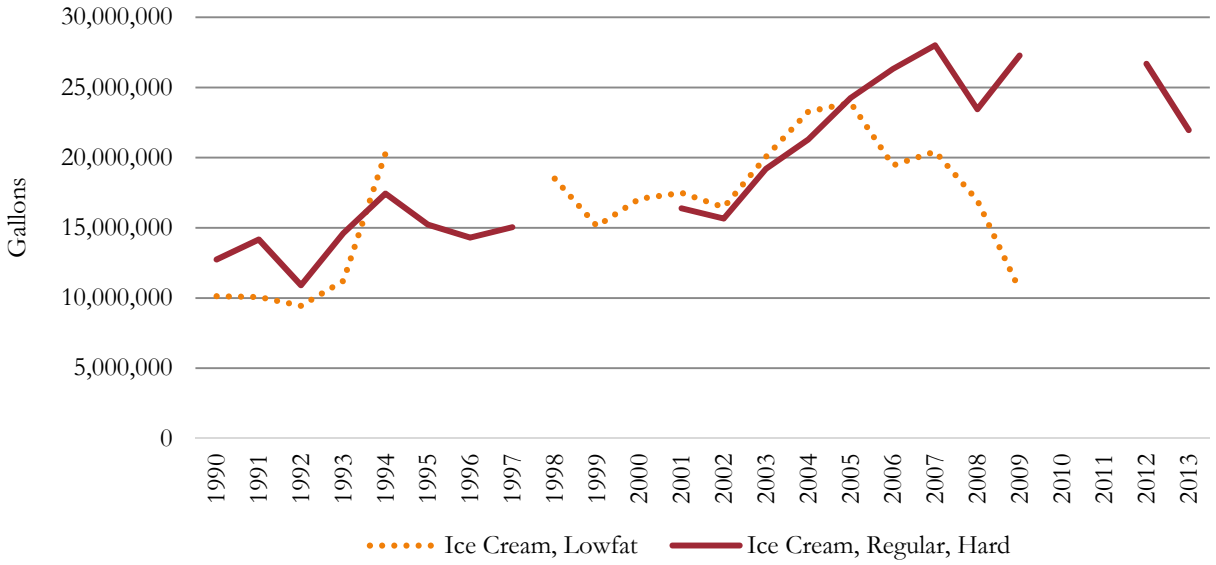
Exhibit 6.3.1 – Missouri Cottage Cheese Production, 2001 to 2012



Source: USDA, National Agricultural Statistics Service

Exhibit 6.3.2 presents the trend in Missouri ice cream production from 1990 to 2013. The chart includes production data for both low-fat hard ice cream and regular hard ice cream. 2009 is the most recent year that USDA reported the state's low-fat hard ice cream production. During that year, Missouri produced more than 10.57 million gallons of low-fat ice cream. Of the data available from USDA, Missouri regular hard ice cream production peaked during 2007. During 2013, five Missouri plants produced 21.97 million gallons of hard regular ice cream.

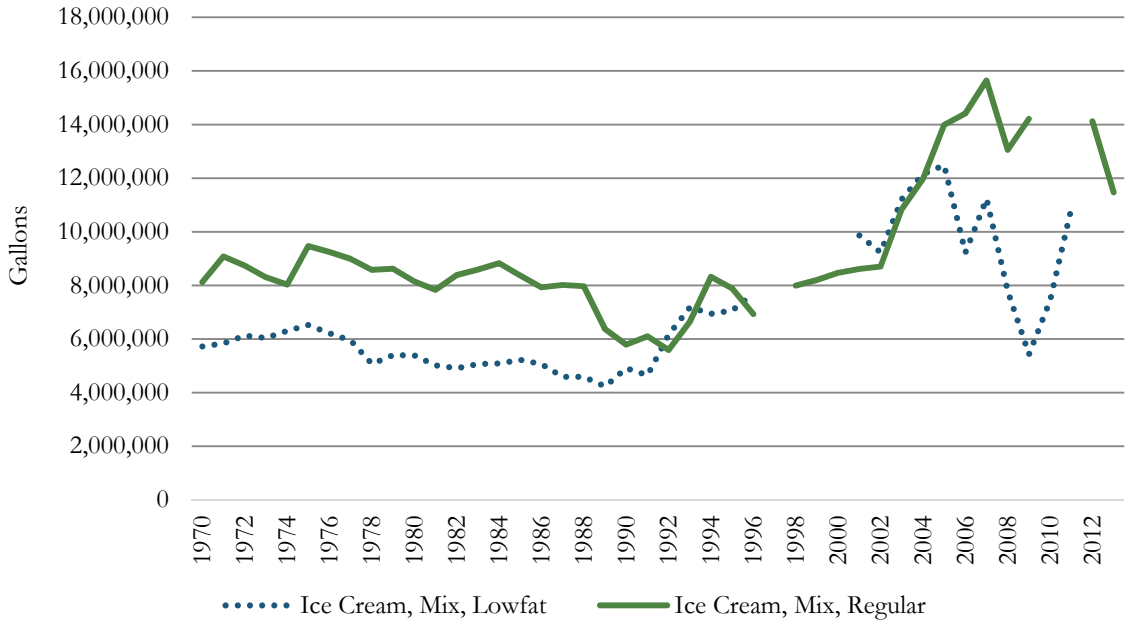
Exhibit 6.3.2 – Missouri Ice Cream Production, 1990 to 2013



Source: USDA, National Agricultural Statistics Service

Ice cream mix is another ice cream-related product that originates from Missouri dairy plants. Exhibit 6.3.3 charts low-fat ice cream mix production and regular ice cream mix production from 1970 to 2013. 2011 is the year with the most recent low-fat ice cream mix data reported. In that year, five Missouri facilities produced 10.881 million gallons of low-fat ice cream mix. During 2013, Missouri regular ice cream mix production totaled 11.471 million gallons from five plants.

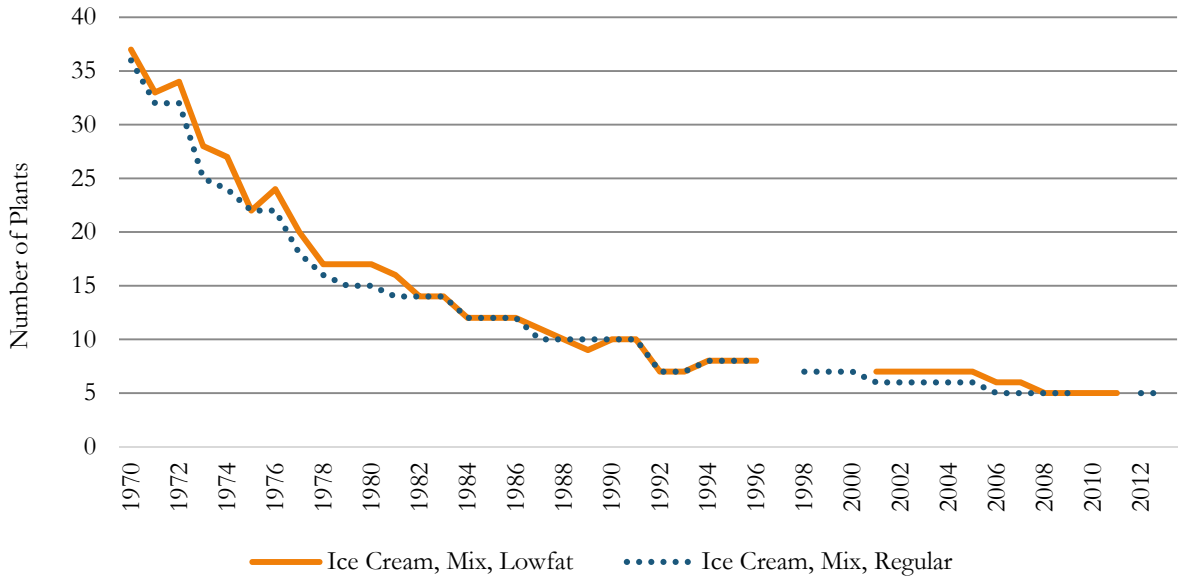
Exhibit 6.3.3 – Missouri Ice Cream Mix Production, 1970 to 2013



Source: USDA, National Agricultural Statistics Service

The number of plants producing ice cream has decreased dramatically since 1970. During 1970, 37 Missouri plants produced low-fat ice cream mix, and 36 facilities produced regular ice cream mix. These numbers dropped to five plants producing low-fat ice cream mix in 2011 and five facilities producing regular ice cream mix in 2013.

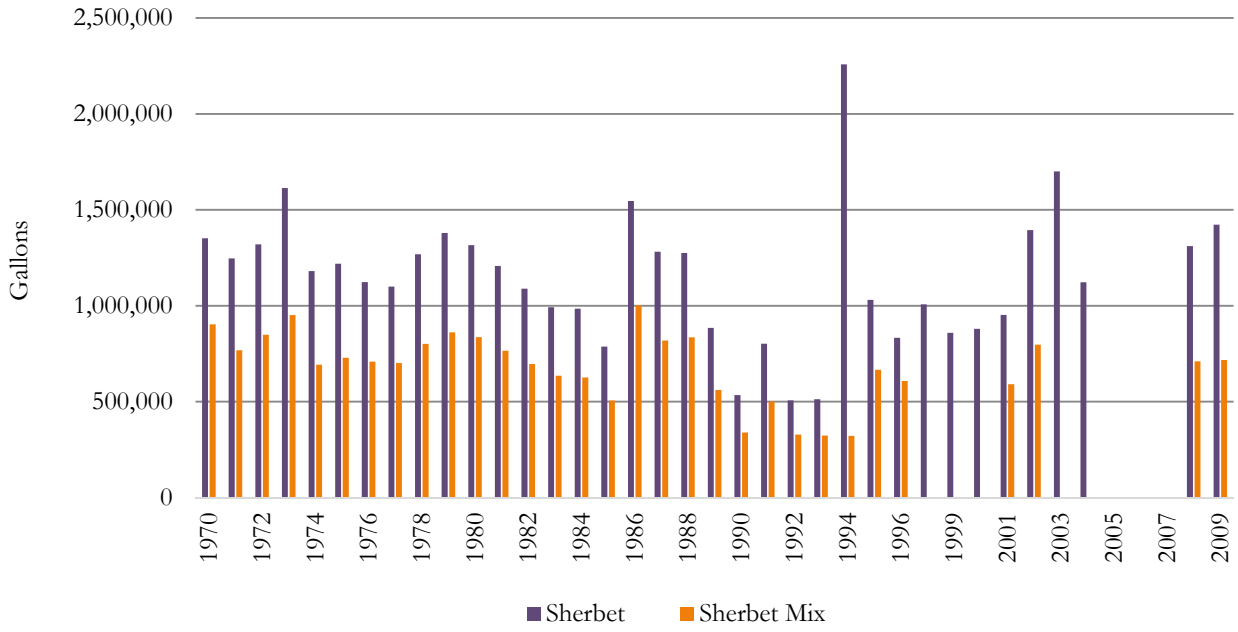
Exhibit 6.3.4 – Missouri Ice Cream Plants, 1970 to 2013



Source: USDA, National Agricultural Statistics Service

Sherbet is the third frozen dairy product with output reported for Missouri. Sherbet production in Missouri has historically exceeded sherbet mix production. Exhibit 6.3.5 illustrates Missouri sherbet production levels from 1970 to 2009. Although the state's sherbet production has varied during the observed period, production levels between 1970 and 2009 didn't differ substantially. In 2009, Missouri production output totaled 1.423 million gallons for sherbet and 717,000 gallons for sherbet mix.

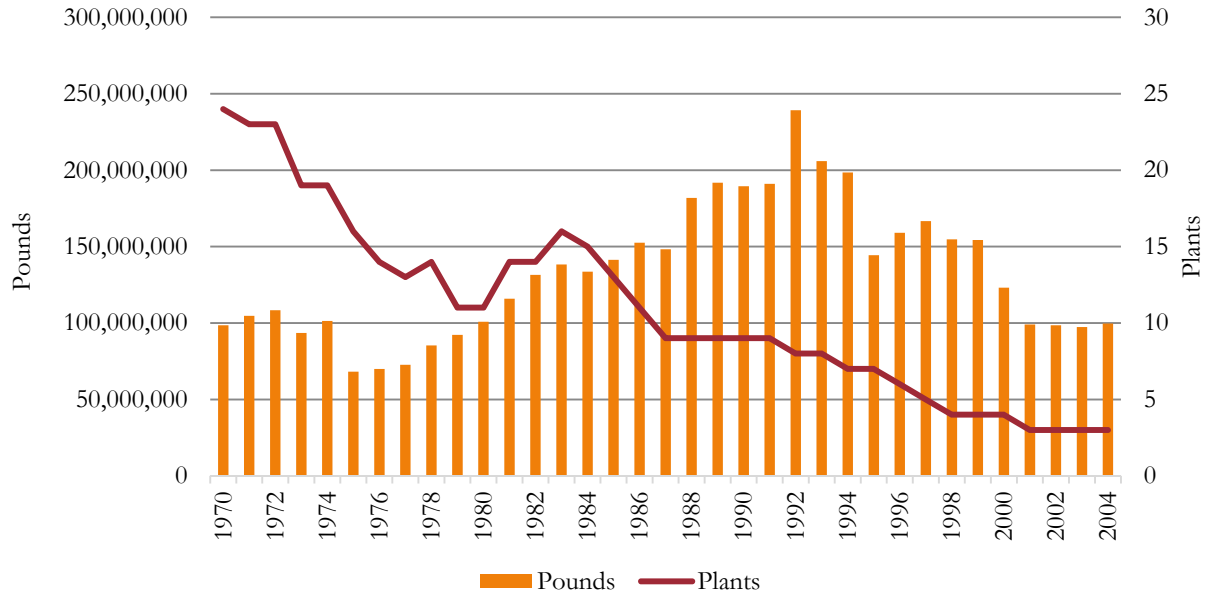
Exhibit 6.3.5 – Missouri Sherbet Production, 1970 to 2009



Source: USDA, National Agricultural Statistics Service

Since 1970, the number of Missouri plants producing cheese has steadily declined. From a cheese production perspective, however, Missouri cheese production peaked in 1992 at 239.2 million pounds, and it has since dropped. Exhibit 6.3.6 illustrates the trend in Missouri cheese production facilities that operate and the state's cheese production. During 2004, which is the most recent year with available data, three Missouri dairy plants produced more than 99.6 million pounds of cheese.

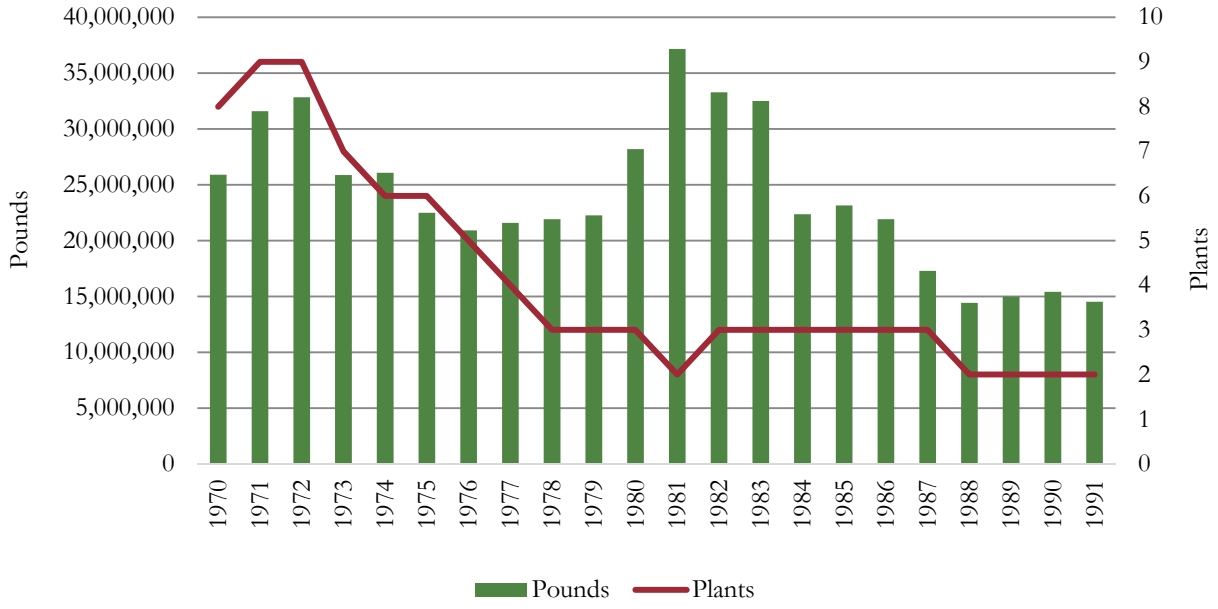
Exhibit 6.3.6 – Missouri Cheese Production and Plants, 1970 to 2004



Source: USDA, National Agricultural Statistics Service

Like the trend in Missouri cheese production facilities, fewer Missouri butter facilities have operated over time. In 1991, which is the most recent year with data available, just two butter production facilities operated in Missouri. In 1971 and 1972, nine facilities in the state produced butter. During 1991, Missouri butter production was at its second lowest level of the two decades analyzed. Butter production in Missouri totaled 14.531 million pounds during 1991.

Exhibit 6.3.7 – Missouri Butter Production and Plants, 1970 to 1991

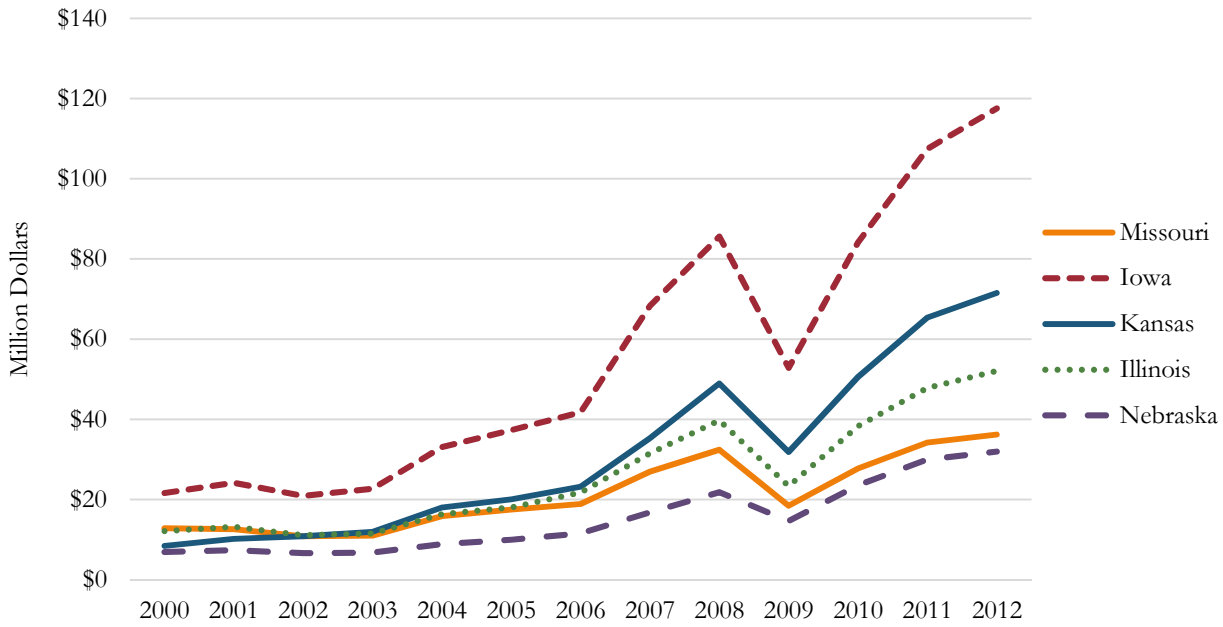


Source: USDA, National Agricultural Statistics Service

6.4 Dairy Product Exports

The USDA Economic Research Service estimates the value of state-level U.S. agricultural exports. Exhibit 6.4.1 shows dairy product export data for Missouri and surrounding states that have earned more than Missouri for dairy product exports or earned values similar to those for Missouri dairy product exports. Areas where dairy industries have grown – for example, Iowa and Kansas – have increased the value of their dairy exports more significantly than Missouri. In 2012, Missouri earned an estimated $36.2 million for its dairy product exports, and it ranked 25th among other U.S. states for the value of its dairy product exports.

Exhibit 6.4.1 – Value of Dairy Products Exports from Missouri and Selected Surrounding States, 2000 to 2012



Note: Export values are calibrated such that the sum of state export estimates for a commodity equals the total U.S. export value for the commodity.
Source: USDA, Economic Research Service

Appendix

Exhibit A1 – Missouri Dairy Cow Inventory by County, 2013

County	Inventory		County	Inventory		County	Inventory
Adair	*		Grundy	400		Pemiscot	*
Andrew	1,000		Harrison	300		Perry	1,000
Atchison	*		Henry	500		Pettis	300
Audrain	1,300		Hickory	900		Phelps	400
Barry	2,300		Holt	*		Pike	400
Barton	500		Howard	*		Platte	*
Bates	1,000		Howell	2,300		Polk	3,600
Benton	600		Iron	*		Pulaski	*
Bollinger	*		Jackson	100		Putnam	100
Boone	200		Jasper	1,900		Ralls	*
Buchanan	500		Jefferson	600		Randolph	100
Butler	*		Johnson	1,000		Ray	200
Caldwell	100		Knox	800		Reynolds	*
Callaway	600		Laclede	3,700		Ripley	*
Camden	400		Lafayette	400		Saline	*
Cape Girardeau	1,800		Lawrence	4,300		Schuyler	200
Carroll	300		Lewis	*		Scotland	2,000
Carter	*		Lincoln	500		Scott	*
Cass	500		Linn	500		Shannon	*
Cedar	700		Livingston	*		Shelby	*
Chariton	100		Macon	200		St. Charles	*
Christian	1,100		Madison	*		St. Clair	100
Clark	*		Maries	400		St. Francois	*
Clay	*		Marion	200		Ste Genevieve	100
Clinton	600		McDonald	600		St. Louis	*
Cole	600		Mercer	*		St. Louis City	*
Cooper	1,000		Miller	200		Stoddard	*
Crawford	*		Mississippi	*		Stone	1,000
Dade	700		Moniteau	1,100		Sullivan	100
Dallas	2,600		Monroe	400		Taney	200
Daviess	100		Montgomery	*		Texas	4,000
DeKalb	300		Morgan	1,500		Vernon	*
Dent	*		New Madrid	*		Warren	*
Douglas	2,600		Newton	3,800		Washington	*
Dunklin	*		Nodaway	700		Wayne	*
Franklin	1,900		Oregon	400		Webster	6,100
Gasconade	200		Osage	400		Worth	*
Gentry	300		Ozark	700		Wright	7,600
Greene	2,000						

*Not reported (No dairy cows or not reported due to USDA confidentiality rules)
Source: USDA, National Agricultural Statistics Service

Exhibit A2 – Missouri Federal Milk Marketing Dairies, Month of December by County, 2000 to 2012

County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Adair	1	1	1	2	2	1	1	1	1	0	1	1	1
Andrew	13	14	14	13	12	12	11	12	11	11	8	7	6
Atchison	0	0	0	0	0	0	0	0	0	0	0	0	0
Audrain	8	9	9	9	11	12	12	11	12	8	3	4	4
Barry	51	45	42	41	37	36	31	28	32	31	28	29	26
Barton	9	8	6	5	5	6	4	3	4	4	4	6	4
Bates	22	18	19	14	14	15	14	12	11	9	9	8	8
Benton	13	12	10	10	10	9	9	8	14	13	8	7	6
Bollinger	2	2	2	2	0	0	0	0	0	0	0	0	0
Boone	2	2	2	2	2	2	2	2	4	2	2	4	2
Buchanan	6	5	4	4	4	3	3	3	3	4	2	2	2
Butler	0	0	0	0	0	0	0	0	0	0	0	0	0
Caldwell	2	2	2	2	2	2	3	2	0	1	1	2	2
Callaway	4	4	4	4	4	3	3	2	2	1	0	0	0
Camden	8	9	7	8	7	7	8	8	8	7	6	5	3
Cape Girardeau	24	20	22	23	22	21	20	15	15	14	15	13	14
Carroll	4	3	3	3	3	3	3	3	1	1	1	2	1
Carter	2	1	1	1	1	1	1	0	0	0	0	0	0
Cass	10	7	7	9	8	7	7	6	6	6	5	4	3
Cedar	9	10	10	11	11	11	9	8	7	6	5	5	7
Chariton	1	1	1	2	2	2	1	2	0	0	0	0	0
Christian	51	38	36	34	32	31	32	27	26	30	30	26	23
Clark	0	0	0	0	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinton	6	6	5	4	5	5	2	4	3	3	3	3	3
Cole	6	3	4	5	1	0	1	7	0	100	9	9	9
Cooper	5	5	6	6	5	7	7	5	4	6	5	7	4
Crawford	0	0	0	0	0	0	0	0	0	0	0	0	0
Dade	10	8	8	7	5	5	7	6	6	6	6	4	5
Dallas	69	64	63	59	52	52	49	47	44	44	41	38	34
Davies	8	7	6	6	6	6	8	6	5	6	7	8	10
De Kalb	5	6	5	4	4	2	4	2	3	2	2	1	1
Dent	2	2	2	1	1	1	1	1	0	0	0	0	0
Douglas	83	86	82	81	74	70	70	57	58	55	52	50	41
Dunklin	0	0	0	0	0	0	0	0	0	0	0	0	0
Franklin	17	16	16	15	15	15	15	14	13	13	13	13	13
Gasconade	0	0	2	2	2	2	1	1	1	3	3	2	2
Gentry	0	0	0	0	0	0	0	0	0	1	0	0	0

County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Greene	40	38	39	38	34	37	34	28	26	22	22	21	17
Grundy	8	6	6	6	6	6	6	7	7	8	2	6	6
Harrison	4	4	3	4	4	3	3	3	0	1	1	1	1
Henry	6	6	5	7	6	6	6	5	4	4	4	3	3
Hickory	10	10	10	8	8	8	7	7	7	7	6	6	4
Holt	1	1	0	0	0	0	0	0	0	0	0	0	0
Howard	2	2	2	2	1	1	1	1	0	0	0	0	0
Howell	65	64	57	56	53	51	48	40	40	32	34	27	20
Iron	0	0	0	0	0	0	0	0	0	0	0	0	0
Jackson	1	1	1	1	2	2	2	1	0	1	1	2	1
Jasper	34	30	24	22	20	18	20	17	18	16	13	12	11
Jefferson	9	9	8	9	9	7	7	5	4	4	4	6	4
Johnson	10	10	10	10	10	8	8	8	3	5	5	5	5
Knox	11	11	12	13	12	11	11	11	12	11	11	11	11
Laclede	93	83	87	77	77	71	70	56	56	60	55	42	40
Lafayette	17	16	15	14	12	10	9	9	1	7	6	6	5
Lawrence	91	90	86	81	79	78	77	73	75	83	79	72	64
Lewis	3	4	3	3	3	3	3	3	2	3	2	2	2
Lincoln	9	9	10	8	9	9	7	5	4	4	4	3	3
Linn	8	8	8	7	6	8	9	10	8	9	3	7	6
Livingston	1	1	1	1	0	1	0	1	0	2	2	5	5
Macon	0	0	0	0	0	0	0	0	1	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0	0	0	0	0
Maries	1	1	4	4	3	3	2	1	3	3	3	3	3
Marion	6	6	6	5	5	5	5	4	4	3	2	2	1
McDonald	23	20	17	15	16	15	12	9	9	7	6	6	5
Mercer	1	1	0	0	1	0	0	1	1	1	1	1	1
Miller	1	1	3	2	1	0	0	1	0	1	1	1	1
Mississippi	0	1	1	1	1	1	0	0	0	0	0	0	0
Moniteau	14	16	15	12	5	2	3	8	6	27	23	23	23
Monroe	8	8	6	7	9	8	8	9	7	6	6	6	5
Montgomery	2	2	3	4	1	2	2	2	5	2	2	2	3
Morgan	35	33	32	19	13	9	11	19	13	45	37	39	38
New Madrid	0	0	0	0	0	0	0	1	1	1	0	0	0
Newton	39	35	32	32	29	29	28	27	24	25	25	22	19
Nodaway	5	5	6	6	7	8	8	8	8	6	6	4	3
Oregon	16	13	13	10	10	10	9	8	8	6	7	7	7
Osage	6	5	7	6	6	6	2	2	0	6	6	6	5
Ozark	53	37	40	40	36	29	28	25	25	21	21	20	15
Pemiscot	0	0	0	0	0	0	0	0	0	0	0	0	0

County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Perry	19	17	18	17	17	16	16	16	17	15	14	12	14
Pettis	12	11	10	9	4	5	4	3	3	3	2	1	2
Phelps	2	2	4	5	4	4	4	4	2	1	0	0	0
Pike	1	1	1	1	1	1	1	1	1	2	2	1	2
Platte	0	0	0	0	0	0	0	0	0	0	0	0	0
Polk	62	58	54	54	54	53	50	45	48	42	41	36	33
Pulaski	2	0	1	1	1	1	1	1	1	1	1	1	1
Putnam	1	1	2	3	3	3	2	2	2	2	1	0	0
Ralls	1	1	1	1	1	1	1	1	1	1	1	1	1
Randolph	0	0	0	2	1	1	0	0	0	0	0	0	0
Ray	4	4	4	3	2	2	2	3	0	1	1	1	1
Reynolds	0	0	0	0	0	0	0	0	0	0	0	0	0
Ripley	0	0	0	0	0	0	0	0	0	0	1	1	0
Saline	2	2	2	2	2	2	2	1	0	1	1	1	1
Schuyler	4	4	4	3	3	2	2	2	2	2	3	3	2
Scotland	39	36	36	38	38	38	38	36	36	39	39	39	41
Scott	1	1	0	0	0	1	1	1	1	1	0	1	0
Shannon	3	3	3	3	3	2	2	2	2	2	2	1	1
Shelby	2	2	3	2	2	2	2	1	0	0	0	0	0
St. Charles	3	3	3	3	3	3	3	3	3	3	2	2	2
St. Clair	6	4	4	4	4	4	3	3	2	2	2	1	1
St. Francois	6	4	0	0	0	0	0	1	0	0	0	0	0
St. Louis	0	0	0	0	0	0	0	0	0	0	0	0	0
Ste. Genevieve	2	2	2	2	2	2	2	0	0	0	0	0	0
Stoddard	0	0	0	0	0	0	0	0	0	0	0	0	1
Stone	35	31	30	28	27	24	24	25	25	25	24	21	19
Sullivan	1	1	1	1	1	1	1	1	1	1	1	1	1
Taney	7	5	5	4	3	3	3	3	3	3	3	3	3
Texas	81	77	71	68	62	56	60	56	58	59	56	57	52
Vernon	4	3	3	2	2	2	4	5	7	6	6	5	4
Warren	1	1	0	0	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0	0	0	0	0
Wayne	0	0	0	0	0	0	0	0	0	0	0	0	0
Webster	132	124	116	105	107	95	88	87	83	89	86	74	67
Worth	0	0	0	0	0	0	0	1	1	1	1	1	1
Wright	217	198	196	186	175	164	152	144	141	130	130	122	108

Exhibit A3 – Missouri Federal Milk Average Marketing Per Farm, Month of December by County, 2000 to 2012

County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Adair	31,260	38,609	30,559	45,995	33,117	30,781	79,915	35,355	20,234	0	137,006	138,730	168,595
Andrew	88,852	86,042	103,284	100,680	95,579	102,715	115,198	94,987	89,084	91,224	87,541	87,451	98,012
Atchison	0	0	0	0	0	0	0	0	0	0	0	0	0
Audrain	100,891	97,179	93,128	86,809	84,640	76,998	73,269	75,805	68,884	88,090	96,768	94,417	94,900
Barry	84,387	88,184	91,840	107,697	104,280	101,754	106,489	106,628	111,516	108,182	109,848	96,962	104,266
Barton	69,641	83,844	103,286	107,685	108,688	92,653	135,248	121,537	113,689	99,509	90,503	137,664	356,408
Bates	76,883	84,210	78,946	93,465	84,943	80,354	92,079	99,341	122,961	111,064	85,199	100,312	64,113
Benton	84,599	69,785	83,660	87,801	101,885	91,137	87,490	97,105	56,694	55,753	56,995	84,827	69,228
Bollinger	64,403	48,084	64,059	60,032	0	0	0	0	0	0	0	0	0
Boone	252,691	203,543	210,582	177,656	65,684	29,130	173,643	62,369	78,283	269,992	277,614	132,683	229,783
Buchanan	113,010	138,153	135,020	150,089	150,763	203,148	224,862	183,772	183,488	130,080	273,327	64,552	179,953
Butler	0	0	0	0	0	0	0	0	0	0	0	0	0
Caldwell	142,699	139,087	154,410	145,286	160,657	134,106	103,802	116,642	0	5,842	158,289	98,845	90,670
Callaway	166,760	299,697	302,383	288,104	277,839	369,762	274,849	557,284	509,695	595,602	0	0	0
Camden	56,505	53,215	60,618	64,226	64,015	73,671	74,624	85,866	52,972	72,143	57,368	41,758	73,609
Cape Girardeau	146,736	154,986	142,960	144,194	150,385	151,385	167,298	172,186	176,792	192,833	179,321	218,504	200,753
Carroll	89,454	57,750	53,526	67,524	60,752	72,254	76,354	49,283	19,902	26,759	15,400	73,279	21,829
Carter	77,106	47,207	93,418	97,700	77,761	78,186	56,688	0	0	0	0	0	0
Cass	72,942	94,322	90,209	69,522	71,704	76,384	76,359	66,074	96,170	86,614	72,213	87,052	126,637
Cedar	71,108	88,967	77,718	77,334	69,823	81,069	93,645	87,454	100,894	109,928	126,944	92,072	84,435
Chariton	112,327	119,771	112,787	56,592	62,311	62,694	89,640	59,842	0	0	0	0	0
Christian	65,163	78,037	72,650	73,863	76,464	76,261	89,471	87,477	86,982	90,643	78,893	90,263	85,243
Clark	0	0	0	0	0	0	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinton	33,464	57,296	62,577	52,758	57,786	48,802	68,822	30,471	38,360	42,333	48,595	41,057	41,149
Cole	32,932	51,267	22,980	21,323	3,551	0	8,890	6,354	0	10,479	100,812	105,383	104,330
Cooper	121,644	103,638	111,503	104,542	140,954	55,485	88,798	100,482	96,223	119,476	133,889	90,194	176,509
Crawford	0	0	0	0	0	0	0	0	0	0	0	0	0
Dade	88,324	90,539	82,390	84,988	120,327	184,320	165,899	165,875	170,511	152,775	141,592	133,780	103,170
Dallas	76,906	75,015	76,783	80,580	81,811	97,303	100,479	95,894	83,169	91,390	91,258	83,797	101,139
Davies	46,752	47,231	46,431	44,606	50,186	43,358	60,035	33,411	26,106	1,350	34,417	42,342	42,278
De Kalb	93,464	86,241	93,143	89,000	84,298	35,987	56,512	28,985	53,706	69,773	59,488	99,128	40,792
Dent	40,818	41,695	25,925	45,946	23,313	25,035	23,010	20,610	0	0	0	0	0
Douglas	62,524	66,451	63,206	66,933	68,339	75,082	73,655	70,005	68,488	70,313	75,568	69,691	87,185
Dunklin	0	0	0	0	0	0	0	0	0	0	0	0	0
Franklin	167,792	197,200	203,309	212,867	240,450	238,764	2,304,315	218,529	237,883	260,155	255,609	270,703	289,356

County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gasconade	0	0	101,013	110,303	109,492	100,713	86,280	94,400	4,935	74,690	71,867	120,732	134,484
Gentry	0	0	0	0	0	0	0	0	0	9,172	0	0	0
Greene	80,292	88,745	90,459	88,642	103,511	103,832	109,694	91,305	88,779	102,858	93,168	78,682	110,507
Grundy	94,020	117,403	116,459	109,783	114,935	104,778	93,820	95,239	70,460	88,716	432,810	110,811	92,303
Harrison	57,576	49,668	65,160	61,800	50,474	75,948	92,860	68,855	0	2,093	106,108	90,653	85,351
Henry	136,072	92,556	110,996	79,998	78,285	84,804	93,501	83,951	97,936	102,350	94,355	131,847	136,440
Hickory	83,407	87,244	91,677	91,876	85,935	87,843	115,018	103,976	111,151	113,000	123,671	129,763	143,096
Holt	67,279	66,416	0	0	0	0	0	0	0	0	0	0	0
Howard	115,883	81,662	85,450	89,388	70,317	51,833	52,711	27,821	0	0	0	0	0
Howell	95,875	94,066	100,296	93,895	87,005	99,145	94,212	91,595	84,660	74,717	69,530	73,914	51,137
Iron	0	0	0	0	0	0	0	0	0	0	0	0	0
Jackson	65,783	62,566	54,765	49,200	90,759	89,644	47,917	61,877	0	73,290	40,215	27,444	42,156
Jasper	118,061	134,497	128,436	118,217	175,211	222,060	199,354	162,599	164,915	110,575	114,902	85,761	156,102
Jefferson	148,207	159,210	174,603	136,584	134,250	182,146	171,428	206,537	203,856	223,325	211,559	124,199	176,916
Johnson	80,035	111,356	88,179	73,260	73,217	86,765	84,453	66,305	56,768	85,533	79,333	77,550	80,910
Knox	77,735	80,202	75,815	83,145	89,071	95,848	103,313	98,999	87,306	101,822	100,110	100,607	118,194
Laclede	86,817	87,784	86,657	95,237	87,577	94,912	94,687	102,551	95,937	83,433	83,354	95,521	98,385
Lafayette	89,759	97,276	94,779	79,955	76,874	83,295	95,679	77,597	37,679	95,121	159,879	241,122	292,334
Lawrence	95,615	92,013	95,078	98,641	110,106	114,855	108,842	115,374	117,776	104,144	108,337	111,568	106,916
Lewis	1,587,644	1,403,165	2,006,152	2,281,998	2,287,230	2,078,776	1,739,530	1,389,117	52,955	1,882,839	2,821,213	3,467,783	4,060,104
Lincoln	161,657	161,917	134,950	173,219	168,327	170,510	154,096	178,253	191,250	186,758	168,692	210,014	186,829
Linn	92,059	85,863	102,117	93,981	98,722	84,138	81,155	76,020	77,332	63,822	137,436	68,431	64,038
Livingston	24,770	37,212	34,718	57,314	0	35,207	0	49,368	0	53,710	160,227	65,896	62,640
Macon	0	0	0	0	0	0	0	0	78,607	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0	0	0	0	0
Maries	112,118	88,960	147,557	156,953	121,697	106,669	93,495	85,928	8,467	124,201	108,712	108,453	118,098
Marion	78,764	70,571	77,850	59,146	59,466	47,997	47,975	45,542	64,076	78,007	65,968	66,813	104,159
McDonald	69,477	83,590	70,982	88,859	93,797	94,316	98,061	103,893	103,747	115,260	111,883	88,199	132,324
Mercer	29,903	26,324	0	0	4,342	0	0	66,197	47,916	77,984	50,288	74,282	85,521
Miller	59,624	47,230	62,814	45,649	7,483	0	0	5,054	0	57,894	57,201	56,815	62,384
Mississippi	0	17,800	24,945	19,366	15,256	14,970	0	0	0	0	0	0	0
Moniteau	35,467	19,666	59,350	9,803	20,047	39,634	36,384	12,030	32,882	43,280	49,129	52,435	50,966
Monroe	97,864	87,350	119,307	118,929	80,472	109,044	123,380	88,937	116,324	121,614	101,321	126,466	122,412
Montgomery	88,623	83,440	75,791	73,174	98,027	67,129	81,476	70,235	31,655	67,426	74,962	71,888	32,359
Morgan	26,006	23,417	52,393	18,190	27,317	59,745	53,638	22,973	72,356	66,373	71,560	69,566	70,526
New Madrid	0	0	0	0	0	0	0	3,424	516,504	1,031,380	0	0	0
Newton	80,053	83,680	87,747	80,832	96,997	112,585	103,264	93,789	91,950	80,003	75,656	83,834	80,371
Nodaway	61,047	57,047	75,480	62,359	62,430	59,373	58,817	54,125	63,089	48,237	46,212	51,952	73,812
Oregon	78,394	92,061	87,032	99,529	99,048	93,529	81,011	99,369	104,347	116,073	86,748	81,077	57,551
Osage	105,911	82,597	85,896	77,763	87,265	95,509	94,630	87,598	0	125,221	118,276	108,677	145,596

County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Ozark	70,661	80,797	85,337	87,570	91,806	82,377	88,965	72,616	70,151	77,113	73,608	84,882	94,777
Pemiscot	0	0	0	0	0	0	0	0	0	0	0	0	0
Perry	102,841	103,495	86,531	88,379	94,518	100,129	95,419	92,930	88,850	90,164	87,224	109,295	92,830
Pettis	62,421	70,221	60,794	65,774	81,288	74,007	162,443	96,417	99,402	83,607	98,319	196,637	82,891
Phelps	142,660	122,683	58,825	61,149	73,563	65,444	74,858	51,452	4,351	69,910	0	0	0
Pike	102,850	68,165	79,965	68,435	50,415	50,214	63,769	85,950	91,271	60,902	83,035	74,630	53,658
Platte	0	0	0	0	0	0	0	0	0	0	0	0	0
Polk	109,157	111,156	134,314	131,566	132,957	153,055	140,880	125,660	117,096	156,259	147,979	126,481	182,440
Pulaski	21,699	0	292,708	354,682	226,704	152,232	358,481	319,747	347,744	341,272	279,424	247,714	262,226
Putnam	16,761	14,861	56,728	56,611	76,347	57,374	62,629	59,750	50,293	45,792	58,367	0	0
Ralls	96,202	91,234	90,533	93,023	104,288	100,721	117,944	91,714	80,128	88,300	58,054	72,313	61,693
Randolph	0	0	0	56,175	74,477	84,748	0	0	0	0	0	0	0
Ray	50,877	40,820	49,861	51,126	53,043	54,894	71,707	35,517	0	105,826	84,871	72,685	85,912
Reynolds	0	0	0	0	0	0	0	0	0	0	0	0	0
Ripley	0	0	0	0	0	0	0	0	0	0	45,622	48,970	0
Saline	85,878	76,667	72,298	65,825	67,351	130,750	109,601	172,168	0	271,103	293,069	266,573	241,384
Schuyler	65,127	64,591	65,897	52,420	42,200	55,641	60,431	51,033	53,404	52,367	60,613	68,073	84,493
Scotland	82,376	87,850	89,747	93,828	98,338	101,677	107,734	108,625	113,649	108,663	111,602	117,045	116,513
Scott	9,919	17,744	0	0	0	50,166	96,425	475,928	478,140	401,228	0	0	0
Shannon	72,195	61,196	76,298	52,241	42,555	70,474	24,874	31,898	24,414	28,342	28,815	16,026	8,458
Shelby	87,189	95,031	118,803	128,406	164,527	188,105	165,773	103,282	0	0	0	0	0
St. Charles	387,512	331,425	310,901	372,178	401,585	401,720	372,787	421,342	418,675	442,332	577,050	582,783	515,730
St. Clair	54,219	77,235	52,395	45,808	51,427	43,592	51,271	35,670	30,169	34,570	30,896	36,088	27,993
St. Francois	79,985	67,049	0	0	0	0	0	0	0	0	0	0	0
St. Louis	0	0	0	0	0	0	0	0	0	0	0	0	0
Ste. Genevieve	75,565	79,211	90,426	82,446	89,613	66,117	78,615	0	0	0	0	0	0
Stoddard	0	0	0	0	0	0	0	0	0	0	0	0	301,700
Stone	80,618	82,203	81,838	90,609	92,610	102,343	92,571	77,207	85,445	69,689	73,976	79,212	83,240
Sullivan	38,608	34,460	45,909	46,986	37,906	52,206	64,615	66,179	51,621	55,613	52,851	54,745	54,781
Taney	50,726	45,075	30,581	40,138	63,621	66,789	51,825	48,408	42,218	45,174	57,954	65,460	52,803
Texas	82,620	85,711	91,952	93,467	92,966	99,861	94,565	92,606	91,615	97,227	97,191	95,144	91,168
Vernon	98,684	63,118	53,846	71,170	73,804	118,874	583,446	547,238	430,036	584,927	485,931	338,482	343,329
Warren	155,043	137,435	0	0	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0	0	0	0	0
Wayne	0	0	0	0	0	0	0	0	0	0	0	0	0
Webster	77,602	80,322	85,321	94,782	73,824	94,849	96,503	87,349	89,845	92,829	82,097	75,991	91,979
Worth	0	0	0	0	0	0	0	27,213	37,854	46,844	42,543	31,384	32,372
Wright	77,296	89,148	81,200	87,434	90,089	98,345	100,806	93,331	88,605	94,880	88,929	92,157	98,951

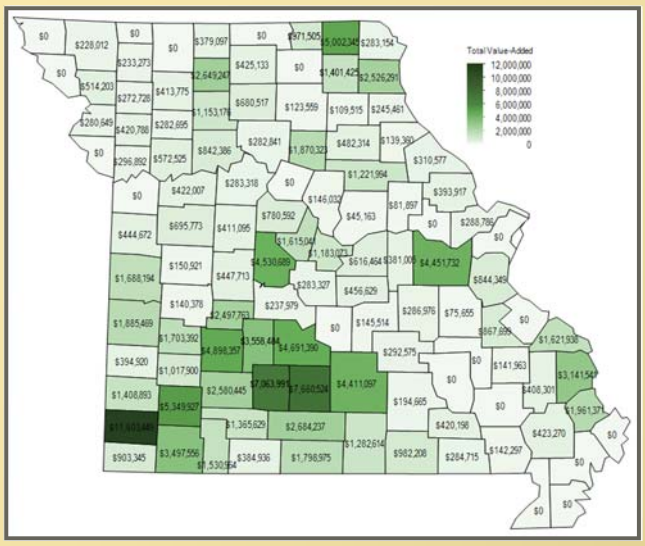
Exhibit A4 – Missouri Dairy Product Manufacturing Plant, City, Products and Website

Plant	City	Products	Website
Baetje Farms	Bloomsdale	Goat and sheep milk and cheese	www.baetjefarms.com/
Belfonte	Kansas City	Ice cream, yogurt, cottage cheese, sour cream & dips, milk, juices and creams	www.belfontedairy.com
Borgman's Dairy Farm	Holden	Cheese, cajeta	www.borgmansdairyfarm.com/
College of the Ozarks	Point Lookout	Milk and milk product	www.cofo.edu/page/students/academic-programs/agriculture/farms-work-stations.383.html
Dairiconcepts	Eldorado Springs	Cheese and dairy powder	www.dairiconcepts.com/
Danisco	St. Joseph	Powder	www.danisco.com/
DFA - Cabool	Cabool	Infant formula	www.dfamilk.com/
DFA - Springfield	Springfield	Sports drinks	www.dfamilk.com/
Goatsbeard Farm	Harrisburg	Goat cheese	www.goatsbeardfarm.com/
Golden L Creamery	Silex	Cheese	www.goldenlcreamery.com/
Good Humor Breyers Ice Cream	Sikeston	Ice cream and novelties	www.unileverusa.com/
Green Dirt Farm	Weston	Sheep cheese and yogurt	www.greendirtfarm.com/
Heartland Dairy	Newark	Cow and goat cheese	heartlandcreamery.com/
Hiland Dairy (formally Roberts Dairy)	Kansas City	Milk and milk product	www.hilanddairy.com/
Hiland Dairy	Springfield	Milk and milk product	www.hilanddairy.com/
Homestead Dairy	Jamesport	Cheese	
International Food Products Corp. (formerly Dairy House)	St. Louis	Powder	ifpc.com/
Ice Cream Specialties	St. Louis	Ice cream and novelties	www.prairiefarmsdairy.com/index.php?p=534
Jasper Products	Joplin	Sports drinks	www.jasperproducts.com/
Kraft, Inc.	Springfield	Cheese	www.kraftfoodsgroup.com/
M & T Farms	Owensville	Cheese	http://www.coolcowcheese.com/
Madison Farms	St. Louis	Butter	www.prairiefarmsdairy.com/index.php?p=540
Marlee's Creamery	Carthage	Milk	www.agrilicious.org/Marlees-Creamery
Memory Lane Dairy	Fordland	Milk	www.memorylanedairy.com/
Milnot	Seneca	Condensed milk	www.milnot.com/
Oakridge Goat Dairy & Creamery	Advance	Cheese	
Ozark Mountain Creamery	Mountain Grove	Milk	ozarkmtncreamery.com/
Pacific Valley Dairy	Pacific	Yogurt, custard, ice cream	www.pvdairy.com/
Prairie Farms (Central Dairy)	Jefferson City	Milk and milk product	www.centraldairy.biz/
Real Farm Foods	Norwood	Cheese	http://www.realfarmfoods.net/

Sanitary Dairy Foods	St. Louis	Cheese	
Schreiber Foods	Mount Vernon	Cheese	www.schreiberfoods.com/
Schreiber Foods	Carthage	Cheese	www.schreiberfoods.com/
Schreiber Foods	Monett	Cheese	www.schreiberfoods.com/
Schreiber Foods	Clinton	Cheese	www.schreiberfoods.com/
Shatto Milk Company	Osborn	Milk and milk product	www.shattomilk.com/
Springhill Dairy	Mountain Grove	Cheese and yogurt	
Terrell Creek Farm	Fordland	Goat cheese	terrellcreekfarm.com/
Trickling Springs Creamery	Koshkonong	Cheese and cultured drinks	www.tricklingspringscreamery.com/
Weiler Dairy	Rutledge	Milk	

Source: Missouri State Milk Board and Missouri Department of Health and Senior Services

January 2015



Missouri Dairy Industry Revitalization Study

Section 2: Economic Contribution

UNIVERSITY OF MISSOURI
Extension
Commercial Agriculture Program

Missouri Dairy Industry Revitalization Study – *Section 2: Economic Contribution*

The following authors contributed to this section:

Joe Horner	Agricultural Economist, Commercial Ag Program, MU Extension
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Other publications from this study include:

Executive Summary
A comprehensive overview of the overall Missouri Dairy Industry Revitalization study.

Section 1: Historical Perspective
Section 1 provides an in-depth discussion about Missouri's dairy industry historical trends concerning its dairy cow inventory, farms, production, prices, production economics and processing industry.

Section 3: Needs Assessment
A survey was conducted in fall 2014 to Missouri Grade A dairy farms and industry stakeholders. This survey was intended to gather their perspectives on producers' needs and characteristics of Missouri dairy farms. Section 3 provides a summary of all survey responses received.

Section 4: Value Chain, Marketing and Processing
Section 4 provides a discussion about dairy product demand and current opportunities to enhance the farmer's position in the value chain. Further processing opportunities and dairy niche marketing are discussed in this section.

Section 5: Comparative Analysis to Identify Gaps
What is the competiveness of Missouri's dairy industry versus other U.S. states? Section 5 seeks to create a common understanding of the Missouri dairy industry's competitive position, benchmark Missouri's dairy industry and environment against other states and look at ways that other states have attempted to revitalize their dairy industries.

Complete copies of all publications can be found at http://dairy.missouri.edu/revitalization/.

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Missouri Dairy Industry Revitalization Study – Section 2: Economic Contribution

Table of Contents

1. Overview and Methodology

Missouri dairy farm production and dairy product manufacturing both provide significant economic impacts to Missouri. The focus of this report section is to analyze the economic contributions of both industries and provide economic metrics that can be used to discuss the value that these industries provide to their various stakeholders or other interested parties.

Estimations were prepared based on the use of the IMPLAN economic impact software system. IMPLAN is an input-output model and includes economic data sets, multipliers and demographic statistics for the entire U.S. economic infrastructure. It is a robust tool that assesses the effects of changes in the economy by sector, and it is widely used by economists and analysts. Estimations in this report used the 2013 IMPLAN data set for Missouri and its counties.

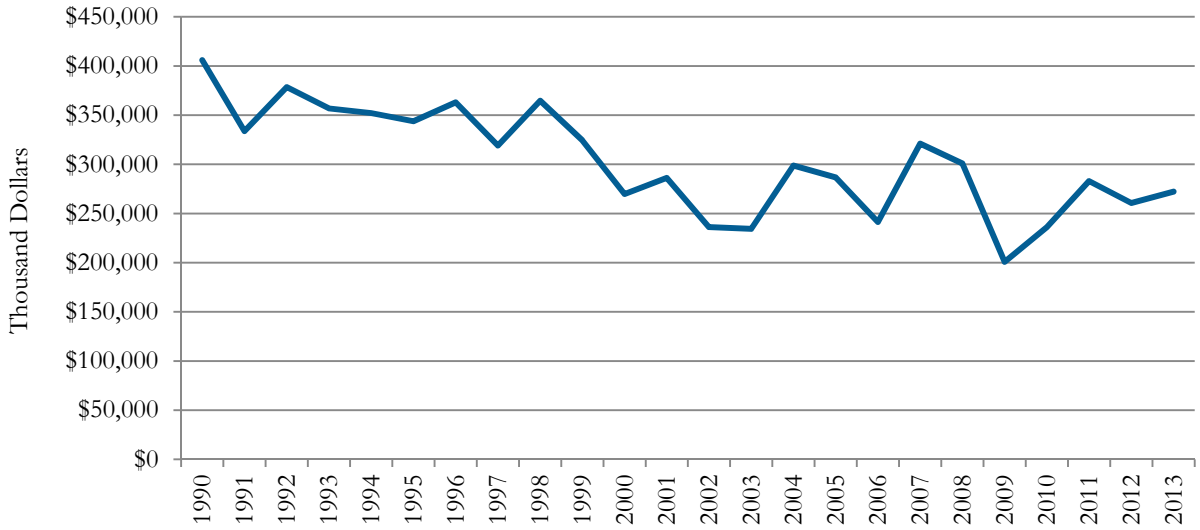
The IMPLAN impacts can be separated into three economic effects: direct, indirect and induced. A **direct** effect can be defined as a direct change in an area that occurs as a result of a change in an industry. For example, estimated sales revenue from dairy farms or dairy product manufacturing plants is a direct economic effect. Farms or plants create an **indirect** effect when they purchase goods or services from other industries (milk, transportation, utilities, repairs, etc.). **Induced** effects are changes in household spending that stem from income generated by direct and indirect effects. For instance, employees at dairy farms or processing facilities will spend their income to buy real estate, shop at grocery stores or spend on other goods or services in the local economy.

Economic impacts from IMPLAN are categorized by various indicators such as output, jobs and value-added. **Value-added** refers to the difference between the industry output (value of production) and the cost of the inputs used in its production. It can also be interpreted as the net gain or contribution to the state's gross domestic product. Salaries, wages, taxes and profit would be included in this value-added classification. Another economic indicator is the number of **jobs**, which can be either full-time or part-time, supported by the industry. **Output** reflects the total value of industry production or sales.

2. Missouri Dairy Farms – Economic Contribution

The dairy farming industry is an important contributor to Missouri's economy. During 2013, the state's dairy farms generated $272.2 million in cash receipts for milk. Of all Missouri livestock cash receipts collected in 2013, milk cash receipts represented 6.4 percent of the total. Missouri milk cash receipts have declined over time as dairy cows and farms maintained in the state have decreased. Exhibit 2.1 charts Missouri milk cash receipts from 1990 to 2013. These milk cash receipts generate economic activity throughout Missouri. However, note that Missouri milk cash receipts decreased 32.9 percent between 1990 and 2013.

Exhibit 2.1 – Missouri Milk Cash Receipts, 1990 to 2013



Source: USDA, Economic Research Service

For each county, economic contributions from Missouri dairy farms were estimated using 2013 IMPLAN county-level data. This information would include direct, indirect and induced economic effects from the operation of Missouri dairy farms. The Missouri dairy farming industry supported a total of 3,680 jobs in 2013 as shown in Exhibit 2.2. Exhibit 2.3 displays the value-added impact from these farms; the value-added impact measures an industry's contribution to Missouri's gross domestic product. In 2013, dairy farms added $131 million to Missouri's gross domestic product. Output or sales values from these operations by county are reported in Exhibit 2.4.

Exhibit 2.2 – Missouri Dairy Farm Economic Contribution, Jobs by County, 2013

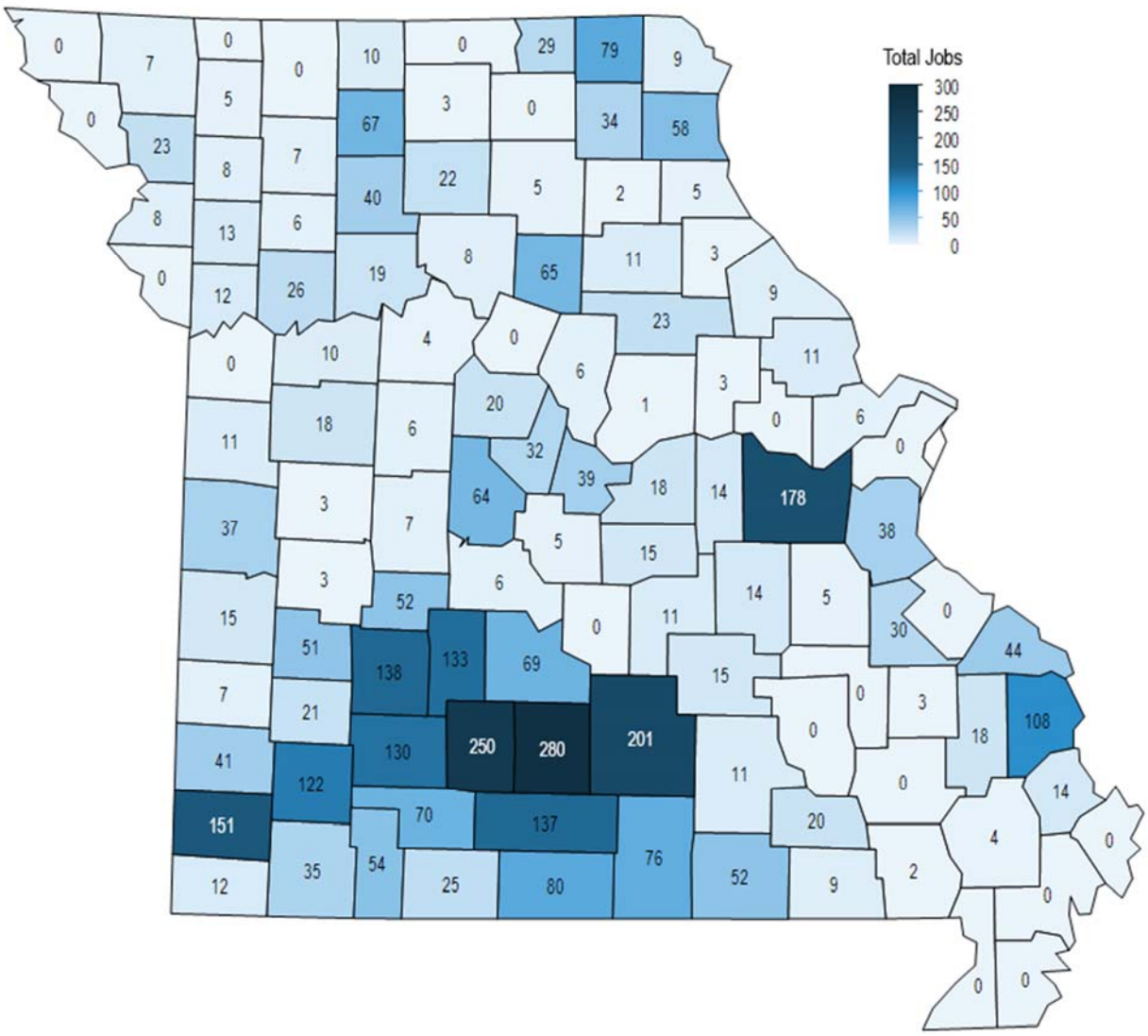


Exhibit 2.3 – Missouri Dairy Farm Economic Contribution, Value-Added by County, 2013

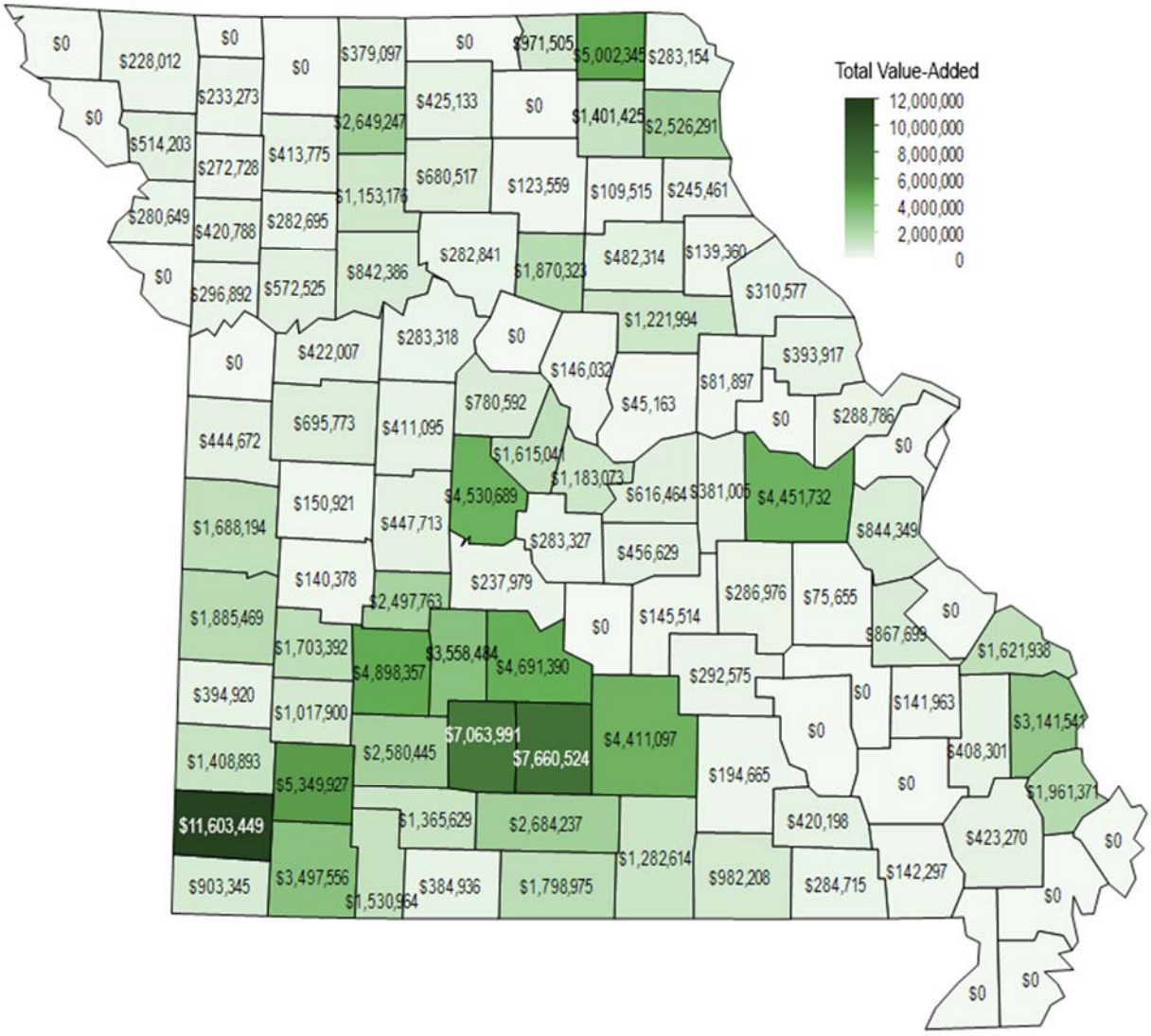


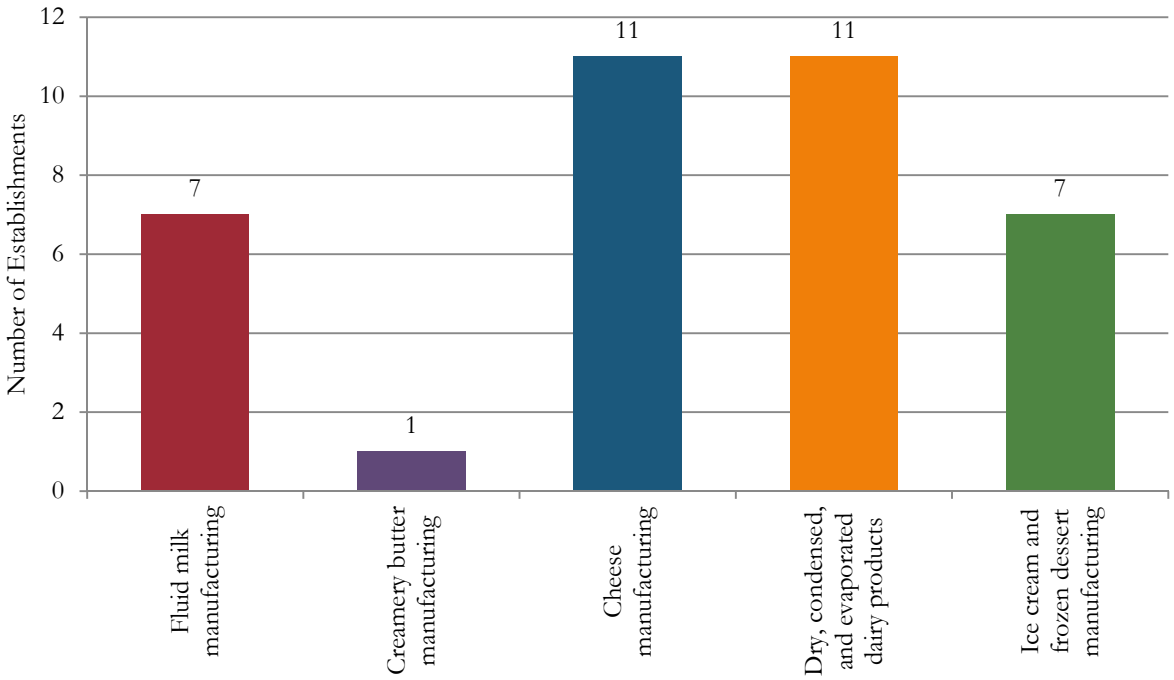
Exhibit 2.4 – Missouri Dairy Farm Economic Contribution, Output by County, 2013

County	Total Output		County	Total Output		County	Total Output
Adair	$0		Greene	$5,212,405		Ozark	$3,877,444
Andrew	$1,087,415		Grundy	$5,567,034		Pemiscot	$0
Atchison	$0		Harrison	$0		Perry	$3,508,263
Audrain	$2,633,163		Henry	$316,788		Pettis	$861,619
Barry	$7,293,996		Hickory	$5,307,890		Phelps	$298,265
Barton	$839,152		Holt	$0		Pike	$652,674
Bates	$3,579,179		Howard	$0		Platte	$0
Benton	$943,625		Howell	$2,654,507		Polk	$10,209,123
Bollinger	$894,795		Iron	$0		Pulaski	$0
Boone	$298,265		Jackson	$0		Putnam	$0
Buchanan	$596,530		Jasper	$2,867,946		Ralls	$298,265
Butler	$298,265		Jefferson	$1,732,226		Randolph	$3,877,444
Caldwell	$596,530		Johnson	$1,465,989		Ray	$1,193,060
Callaway	$94,362		Knox	$2,991,516		Reynolds	$0
Camden	$480,799		Laclede	$9,833,920		Ripley	$596,530
Cape Girardeau	$6,405,416		Lafayette	$894,795		St. Charles	$596,530
Carroll	$1,789,590		Lawrence	$11,348,212		St. Clair	$298,265
Carter	$894,795		Lewis	$5,368,769		Ste Genevieve	$0
Cass	$921,158		Lincoln	$826,795		St. Francois	$1,789,590
Cedar	$3,579,179		Linn	$1,421,054		St. Louis	$0
Chariton	$596,530		Livingston	$2,386,120		Saline	$596,530
Christian	$2,874,686		Macon	$1,880,510		Schuyler	$2,087,855
Clark	$596,530		Madison	$260,620		Scotland	$10,595,559
Clay	$596,530		Maries	$298,265		Scott	$4,075,561
Clinton	$894,795		Marion	$980,696		Shannon	$413,398
Cole	$2,438,821		McDonald	$508,883		Shelby	$229,166
Cooper	$1,637,863		Mercer	$775,120		Stoddard	$894,795
Crawford	$596,530		Miller	$596,530		Stone	$3,230,792
Dade	$2,162,474		Mississippi	$0		Sullivan	$894,795
Dallas	$7,417,566		Moniteau	$3,407,160		Taney	$780,737
Daviess	$870,606		Monroe	$1,022,260		Texas	$9,220,563
DeKalb	$596,530		Montgomery	$172,998		Vernon	$3,877,444
Dent	$596,530		Morgan	$9,471,073		Warren	$0
Douglas	$5,626,925		New Madrid	$0		Washington	$160,641
Dunklin	$0		Newton	$24,643,214		Wayne	$0
Franklin	$9,240,784		Nodaway	$479,676		Webster	$14,911,520
Gasconade	$798,711		Oregon	$2,087,855		Worth	$0
Gentry	$483,046		Osage	$1,451,385		Wright	$16,934,696

3. Missouri Dairy Product Manufacturing Industry – Economic Contribution

Dairy product manufacturing also provides valuable economic contributions to Missouri. The state's dairy product manufacturing industry processes dairy products from raw milk, processed milk and dairy substitutes. This industry can be divided into subsectors: fluid milk; creamery butter; cheese; dry, condensed and evaporated dairy; and ice cream and frozen desserts. Exhibit 3.1 shows the breakdown of dairy product manufacturing establishments in Missouri by industry sector.

Exhibit 3.1 – Missouri Dairy Product Manufacturing Establishments by Sector, 2013



Note: Dairy manufacturing plants may be engaged in multiple sectors.
Source: U.S. Bureau of Labor Statistics

The U.S. Bureau of Labor Statistics reports industry data on establishments, employment and wages for the dairy manufacturing sector. Exhibit 3.2 provides information concerning Missouri's dairy product manufacturing industry during 2013. Total wages paid to Missouri dairy manufacturing employees totaled $275 million. Overall, the dairy product manufacturing industry directly employed 5,354 people, and annual wages per employee averaged $51,340.

Exhibit 3.2 – Missouri Dairy Product Manufacturing, 2013

Metric	Dairy Product Manufacturing *(including ice cream and frozen desserts)*
Establishments	36
Employees (#)	5,354
Total wages (dollars)	$274,892,000
Average annual pay (dollars)	$51,340

Source: U.S. Bureau of Labor Statistics

Missouri's large milk bottling plants are owned by dairy farmers through their dairy cooperatives. The Prairie Farms cooperative runs these bottling plants directly or in joint ventures with the Dairy Farmers of America (DFA) cooperative. These same two cooperatives own other dairy processing plants that make soft products, specialty drinks and other custom dairy products. DairiConcepts, a national dairy ingredient company that's headquartered in Springfield and operates an El Dorado Springs plant, is also owned by dairy farmers via a joint venture between DFA and Fonterra cooperatives. Missouri's non-farmer-owned dairy product manufacturing facilities are owned by privately held companies and public corporations. Privately held companies include Schreiber Foods and Jasper Products. Public corporations include Kraft, Unilever, Smucker and DuPont.

Exhibit 3.3 details the 2013 economic contributions of Missouri dairy product manufacturers to the state. Missouri dairy manufacturing plants produced $5.1 billion in dairy product sales during 2013. After accounting for indirect and induced economic effects, dairy manufacturing plant estimated revenues in Missouri translate into total sales of $7.6 billion. Please note that an indirect effect would include the contribution from the Missouri dairy farms that supplied milk to these plants, so adding the previously reported economic contribution from the Missouri dairy farming industry would be considered double-counting some economic effects. The Missouri dairy product manufacturing industry supported a total 23,049 jobs when considering all economic effects. Total value-added impact or Missouri gross domestic product (GDP) contribution was nearly $2 billion in 2013.

Exhibit 3.3 – Economic Contributions of Missouri Dairy Manufacturing, 2013

Impact Type	Employment *(Jobs)*	Value-Added *(Dollars)*	Output *(Dollars)*
Direct effect	5,452	$656,581,450	$5,091,058,527
Indirect effect	11,496	$876,683,534	$1,715,051,609
Induced effect	6,101	$430,942,493	$754,675,618
Total effect	**23,049**	**$1,964,207,477**	**$7,560,785,754**

Note: May not sum due to rounding

A further breakdown of the leading industry sectors impacted economically by the Missouri dairy manufacturing industry can be seen in Exhibit 3.4. Please note that this information includes all direct, indirect and induced economic effects. Dairy cattle and milk production farms were the leading industry impacted based on total employment from dairy manufacturing. Cheese manufacturing and wholesale trade followed. In terms of total value-added impact, the sectors with the highest impact values were cheese manufacturing and wholesale trade, and with regard to total output, the sectors with the highest impact values were cheese manufacturing and dry, condensed and evaporated dairy product manufacturing.

Exhibit 3.4 – Top 10 Industries Affected by the Missouri Dairy Manufacturing Industry (Ranked Based on Total Employment), 2013

Industry Sector Description	Total Employment *(Jobs)*	Total Value-Added *(Dollars)*	Total Output *(Dollars)*
Dairy cattle and milk production	3,056	$105,702,637	$228,125,358
Cheese manufacturing	2,697	$318,528,368	$2,640,394,662
Wholesale trade	2,176	$294,791,967	$464,113,023
Truck transportation	1,523	$96,554,290	$228,209,850
Dry, condensed, and evaporated dairy product mfg.	1,159	$163,003,468	$1,608,134,842
Ice cream and frozen dessert manufacturing	1,028	$108,396,824	$397,981,749
Fluid milk manufacturing	559	$63,878,696	$429,318,394
Real estate	497	$51,237,042	$69,390,334
Full-service restaurants	428	$9,642,028	$19,802,494
Management of companies and enterprises	424	$56,384,046	$96,038,412

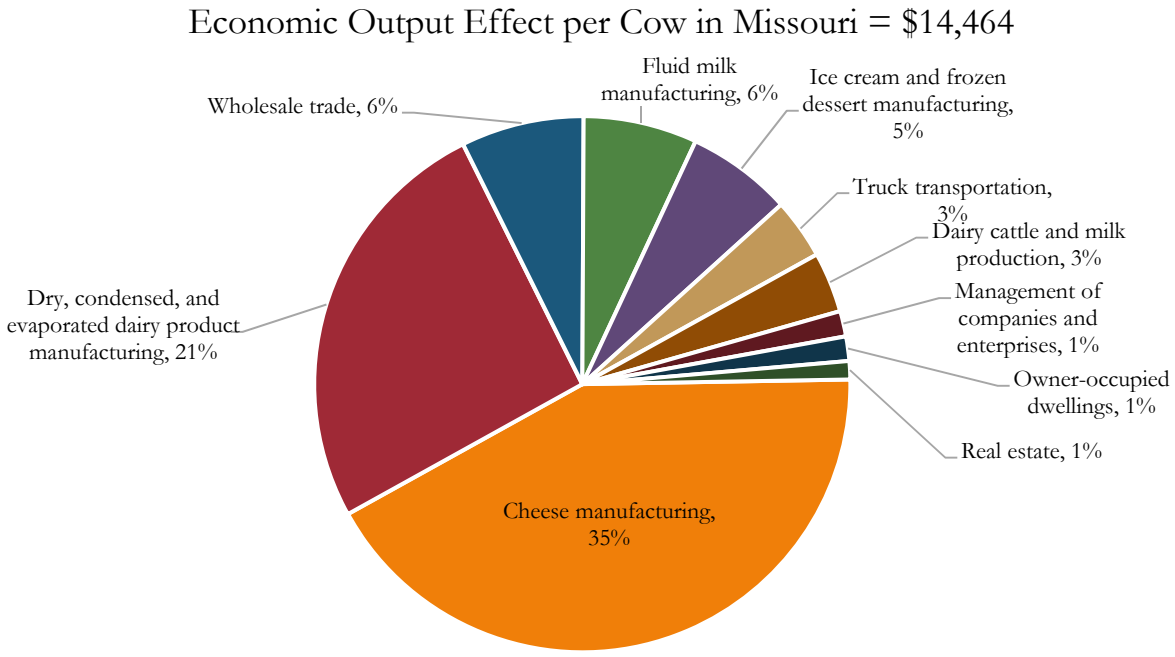
Other states have estimated the economic output effect of one dairy cow for their respective state. These studies typically calculate the total economic contribution from dairy farming and processing industries in a given state and simply divide that number by that given state's reported dairy cow inventory. Timms (2013) estimated that the economic output effect for Iowa dairy farming and processing industries was $23,445 per dairy cow. A study by Deller (2014) estimated the total economic impact for Wisconsin's dairy and dairy processing industry. That number was translated to approximately $34,000 per cow by the Wisconsin Milk Marketing Board. In states with a balanced processing and dairy farming industry, this simple economic impact/cow value is a reasonable metric in explaining the economic impact of a dairy cow. Missouri has a more unique situation, however, with its large processing industry and relatively small dairy cow inventory. A large amount of milk derivatives, cheese and other specialty dairy products are imported to Missouri from other states for further processing by existing Missouri dairy product manufacturers. Many of these manufacturers are located in Missouri due to the state's past legacy as a major dairy state. If Missouri followed the same methodology reported by other states for estimating economic impact per dairy cow, then the calculation would suggest that the economic output per Missouri dairy cow would have been $82,182 in 2013 ($7.5 billion in economic contribution from Missouri's dairy farm and dairy manufacturing industries divided by 92,000 dairy cow inventory reported by USDA-NASS).

An approach to adjust this number to more accurately estimate the economic impact per cow in Missouri is to multiply the state's economic output from dairy by the regional purchasing coefficient (RPC) factor. The RPC is the percentage of the total demand for a commodity that is supplied by

producers within a designated area. IMPLAN data report this factor by industry sector. Thus, in this case, the RPC for the dairy cattle and milk production industry sectors in Missouri can be used to derive the percentage of the value of the total dairy demand by product manufacturers being supplied by Missouri dairy farms. The three-year average (2011 to 2013) RPC for the Missouri dairy cattle and milk production industry in IMPLAN data is 17.6 percent. In other words, 17.6 percent of the total demand for milk and dairy ingredients from Missouri's dairy product manufacturers and other end-users is being met by the Missouri dairy farming industry. Adjusting the overall industry economic output by this RPC factor and then presenting it on a per-cow basis suggests that the economic output effect of one dairy cow in Missouri was $14,464 in 2013.

Exhibit 3.5 shows the top 10 industries economically impacted by Missouri dairy product manufacturing economic output and their percentage of the overall total output from direct, indirect and induced economic effects. Based on this graphic, cheese manufacturing and dry, condensed and evaporated dairy product manufacturing had the greatest annual impacts on average in 2013. This graphic demonstrates the industries impacted by each dairy cow. If Missouri increased its number of dairy farms and/or Missouri dairy producers increased their farms' milk production, then there would be further increases in the output effect from the dairy cattle and milk production industry sector. Additionally, these relationships would change if existing Missouri dairy product manufacturers were to cease operations.

Exhibit 3.5 – Top 10 Industries Affected by the Missouri Dairy Manufacturing Industry (Based on Total Output), 2013



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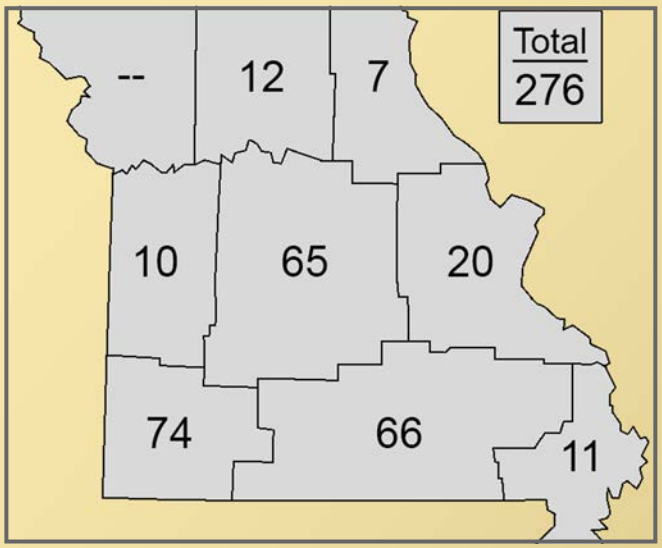
January 2015



Missouri Dairy Industry Revitalization Study

Section 3: Needs Assessment

UNIVERSITY OF MISSOURI
Extension
Commercial Agriculture Program

Missouri Dairy Industry Revitalization Study – *Section 3: Needs Assessment*

The following authors contributed to this section:

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Other publications from this study include:

Executive Summary
A comprehensive overview of the overall Missouri Dairy Industry Revitalization study.

Section 1: Historical Perspective
Section 1 provides an in-depth discussion about Missouri's dairy industry historical trends concerning its dairy cow inventory, farms, production, prices, production economics and processing industry.

Section 2: Economic Contribution
Section 2 discusses what the economic contributions such as jobs, value-added and industry sales are from Missouri dairy farms and the Missouri dairy product manufacturing industry.

Section 4: Value Chain, Marketing and Processing
Section 4 provides a discussion about dairy product demand and current opportunities to enhance the farmer's position in the value chain. Further processing opportunities and dairy niche marketing are discussed in this section.

Section 5: Comparative Analysis to Identify Gaps
What is the competiveness of Missouri's dairy industry versus other U.S. states? Section 5 seeks to create a common understanding of the Missouri dairy industry's competitive position, benchmark Missouri's dairy industry and environment against other states and look at ways that other states have attempted to revitalize their dairy industries.

Complete copies of all publications can be found at http://dairy.missouri.edu/revitalization/.

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The Missouri Dairy Industry Revitalization Study
Section 3: Needs Assessment

Table of Contents

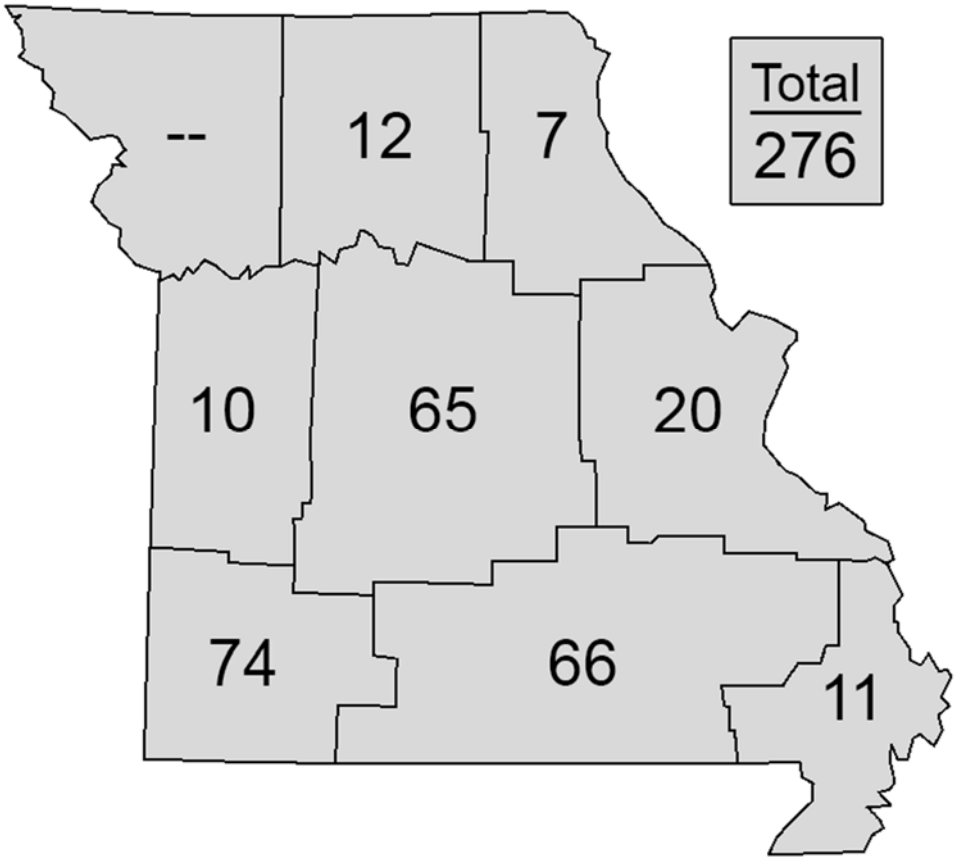
1. Producer Survey: Locations, Age, Land Use & Expansion Plans

During fall 2014, the University of Missouri Commercial Agriculture Program conducted an 18-question survey of Missouri dairy producers to gather their perspectives about needs associated with strengthening the state's dairy industry. Surveys were mailed to all 875 Grade A dairy producers currently permitted by the Missouri State Milk Board. Producers had about one month to complete and return the survey. As an alternate method to reach producers, the Commercial Agriculture Program team encouraged producers attending 13 USDA Margin Protection Program meetings to complete the survey on site or online. This section summarizes all responses submitted.

1.1 Survey Respondents

In total, 276 Missouri dairy producers responded to the survey developed for this study. Survey responses represent 32 percent of the survey population. Agricultural statistics districts with the most producers responding to the survey were the southwest district, 74 respondents; south central district, 66 respondents; and central district, 65 respondents. Exhibit 1.1.1 shares the number of respondents from Missouri agricultural statistics districts, which the USDA National Agricultural Statistics Service defines. Note that no dairy producers in the northwest district participated. Response rates by district roughly represent the geographic distribution of Missouri dairy operations.

Exhibit 1.1.1 – Number of Respondents by Missouri Agricultural Statistics District

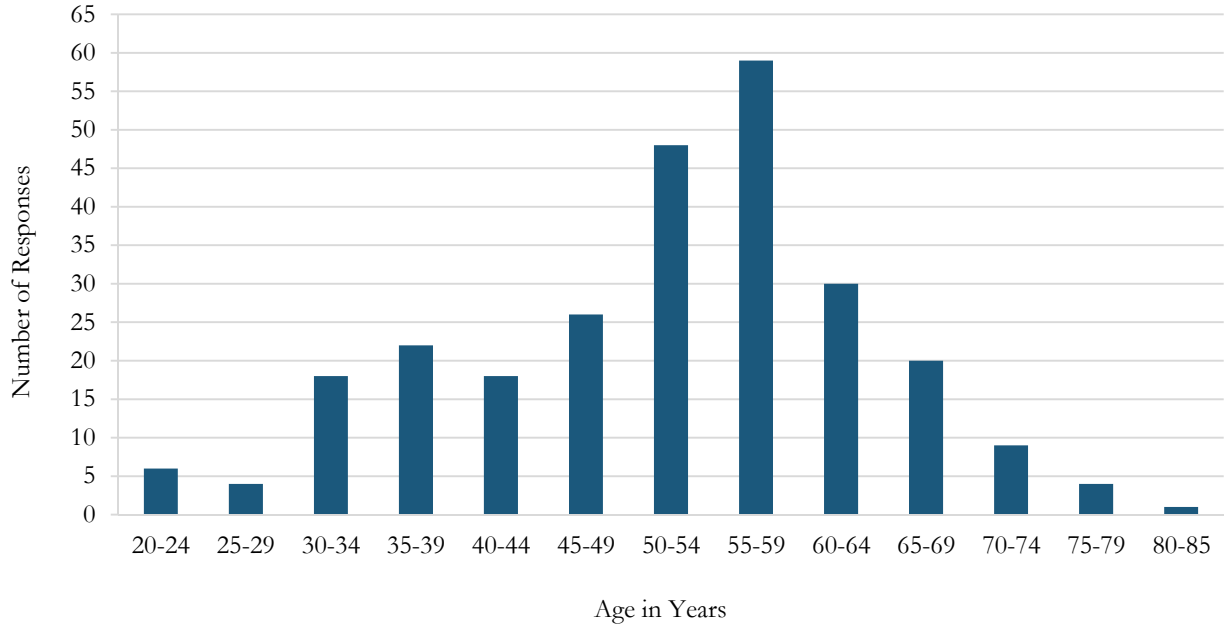


Source: University of Missouri, Commercial Agriculture Program

1.2 Age & Land Use

By age, more dairy producers responding to the survey were in their 50s than the other age categories provided. Respondent age averaged 51.5, and 107 respondents shared that they were 50- to 59-year-olds. Exhibit 1.2.1 illustrates the distribution of dairy producers by age category. The survey question asked respondents to provide their current age when they completed the survey. Fifty respondents noted being in their 60s, 44 respondents shared that they were in their 40s, and 40 respondents indicated being in their 30s. Fewer participants were in their 20s, 70s and 80s.

Exhibit 1.2.1 – Age Distribution of Survey Respondents (N = 265)



Source: University of Missouri, Commercial Agriculture Program

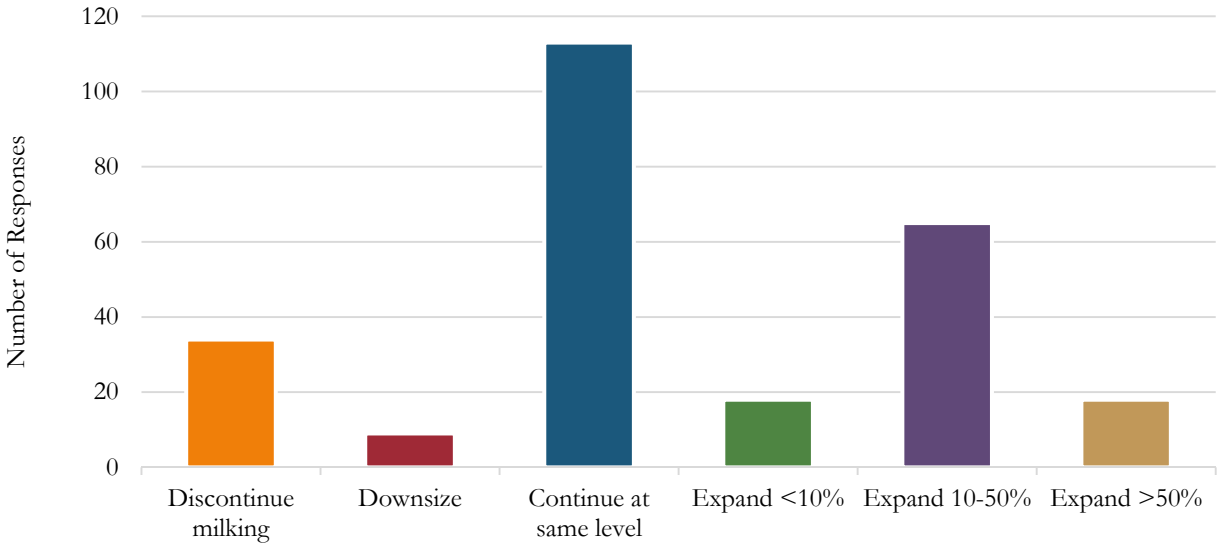
Regarding respondents' land use, the average respondent owned and operated 440.52 acres. Of the total acreage, producer-respondents on average maintained 45.83 acres in corn silage, 30.83 acres in alfalfa, 117.18 acres in other hay or haylage and 173.97 acres for grazing both cows and heifers.

1.3 Producer Expansion Plans

Of the producer-respondents who shared five-year plans for their dairy operations, the greatest number indicated that they planned to continue to produce at the same level. About 44 percent of respondents shared that they plan to continue operating at the same level. However, several indicated that they would discontinue milking, downsize or expand their operations. Exhibit 1.3.1 presents the survey respondents' plans for their dairy operations in the next five years. Thirty-four respondents, or 13.2 percent of those responding, shared that they would discontinue milking, and nine respondents, or 3.5 percent of those responding, indicated that they plan to downsize. Based on the survey responses, some producers are considering growth. Of the respondents answering this question, 101 producers, or 39.3 percent, indicated that they're planning to expand. Of those suggesting that they may expand, most plan to grow 10 percent to 50 percent. However, 18

respondents shared that they're planning for more than 50 percent growth, and another 18 respondents indicated that they plan to expand by less than 10 percent.

Exhibit 1.3.1 – Producers' Dairy Farm Plans for the Next Five Years (N = 257)



Source: University of Missouri, Commercial Agriculture Program

Like other responses included in this survey summary, producers in different Missouri districts also have varying five-year plans for their operations. See Exhibit 1.3.2. Within the next five years, the greatest share of central district respondents plan to continue operating at the same level. The north central, northeast, south central, southeast and southwest districts also had the greatest share of their respondents indicating that they plan to continue producing at the same level. In the west district, a majority of the survey respondents shared that they have plans to expand their operations by 10 percent to 50 percent in the next five years. In the east district, the share of producers indicating that they plan to continue producing at the same level was equivalent to the share of respondents that noted plans to expand their operations by 10 percent to 50 percent.

In the central, east, south central, southwest and west districts, at least 10 percent of the respondents from each respective district noted that they plan to stop milking in the next five years. A relatively low share in all districts shared that they plan to downsize their dairies. Of the producers that indicated that they plan to expand, the greatest share of respondents in all districts but the southeast district indicated that they'd most likely expand by 10 percent to 50 percent. In the southeast, 18.2 percent of the respondents said that they planned to expand by less than 10 percent, and the same share indicated that they planned to increase their operations by 10 percent to 50 percent.

Exhibit 1.3.2 – Producers' Dairy Farm Plans for the Next Five Years by District*

	Central	East	North Central	Northeast	South Central	Southeast	Southwest	West	State Average
Discontinue milking	13.8%	15.8%	0.0%	0.0%	17.5%	9.1%	11.6%	11.1%	**13.2%**
Downsize	1.5%	5.3%	0.0%	0.0%	4.8%	0.0%	4.3%	0.0%	**3.5%**
Continue at same level	43.1%	36.8%	72.7%	50.0%	38.1%	45.5%	50.7%	11.1%	**44.0%**
Expand <10%	7.7%	5.3%	0.0%	0.0%	7.9%	18.2%	5.8%	11.1%	**7.0%**
Expand 10-50%	29.2%	36.8%	27.3%	33.3%	22.2%	18.2%	18.8%	55.6%	**25.3%**
Expand >50%	4.6%	0.0%	0.0%	16.7%	9.5%	9.1%	8.7%	11.1%	**7.0%**

** N = 65 for central district; N = 19 for east district; N = 11 for north central district; N = 6 for northeast district; N = 63 for south central district; N = 11 for southeast district; N = 69 for southwest district; and N = 9 for west district.*

Source: University of Missouri, Commercial Agriculture Program

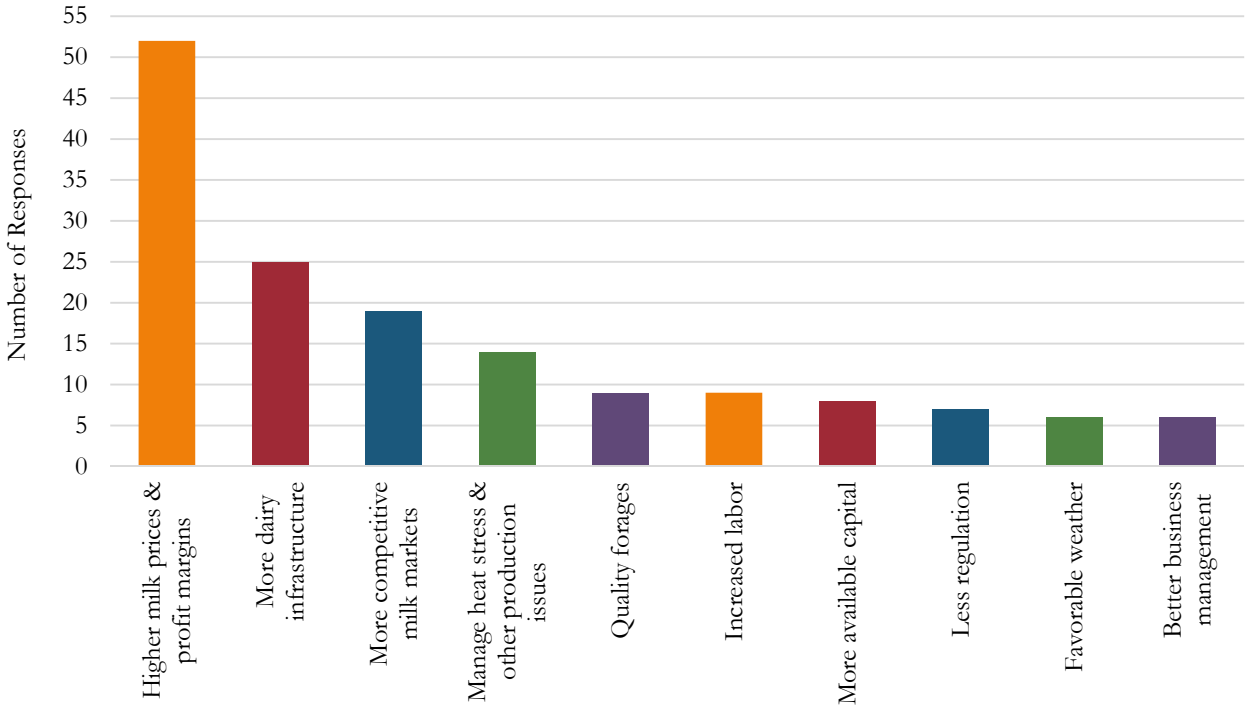
2. Producer Survey: Producer Needs

The following sections share producer-respondents' thoughts about the state of the Missouri dairy industry, and they highlight dairy industry needs identified by producers responding to the survey.

2.1 Dairy Producers Identify Greatest Need

The survey presented two open-ended questions to identify needs and challenges that affect Missouri dairies. Coding the open-ended responses involved combining responses into similar categories and including one response from each producer. When producers shared multiple responses, the coding method averaged the responses. For example, if both Producer 1 and Producer 2 listed "A" and "B" as responses, then the coding process assigned "A" to Producer 1 and "B" to Producer 2. Exhibit 2.1.1 shares the top 10 responses, not all responses, to the question that asked survey participants to share needs that would make them more successful. Of all responses collected to this question, the top need identified based on number of responses was higher milk prices and profit margins. By earning more revenue and profit, producers may have improved opportunities to be successful. Needs that ranked as the second to fourth most important based on number of responses were more dairy infrastructure, more competitive milk markets and options to manage heat stress and other production-related issues. The other six items included in the top 10 needs based on number of responses were quality forages, increased labor, more available capital, less regulation, favorable weather and better business management.

Exhibit 2.1.1 – What do Dairy Producers Need to be More Successful?*

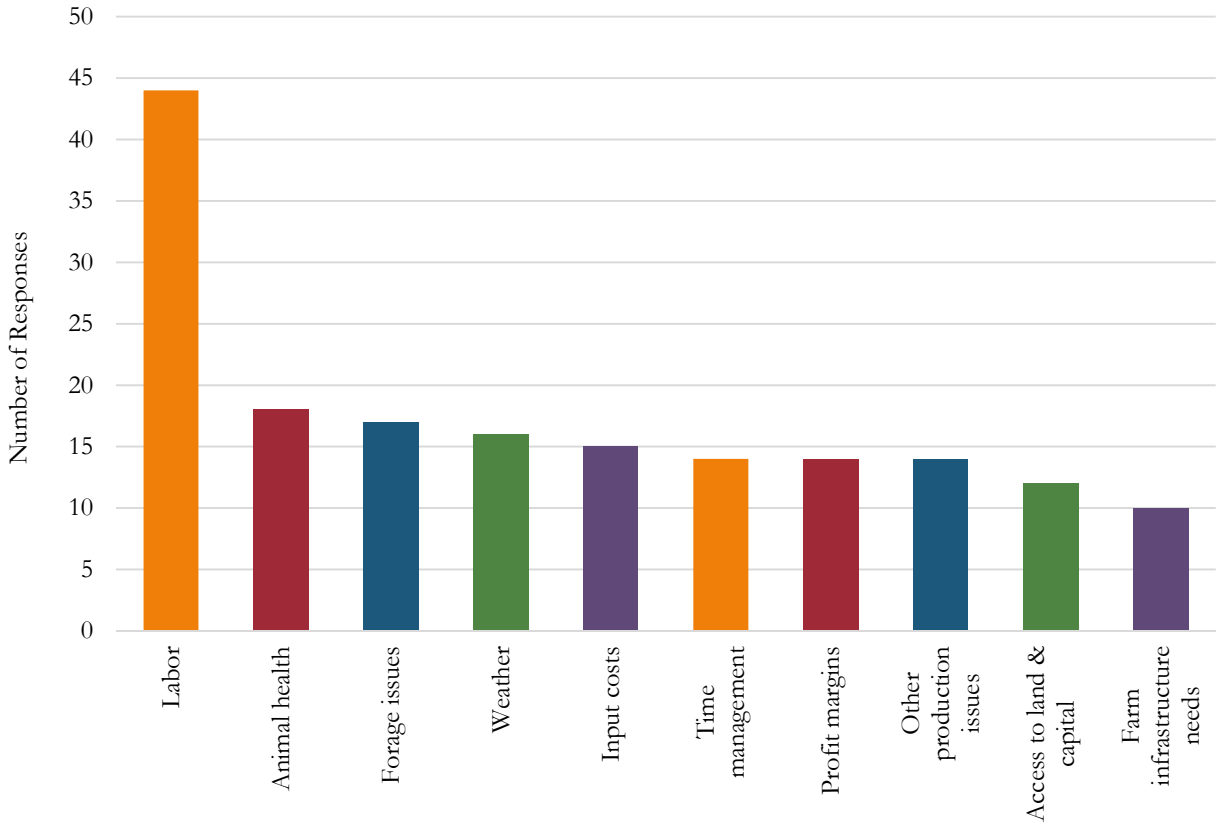


** Total N = 181 responses; chart presents just responses for the top 10 needs based on number of responses.*
Source: University of Missouri, Commercial Agriculture Program

2.2 Dairy Producers Identify Greatest On-Farm Challenges

Like in the previous question, respondents also had an opportunity in an open-ended format to share the greatest challenge that they face on their dairy farms. Coding the responses uncovered several category themes. Exhibit 2.2.1 shares the top 10 greatest challenges, not necessarily all greatest challenges shared by the respondents, based on the number of responses that shared each challenge. Based on number of responses, respondents significantly identified that labor was the greatest challenge that they must address. More than twice as many respondents identified labor as their greatest challenge relative to the number of respondents that named the challenge that ranked second, which was animal health. The other challenges shared in the top 10 list had a somewhat similar number of responses. The three remaining challenges ranked in the top five based on number of responses were forage issues, weather and input costs. Of the challenges listed in the top 10, the fifth to 10th greatest challenges based on number of responses were time management, profit margins, other production issues, access to land and capital and farm infrastructure needs.

Exhibit 2.2.1 – What are Dairy Producers' Greatest Challenges?*



** Total N = 207 responses; chart presents just responses for the top 10 needs based on number of responses.*
Source: University of Missouri, Commercial Agriculture Program

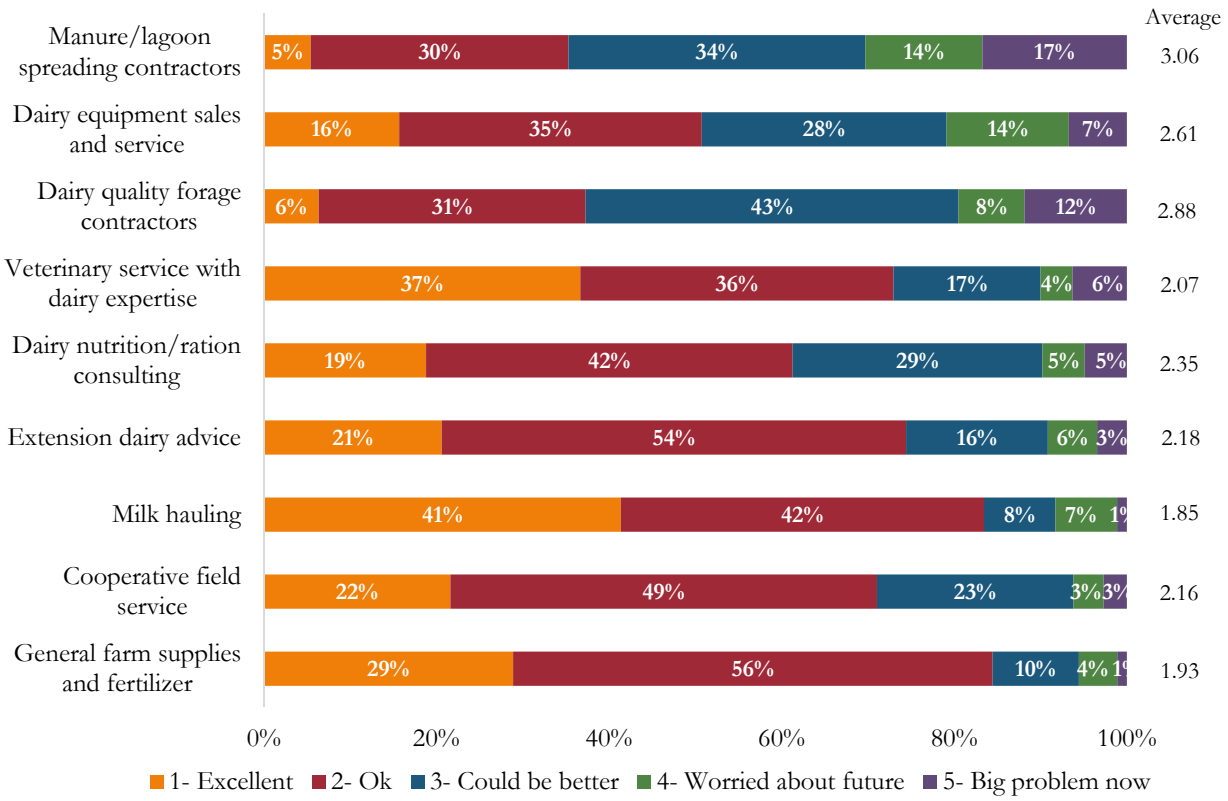
2.3 Dairy Producers Rate the State of Dairy Infrastructure in Missouri

Using a five-point scale, producers were asked to rate their perceptions of dairy infrastructure quality in their areas. To interpret the scoring, higher scores, such as "4" and "5" scores, indicate poorer

infrastructure quality, and lower scores, such as "1" and "2" scores, indicate better infrastructure quality. Exhibit 2.3.1 summarizes producer-respondents' thoughts about nine dairy infrastructure resources. On average, respondents assigned the highest rating to manure/lagoon spreading contractors. Based on the 3.06 average score, respondents on average think that this infrastructure component could be better. Of the nine infrastructure components evaluated in the survey, manure/lagoon spreading contractors also received the highest proportion of "5" scores, indicating that this infrastructure factor is a big problem now, and it received the smallest share of "excellent" ratings. The other infrastructure resources receiving the highest average scores – thus, indicating possible problem areas – were dairy quality forage contractors, which scored 2.88 on average, and dairy equipment sales and service, which scored 2.61 on average. Infrastructure components with the lowest average scores were milk hauling, which scored 1.85 on average, and general farm supplies and fertilizer, which scored 1.93 on average. Low scores indicate that the quality of the particular infrastructure resource is excellent or OK.

Dairy infrastructure resources receiving the greatest share of "excellent" ratings were milk hauling, veterinary service with dairy expertise and general farm supplies and fertilizer. Those generating the greatest share of "OK" responses were general farm supplies and fertilizer, extension dairy advice and cooperative field service. In the "could be better" category, dairy quality forage contractors, manure/lagoon spreading contractors, dairy nutrition/ration consulting and dairy equipment sales and service infrastructure categories received the greatest share of "3" scores. As a group, the respondents shared that they worry most that dairy equipment sales and service and manure/lagoon spreading contractors may become problems in the future, based on the share of "4" scores awarded to them. The two infrastructure resources receiving the greatest share of "big problem now" ratings were the manure/lagoon spreading contractors and dairy quality forage contractors. Exhibit 2.3.1 lists dairy infrastructure resources by the share of combined "4" and "5" scores assigned by respondents, so resources listed high in the chart had the greatest shares of "4" and "5" scores and, thus, were recognized as being more problematic. Manure/lagoon spreading contractors, dairy equipment sales and service and dairy quality forage contractors had the greatest share of combined "4" and "5" scores assigned.

Exhibit 2.3.1 – Dairy Infrastructure Quality Ratings in Respondents' Areas*



** N = 270 for veterinary service with dairy expertise; N = 268 for dairy equipment sales and service; N = 266 for dairy nutrition/ration consulting; N = 236 for dairy quality forage contractors; N = 221 for manure/lagoon spreading contractors; N = 266 for milk hauling; N = 259 for cooperative field service; N = 270 for general farm supplies and fertilizer; and N = 262 for extension dairy advice.*
Source: University of Missouri, Commercial Agriculture Program

Based on an average rating of scores for all nine infrastructure components in each district, the northeast and central districts reported the lowest aggregate average ratings at 1.94 and 2.12, respectively, which indicates that respondents in these districts were most satisfied with the dairy infrastructure quality in their areas. Aggregate rating averages were highest in the southeast and west districts at 2.76 and 2.69, respectively, which indicate greater concern about the dairy infrastructure quality in these districts. See Exhibit 2.3.2.

By district, the survey data indicate some slight differences in perceived dairy infrastructure quality in various areas. This discussion shares the three infrastructure resources with the highest average scores in each district. Note that a higher score indicates the perception that the given resource has poorer quality. Central, northeast and west district respondents on average indicated that manure/lagoon spreading contractors, dairy quality forage contractors and dairy equipment sales and service were the most problematic infrastructure resources in that order. In the north central district, respondents ranked manure/lagoon spreading contractors as the most problematic infrastructure resource on average, and dairy equipment sales and service and dairy quality forage contractors tied for ranking second based on average scores assigned. For respondents in the east and south central districts, infrastructure resources receiving the highest ratings were dairy quality forage contractors followed by manure/lagoon spreading contractors and dairy equipment sales and service.

The other two districts had slightly more variability in their most concerning dairy infrastructure resources. In the southeast district, respondents assigned highest ratings on average to manure/lagoon spreading contractors, dairy equipment sales and service and veterinary service with dairy expertise. Southwest district respondents shared that manure/lagoon spreading contractors, dairy quality forage contractors and dairy nutrition/ration consulting were resources of most concern based on their average scores.

Respondents tended to be least concerned about two main infrastructure resources. In the central, north central, south central, southeast and southwest districts, respondents awarded the lowest scores on average to milk hauling. Respondents from the east and west districts assigned the lowest average scores to general farm supplies and fertilizer. The northeast district was the exception. On average, respondents assigned the lowest score to veterinary service with dairy expertise.

Exhibit 2.3.2 – Dairy Infrastructure Quality Ratings in Respondents' Areas by District

	Central	East	North Central	Northeast	South Central	Southeast	Southwest	West	State Average
Veterinary service with dairy expertise	1.67	1.85	2.25	1.29	2.40	3.18	2.04	2.00	**2.07**
Dairy equipment sales and service	2.51	2.50	3.25	2.14	2.64	3.45	2.32	3.50	**2.61**
Dairy nutrition/ration consulting	2.16	1.90	2.42	1.57	2.52	3.00	2.40	2.44	**2.35**
Dairy quality forage contractors	2.65	3.00	3.25	2.57	3.02	3.00	2.72	3.78	**2.88**
Manure/lagoon spreading contractors	2.94	2.88	3.30	2.86	2.85	3.63	3.18	4.00	**3.06**
Milk hauling	1.53	2.20	1.75	1.71	2.00	1.91	1.80	2.00	**1.85**
Cooperative field service	1.97	2.28	2.18	1.71	2.26	2.00	2.24	2.33	**2.16**
General farm supplies and fertilizer	1.56	1.80	1.92	1.57	2.20	2.09	2.08	1.80	**1.93**
Extension dairy advice	2.07	1.90	2.17	2.00	2.24	2.55	2.23	2.38	**2.18**
	2.12	**2.26**	**2.50**	**1.94**	**2.46**	**2.76**	**2.33**	**2.69**	

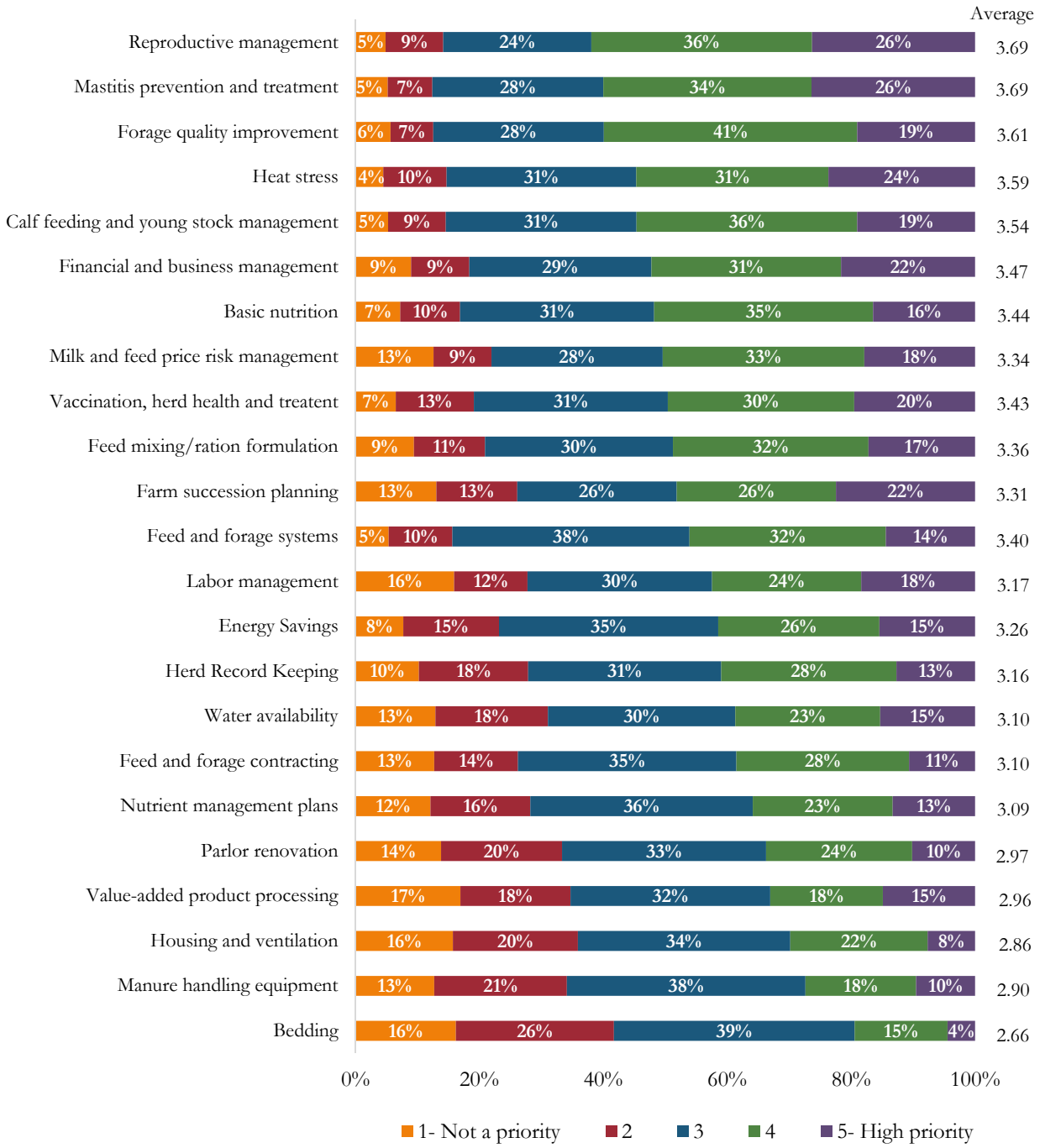
* "1" signifies excellent, "2" signifies OK, "3" signifies could be better, "4" signifies worried about future, and "5" signifies big problem now.
Source: University of Missouri, Commercial Agriculture Program

2.4 Dairy Producers Rank Training and Information Needs

Regarding the training and information topics that Missouri producers describe needing, Exhibit 2.4.1 lists various topics and respondent attitudes about information and training needs on those topics. The chart organizes topics based on the combined share of four and five scores awarded to them by respondents. On a one-to-five scale, assigning a five to a given topic indicated that it is a high priority. Assigning one point indicated that the given topic is not an information or training priority. Those listed at the top of the chart had a greater combined share of four or five scores awarded than those listed at the bottom of the chart. The topics receiving the greatest share of combined four and five scores were reproductive management, 61.9 percent of scores were a four or five; mastitis prevention and treatment, 60 percent of scores were a four or five; and forage quality improvement, 59.9 percent of scores were a four or five. Because these three topics received the greatest combined share of four and five scores, respondents view these topics as the most significant information and training priorities. These three topics also averaged the highest score when calculating the mean score provided by producers responding to each question component.

Of the 23 topics from which respondents could choose, others ranked in the top 10 based on the share of combined four and five scores awarded were heat stress; calf feeding and young stock management; financial and business management; basic nutrition; milk and feed price risk management; vaccination, herd health and treatment; and feed mixing/ration formulation. The three topics with the smallest share of combined four and five scores were bedding, manure handling equipment and housing and ventilation.

Exhibit 2.4.1 – Dairy Producers' Views of Training and Information Topic Needs*



** N = 249 for basic nutrition; N = 244 for feed mixing/ ration formulation; N = 244 for feed and forage contracting; N = 247 for forage quality improvement; N = 243 for feed and forage systems; N = 247 for calf feeding and young stock management; N = 250 for mastitis prevention and treatment; N = 247 for reproductive management; N = 246 for vaccination, herd health and treatment; N = 248 for housing and ventilation; N = 247 for bedding; N = 246 for energy savings; N = 248 for water availability; N = 245 for heat stress; N = 246 for parlor renovation; N = 244 for herd record keeping; N = 245 for farm succession planning; N = 245 for financial and business management; N = 245 for labor management; N = 246 for milk and feed price risk management; N = 242 for value-added product processing; N = 252 for manure handling equipment; and N = 248 for nutrient management plans.*

Source: University of Missouri, Commercial Agriculture Program

Based on an average priority score provided by respondents in a given district, the information or training topics identified as the highest priorities vary fairly widely by district. See Exhibit 2.4.2. Three topics ranked as first or tied for the highest average in two districts: mastitis prevention and treatment in the central and east districts, reproductive management in the south central and southeast districts and energy savings in the northeast and southeast districts. Note that reproductive management and energy savings tied for first in the southeast district. Heat stress in the central district tied with mastitis prevention and treatment as the top information and training topic priority, and bedding tied for first with energy savings among northeast district respondents. Respondents in the north central district identified forage quality improvement as the top priority. Milk and feed price risk management averaged the highest score among the southwest district respondents, and financial and business management ranked as the top priority in the west district.

Based on average scores, the following list shares other information and training topics identified as high priorities by district: forage quality improvement and reproductive management, central district; calf feeding and young stock management and reproductive management, east district; water availability and feed mixing/ration formulation, north central district; reproductive management and feed and forage systems, northeast district; calf feeding and young stock management and forage quality improvement, south central district; mastitis prevention and treatment and forage quality improvement, southeast district; reproductive management and mastitis prevention and treatment, southwest district; and farm succession planning, reproductive management and vaccination, herd health and treatment, west district.

Exhibit 2.4.2 – Dairy Producers' Views of Training and Information Topic Needs by District

	Central	East	North Central	Northeast	South Central	Southeast	Southwest	West	State Average
Basic nutrition	3.11	3.35	3.45	2.33	3.71	3.45	3.51	3.88	**3.44**
Feed mixing/ration formulation	3.23	3.20	3.50	2.83	3.62	3.55	3.22	3.71	**3.36**
Feed and forage contracting	2.75	3.11	2.55	2.50	3.59	3.40	3.10	2.63	**3.10**
Forage quality improvement	3.50	3.60	3.73	2.67	3.77	3.70	3.56	3.89	**3.61**
Feed and forage systems	3.17	3.35	3.45	3.00	3.70	3.40	3.30	3.44	**3.40**
Calf feeding and young stock management	3.28	3.80	3.36	2.67	3.79	3.36	3.52	3.75	**3.54**
Mastitis prevention and treatment	3.58	4.15	2.64	2.83	3.76	3.82	3.78	3.89	**3.69**
Reproductive management	3.41	3.80	3.40	3.17	3.81	3.91	3.80	4.00	**3.69**
Vaccination, herd health and treatment	3.21	3.55	3.00	2.40	3.63	3.36	3.51	4.00	**3.43**
Housing and ventilation	3.02	3.25	2.64	2.83	2.90	2.82	2.61	2.88	**2.86**
Bedding	2.63	2.95	2.82	3.33	2.70	2.91	2.39	2.75	**2.66**
Energy savings	2.96	3.25	3.09	3.33	3.32	3.91	3.36	2.88	**3.26**
Water availability	2.80	2.75	3.55	2.50	3.24	2.70	3.22	3.88	**3.10**
Heat stress	3.58	3.79	3.45	2.67	3.56	3.55	3.71	3.75	**3.59**
Parlor renovation	2.68	3.10	3.45	2.33	3.13	3.00	2.97	2.88	**2.97**
Herd record keeping	3.00	3.47	3.09	2.50	3.31	3.00	3.12	3.13	**3.16**
Farm succession planning	2.89	3.70	3.45	2.67	3.47	3.55	3.26	4.25	**3.31**
Financial and business management	3.18	3.37	3.36	2.33	3.66	3.64	3.47	4.38	**3.47**
Labor management	2.77	3.05	3.00	2.67	3.37	3.36	3.25	3.75	**3.17**
Milk and feed price risk management	2.89	3.20	3.09	2.17	3.48	2.82	3.82	3.25	**3.34**
Value-added product processing	2.44	3.15	3.45	2.67	3.10	3.18	3.07	2.88	**2.96**
Manure handling equipment	2.88	3.10	2.64	2.33	3.00	3.09	2.76	3.50	**2.90**
Nutrient management plans	2.95	3.15	3.09	2.67	3.26	3.27	2.91	3.88	**3.09**

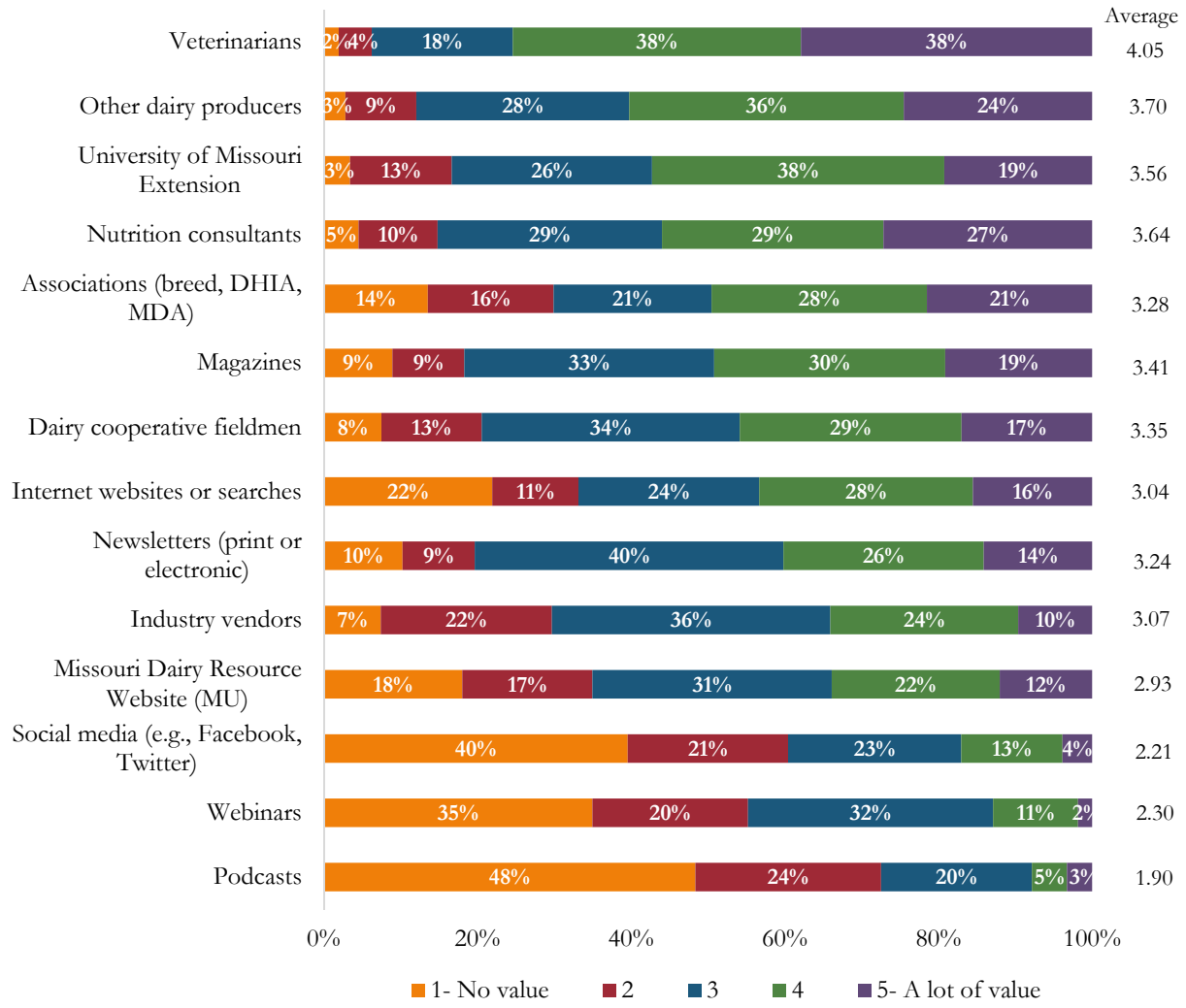
* "1" signifies not a priority, and "5" signifies a high priority.
Source: University of Missouri, Commercial Agriculture Program

2.5 Dairy Producers Rank Preferred Information Sources

On a scale from one to five, the survey requested that respondents indicate their use of several information sources. By assigning five points, producers suggested that the information source has a lot of value, and by assigning one point, they indicated that the information source has no value. Exhibit 2.5.1 presents the share of respondents assigning one, two, three, four or five points for each information source, and it averages the scores for each source to estimate an overall average point rating. The chart ranks information sources by their total percentage of combined four and five scores. Using this criterion, at least 50 percent of respondents rated four information sources with a four or five score: veterinarians, 75.4 percent of respondents provided a four or five score; other dairy producers, 60.2 percent of respondents provided a four or five score; University of Missouri Extension, 57.3 percent of respondents provided a four or five score; and nutrition consultants, 56 percent of respondents provided a four or five score.

Based on the average ratings for information source use, the respondents regarded veterinarians, other dairy producers, nutrition consultants and University of Missouri Extension as information sources that have the most value. Information sources with the lowest average ratings were podcasts, social media such as Facebook and Twitter and webinars.

Exhibit 2.5.1 – Dairy Producers' Preferred Information Sources*



** N = 234 for University of Missouri Extension; N = 256 for veterinarians; N = 243 for nutrition consultants; N = 229 for industry vendors; N = 253 for dairy cooperative fieldmen; N = 249 for other dairy producers; N = 183 for Missouri Dairy Resource Guide Website (MU); N = 234 for newsletters (print or electronic); N = 246 for magazines; N = 182 for social media; N = 214 for associations; N = 164 for webinars; N = 187 for Internet websites or searches; and N = 153 for podcasts.*
Source: University of Missouri, Commercial Agriculture Program

Based on average ratings, respondents in the central, east, south central, southeast, southwest and west districts all agreed that veterinarians provide the most value as an information source. See Exhibit 2.5.2. Respondents in two districts – the north central and northeast – identified a source other than veterinarians as having the most value based on their average sources. On average, north central district respondents identified that other dairy producers had the most value as an information source, and northeast district respondents identified that industry vendors were the most valuable information source. Other top information sources valued by producer-respondents had some variability by district. Exhibit 2.5.2 illustrates that variability. However, respondents in at least six of the eight districts contributed to an average score for the following sources that ranked the sources in the top four of those used in the respective district or tied for being in the top four: University of Missouri Extension, veterinarians, nutrition consultants and other dairy producers.

Exhibit 2.5.2 – Dairy Producers' Use of Information Sources by District

	Central	East	North Central	Northeast	South Central	Southeast	Southwest	West	State Average
University of Missouri Extension	3.46	3.95	3.80	3.40	3.60	3.75	3.41	3.83	**3.56**
Veterinarians	4.05	4.20	4.00	3.50	3.97	4.09	4.03	4.78	**4.05**
Nutrition consultants	3.63	3.85	4.18	4.33	3.69	3.91	3.27	4.00	**3.64**
Industry vendors	2.86	3.53	3.00	4.50	3.20	3.10	2.91	2.71	**3.07**
Dairy cooperative fieldmen	3.23	3.75	3.18	4.17	3.21	3.60	3.39	3.50	**3.35**
Other dairy producers	3.86	4.00	4.36	4.17	3.52	3.64	3.60	3.11	**3.70**
Missouri Dairy Resource website (MU)	2.84	3.50	3.20	2.67	2.71	3.00	3.00	2.67	**2.93**
Newsletters (print or electronic)	3.20	4.00	3.18	3.20	3.16	2.67	3.24	3.00	**3.24**
Magazines	3.57	3.95	3.45	3.50	3.18	3.36	3.26	3.75	**3.41**
Social media (e.g., Facebook, Twitter)	2.34	2.62	2.20	1.50	2.27	2.22	2.13	1.40	**2.21**
Associations (breed, DHIA, MDA)	3.45	3.72	3.20	4.17	3.30	3.64	2.98	2.86	**3.28**
Webinars	2.45	3.10	2.70	2.25	2.30	2.22	2.07	1.67	**2.30**
Internet websites or searches	2.74	3.58	2.80	2.40	3.04	3.36	3.10	3.00	**3.04**
Podcasts	1.68	2.70	2.11	1.50	1.96	1.75	1.84	1.60	**1.90**

* "1" signifies no value, and "5" signifies a lot of value.
Source: University of Missouri, Commercial Agriculture Program

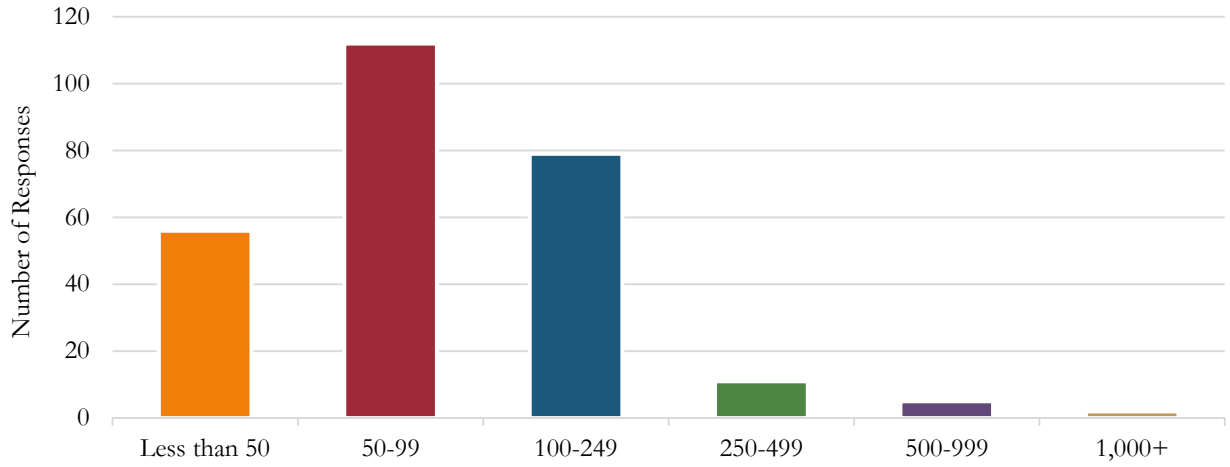
3. Dairy Farm Characteristics

The following sections detail producer-respondents' dairy farm characteristics. This section summarizes herd size, rolling herd averages, somatic cell counts, milking systems, housing systems, using of grazing and nutrient management systems.

3.1 Herd Size

Most commonly, producers responding to the survey indicated that they maintained a 50-cow to 99-cow herd size. Of the 265 survey respondents answering this question, 112 shared that their dairy cow inventory ranged from 50 cows to 99 cows. Exhibit 3.1.1 shares the number of respondents by their milking cow herd size. The survey requested that respondents include milking cows and dry cows in the herd size data that they reported. Seventy-nine respondents shared that their milking cow herd ranged from 100 cows to 249 cows, and 56 respondents indicated that they had fewer than 50 milking cows. Few dairy producer-respondents, 18 total, maintained at least 250 milking cows.

Exhibit 3.1.1 – Respondents' Milking Cow Herd Size (N = 265)

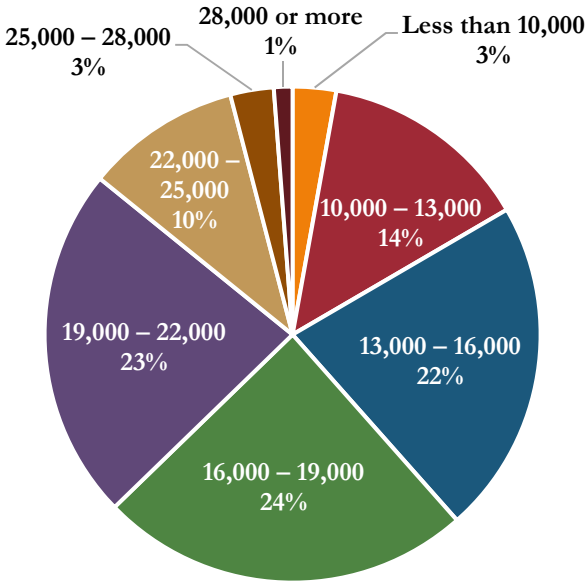


Source: University of Missouri, Commercial Agriculture Program

3.2 Rolling Herd Average

The milk production rolling herd average data shared in Exhibit 3.2.1 indicate that this measure varies widely among respondents. The pie chart indicates the share of respondents reporting various milk production rolling herd averages in pounds per cow per year. Seventeen percent of producers responding to this question indicated that their milk production rolling herd averages didn't exceed 13,000 pounds per cow per year, and 14 percent reported milk production rolling herd averages that were at least as high as 22,000 pounds per cow per year. Relatively similar shares of respondents reported milk production rolling herd averages that fit in the other categories: 13,000 to 16,000 pounds per cow per year, 22 percent of respondents; 16,000 to 19,000 pounds per cow per year, 24 percent of respondents; and 19,000 to 22,000 pounds per cow per year, 23 percent of respondents.

Exhibit 3.2.1 – Milk Production Rolling Herd Averages at Respondents' Dairies, Pounds per Cow per Year (N = 247)



Source: University of Missouri, Commercial Agriculture Program

3.3 Somatic Cell Count

Somatic cell count also varied widely among survey respondents, and it had geographic effects, too. Exhibit 3.3.1 illustrates that somatic cell count reported by producers responding to the question averaged 251,864. However, notice the extent to which somatic cell count varied depending on the agricultural statistics district. Based on the survey data, somatic cell count tended to be highest in the southeast and west agricultural statistics districts. In both of these districts, somatic cell counts averaged more than 300,000, and their averages exceeded the state average. The somatic cell count average for the southwest district also exceeded the state average.

Producer-respondents from the north central agricultural statistics district by far reported the lowest somatic cell counts, which averaged less than half of levels reported as averages in the southeast and west districts. Other agricultural statistics districts with somatic cell counts that averaged lower values than the state average were the northeast, central, east and south central districts.

Although these data give indications of possible somatic cell count problem areas, note that some districts included relatively few data points in their averages. For example, the northeast, north central, west and southeast districts all had 10 or fewer responses included in their averages.

Exhibit 3.3.1 – Average Somatic Cell Count in Respondents' Herds (N = 257)*

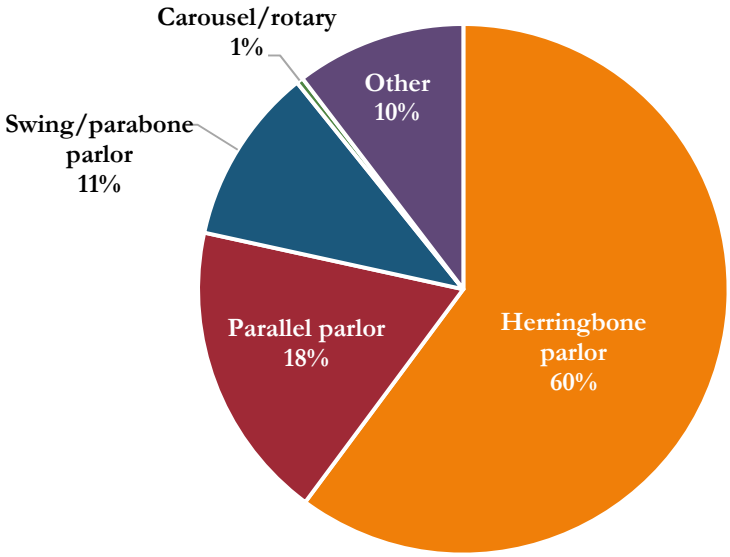
Ag District	SCC	# of Responses
Central	226,794	63
East	239,850	20
North Central	149,444	9
Northeast	218,571	7
South Central	241,984	64
Southeast	338,700	10
Southwest	284,514	72
West	302,222	9
State Average	**251,864**	**257**

** Not all respondents indicated their location, thus the sum of the eight ag district responses is less than the state average total of 257.*
Source: University of Missouri, Commercial Agriculture Program

3.4 Milking System

Among the producers who reported the milking system that they use, most shared that they use a herringbone parlor. Exhibit 3.4.1 illustrates the percentage of respondents that use various milking systems. Sixty percent of respondents shared that they have a herringbone parlor design. Of the respondents indicating the milking systems that they use, 18 percent reported that they use a parallel parlor, and 11 percent indicated that they use a swing/parabone parlor. Just 1 percent of the respondents shared that they use a carousel or rotary milking system. Ten percent of respondents noted that they use another type of milking system. Some of the more popular "other" responses included bypass milking systems, walk-through milking systems and flat-style milking systems. Two respondents shared that they use robotic systems.

Exhibit 3.4.1 – Milking Systems Used by Respondents (N = 241)

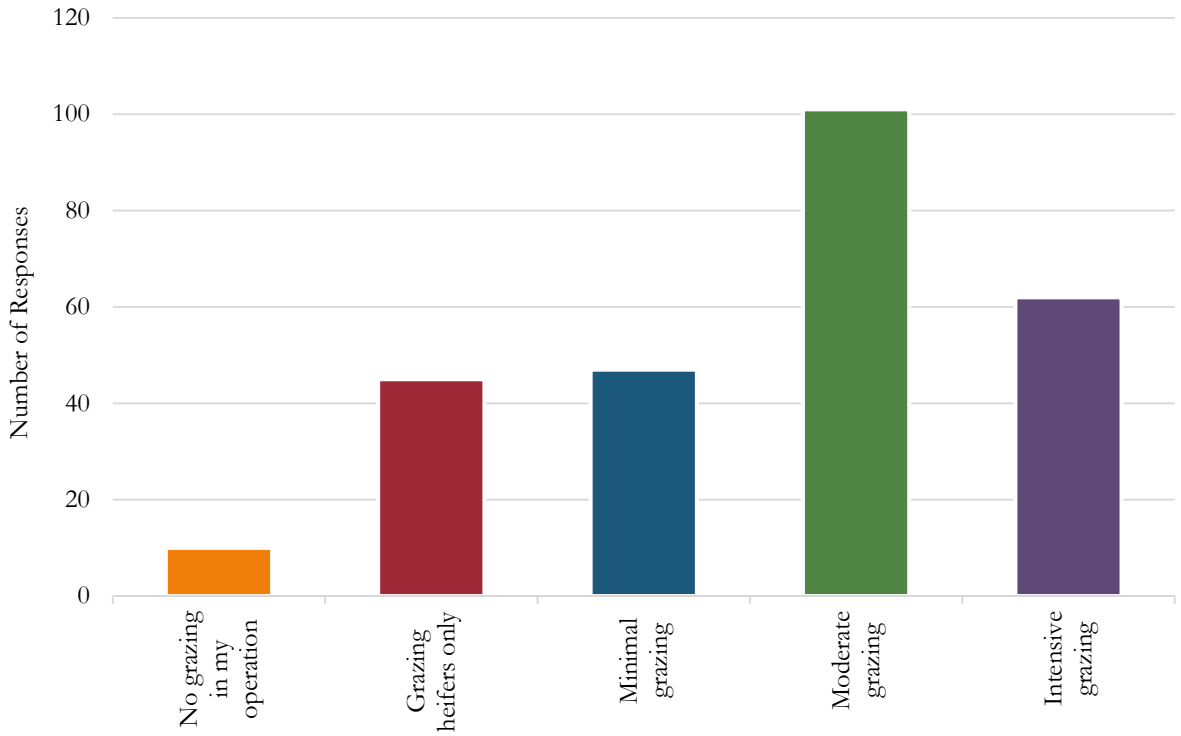


Source: University of Missouri, Commercial Agriculture Program

3.5 Use of Grazing

Production practices varied among producers responding to this project's survey. Exhibit 3.5.1 shares the number of respondents that reported using grazing for various purposes and at various levels. For the most part, Missouri dairy producers integrate at least some grazing into their production practices. Just 10 respondents noted that they use no grazing on their operations. Many producers, 101 respondents in total, shared that they've adopted moderate grazing use on their dairy operations. A smaller group, 62 respondents, reported using intensive grazing practices. Forty-seven respondents shared that they use minimal grazing on their dairies, and 45 respondents reported that they only graze their operations' heifers.

Exhibit 3.5.1 – Grazing Use at Respondents' Dairy Operations, Missouri (N = 265)



Source: University of Missouri, Commercial Agriculture Program

The extent of grazing use in dairy production has some differences among varying Missouri agricultural statistics districts. Exhibit 3.5.2 lists the share of respondents from each district that use grazing practices for their dairies to various extents. Based on the survey responses, the southeast, east and northeast districts had the greatest share of producers reporting that they don't use grazing in their operations. The southeast and northeast districts had the greatest share of producers who exclusively graze their heifers. Intensive grazing had the highest penetration rates in the north central, west and southwest districts as 41.7 percent, 33.3 percent and 31.5 percent of respondents from each respective district reported using intensive grazing practices. In the south central, southwest, north central and west districts, at least two-thirds of producer-respondents indicated that they use moderate or intensive grazing. In the central district, 68.8 percent of respondents used minimal or moderate grazing for their dairy operations.

Exhibit 3.5.2 – Grazing Use at Respondents' Dairy Operations by Missouri Agricultural Statistics District

	Central	East	North Central	Northeast	South Central	Southeast	Southwest	West	State Average
No grazing in my operation	0.0%	15.0%	0.0%	14.3%	1.6%	18.2%	4.1%	0.0%	**3.8%**
Grazing heifers only	20.3%	35.0%	16.7%	42.9%	14.1%	45.5%	6.8%	11.1%	**17.0%**
Minimal grazing	31.3%	25.0%	16.7%	14.3%	7.8%	9.1%	13.7%	22.2%	**17.7%**
Moderate grazing	37.5%	15.0%	25.0%	0.0%	48.4%	27.3%	43.8%	33.3%	**38.1%**
Intensive grazing	10.9%	10.0%	41.7%	28.6%	28.1%	0.0%	31.5%	33.3%	**23.4%**

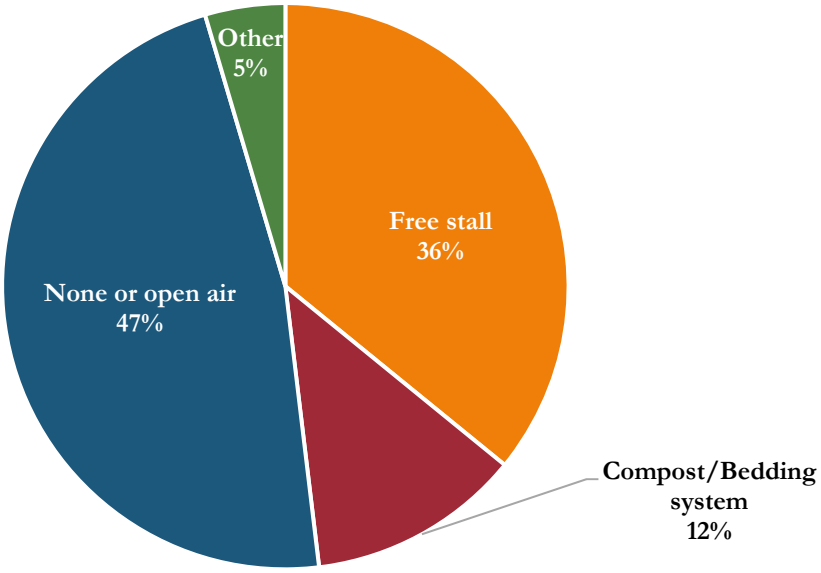
** N = 64 in central district; N = 20 in east district; N = 12 in north central district; N = 7 in northeast district; N = 64 in south central district; N = 11 in southeast district; N = 73 in southwest district; and N = 9 in west district.*

Source: University of Missouri, Commercial Agriculture Program

3.6 Cow Housing

With regard to the animal housing used on respondents' dairy operations, the greatest share of respondents reported using no housing or open-air housing. See Exhibit 3.6.1. Of the producers responding to this question, 47 percent shared that they use no housing or open-air housing. Free stall housing was also popular as 36 percent of respondents reported using this type of housing, and just 12 percent of respondents indicated that they use a compost or bedding system. A few producers, representing 5 percent of those answering the question, shared that they use other types of animal housing. "Other" responses included grazing, tie-stall configurations, straw bedding, pack bedding and other types of barn housing.

Exhibit 3.6.1 – Type of Animal Housing Used by Survey Respondents (N = 262)



Source: University of Missouri, Commercial Agriculture Program

Exhibit 3.6.2 lists the share of respondents from each district that use different housing systems for their dairies. Based on the survey responses, the east, northeast and north central districts used free stall barns the most. Respondents from the south central, west and southwest districts reported using free stalls the least. Compost bedding systems were most popular in the southeast, west and northeast districts. The south central district, which is the traditional heart of Missouri's dairy industry, reported using the least housing of any district. Likely, this is due to the area's gravelly well-drained soils and smaller herds. At least half of respondents from the southwest and west districts also reported using no housing or open-air housing.

Exhibit 3.6.2 – Housing Systems at Respondents' Dairy Operations by Missouri Agricultural Statistics District

	Central	East	North Central	Northeast	South Central	Southeast	Southwest	West	State Average
Free stall	49.2%	68.4%	54.5%	57.1%	15.6%	45.5%	29.2%	20.0%	**35.9%**
Compost/bedding system	12.7%	15.8%	18.2%	28.6%	9.4%	36.4%	5.6%	30.0%	**12.2%**
None or open air	36.5%	10.5%	9.1%	0.0%	73.4%	9.1%	58.3%	50.0%	**46.2%**
Other	1.6%	5.3%	18.2%	14.3%	1.6%	9.1%	6.9%	0.0%	**5.7%**

** N = 63 in central district; N = 19 in east district; N = 11 in north central district; N = 7 in northeast district; N = 64 in south central district; N = 11 in southeast district; N = 72 in southwest district; and N = 10 in west district.*

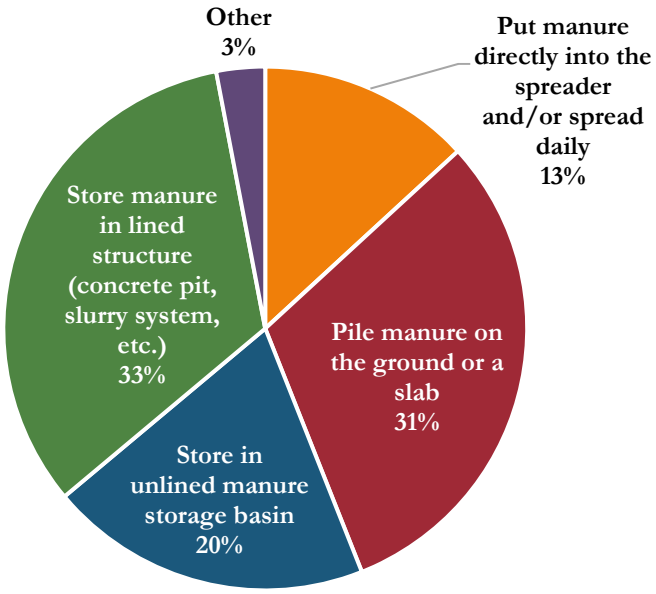
Source: University of Missouri, Commercial Agriculture Program

3.7 Manure & Nutrient Management System

To manage manure at their farms, survey respondents use different practices. Exhibit 3.7.1 presents the share of respondents that indicated using several manure handling practices. Based on these data, the greatest share of respondents store manure in lined structures such as concrete pits or slurry systems, or they pile manure on the ground or a slab. Twenty percent of respondents indicated that they store manure in an unlined storage basin, and 13 percent shared that they directly put manure in a spreader or that they daily spread manure. A few producers have adopted management practices other than these four options. For example, two respondents mentioned composting manure.

The average time that producers store livestock manure varies significantly depending on the management practices used. Respondents that pile livestock manure on the ground or a slab tend to store the manure for about 77 days on average. Those who store livestock manure in an unlined storage basin on average store the manure for 264 days, and those who store it in lined structures tend to store the manure for 101 days on average. For producers who have adopted other manure management practices, they store livestock manure for 94 days on average.

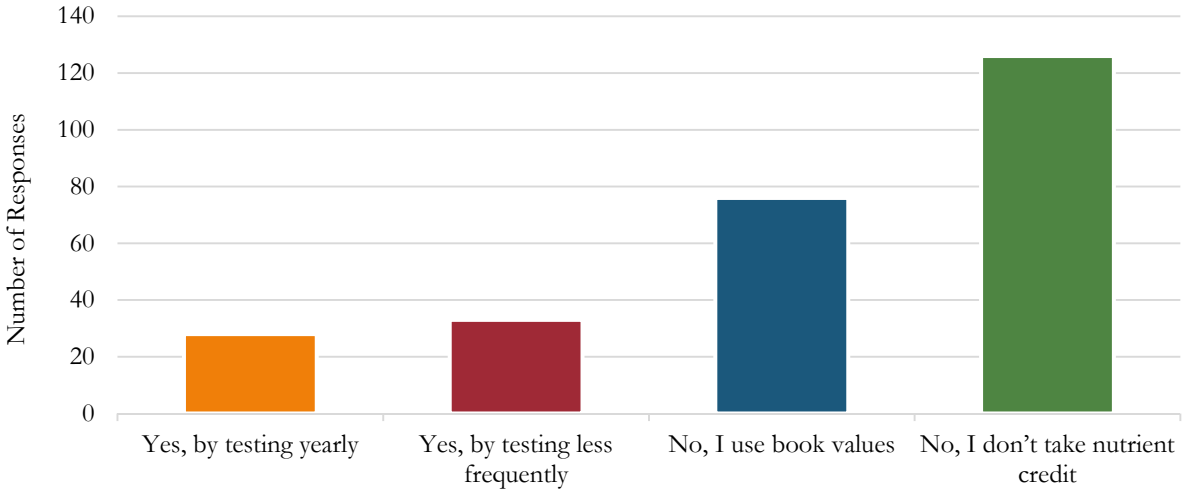
Exhibit 3.7.1 – Respondents' Use of Livestock Manure Management Practices (N = 266)



Source: University of Missouri, Commercial Agriculture Program

For the most part, Missouri dairy producers responding to the survey shared that they don't assess the nutrient content of their farms' livestock manure. Exhibit 3.7.2 illustrates respondents' actions toward assessing the nutrient content of manure. Of the respondents answering this question, 126 shared that they don't assess manure nutrient content or take nutrient credit. Seventy-six producers noted that they don't assess manure nutrient content, but they do use book values. Sixty-one respondents indicated that they do assess manure nutrient content, and of those, 54 percent assess the livestock manure nutrient content, but they conduct tests less frequently than each year. Forty-six percent of those assessing the nutrient content shared that they conduct annual tests.

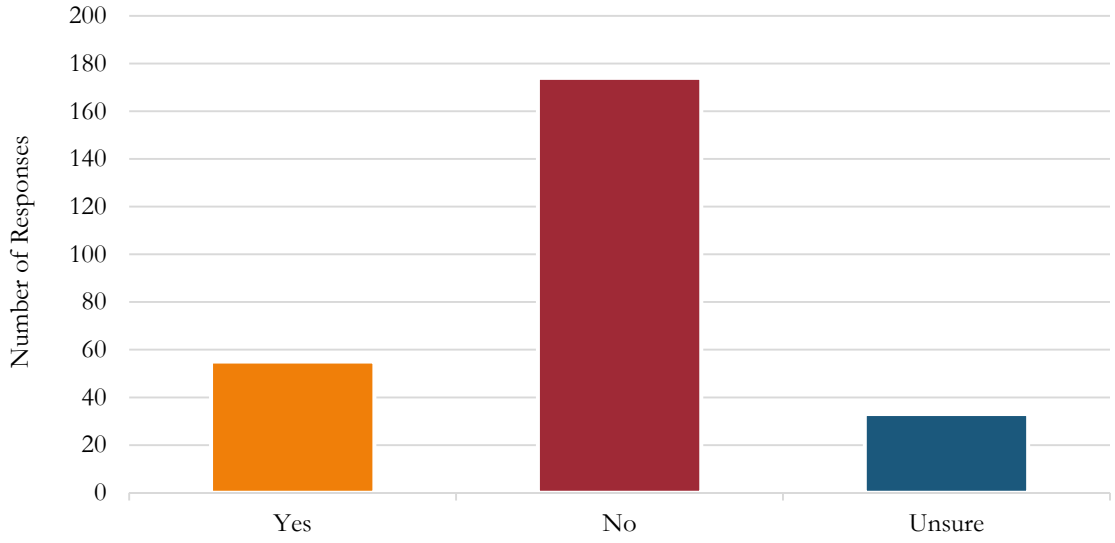
Exhibit 3.7.2 – Respondents' Attitudes toward Manure Nutrient Assessment (N = 263)



Source: University of Missouri, Commercial Agriculture Program

Based on the survey data, most Missouri dairy producers don't have a written nutrient plan for their farms. Exhibit 3.7.3 presents the number of survey respondents who have created a written nutrient plan. Of the 262 producers responding to this question, 174 respondents, or 66.4 percent, shared that they don't have a written nutrient plan. Twenty-one percent of the respondents, or 55 individuals, noted that they did have a written nutrient plan, and 12.6 percent, or 33 individuals, shared that they were unsure whether they had a written plan.

Exhibit 3.7.3 – Number of Respondents with Written Nutrient Plan for Farm (N = 262)



Source: University of Missouri, Commercial Agriculture Program

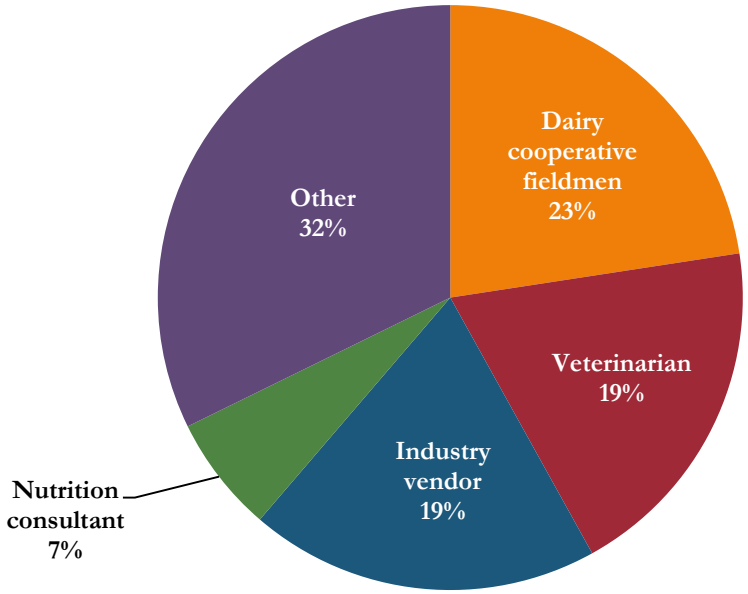
4. Industry Stakeholder Survey

During fall 2014, the Commercial Agriculture Program at the University of Missouri also administered a seven-question dairy industry survey directed at stakeholders that support the state's dairy industry. The survey's purpose was to gather stakeholders' perspectives about Missouri dairy industry needs and revitalizing the industry. To conduct the survey, the Commercial Agriculture Program included stakeholders such as veterinarians, dairy cooperative representatives, vendors and consultants. Such stakeholders could participate in the survey by attending dairy meetings and completing the survey on site or online. Alternatively, stakeholders receiving the Missouri Dairy Business Update monthly electronic newsletter also had the opportunity to participate in the survey. The newsletter is distributed to 435 dairy producers and stakeholders. Personalized survey invitations were emailed to key stakeholders.

4.1 Respondent Stakeholder Characteristics

Thirty-one dairy industry stakeholders responded to the survey. Exhibit 4.1.1 shares the roles that the respondents assume to support the industry. Dairy cooperative fieldmen represented 23 percent of the respondents. Veterinarians and industry vendors each represented 19 percent of the respondents. Nutrition consultants represented just 7 percent of the respondents. The "other" category includes respondents that were industry inspectors, regulatory personnel and lenders.

Exhibit 4.1.1 – Role of Dairy Stakeholder Survey Respondents (N = 31)



Source: University of Missouri, Commercial Agriculture Program

In the stakeholder survey, respondents also could share the geographic area that they represent within Missouri. Six respondents, or 19.4 percent of all 31 stakeholders participating in the stakeholder survey, noted that they serve all Missouri counties or regions or they serve the dairy industry statewide. Two respondents indicated that they serve most of the state. The remaining respondents had more variability in their coverage areas.

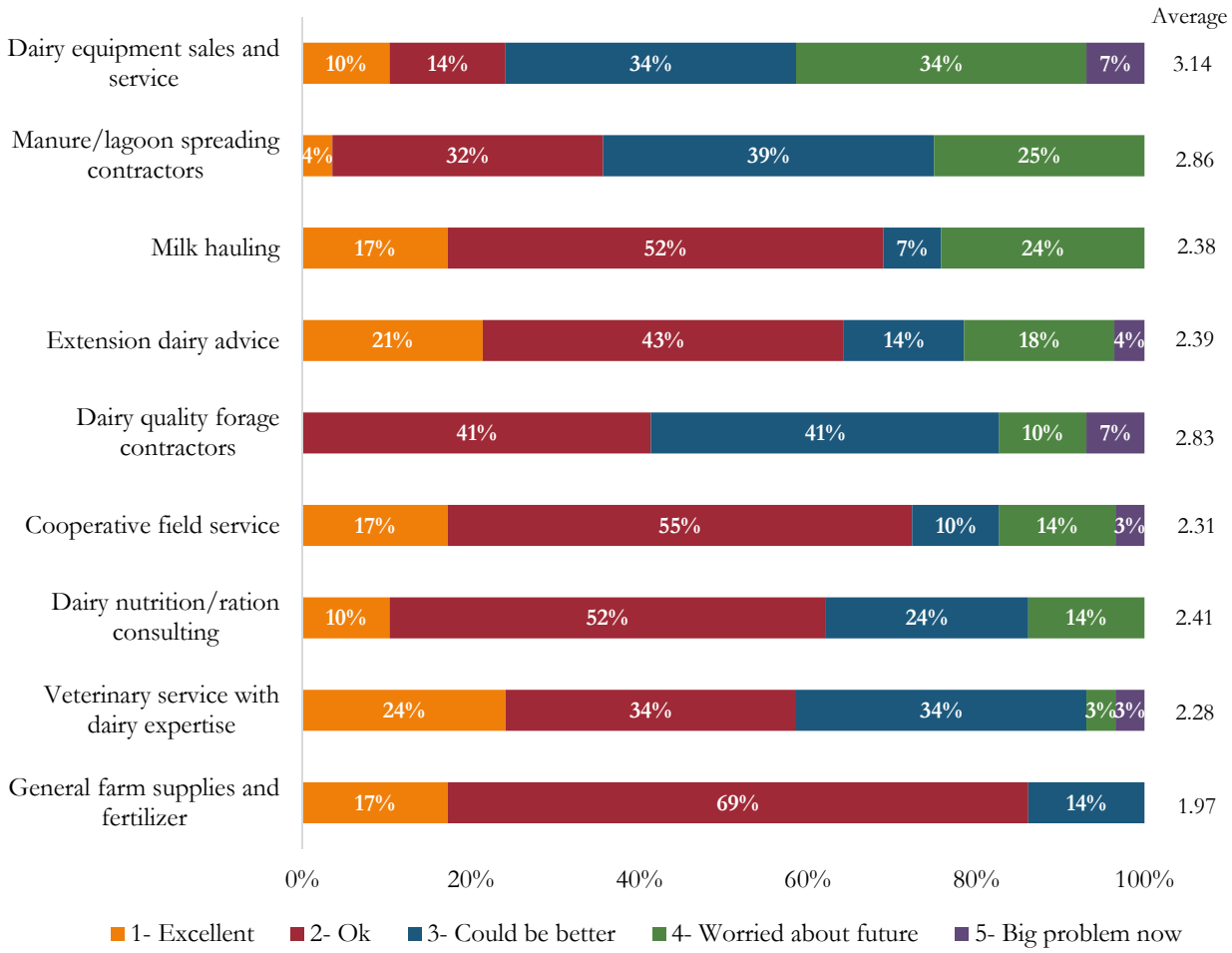
4.2 Stakeholder View – Infrastructure Quality

Of the dairy stakeholders that participated in the survey, they for the most part didn't overwhelmingly identify infrastructure resources that were big problems now. Just 6.9 percent of the stakeholders responding shared that they thought dairy equipment sales and service and dairy quality forage contractors were big problems now, and these two resources had the highest shares of "big problem now" responses. Extension dairy advice, cooperative field service and veterinary service with dairy expertise categories reported smaller shares of "big problem now" responses.

To share thoughts about dairy infrastructure, the survey prompted stakeholders to assign a one-to-five score for each infrastructure variable shared in Exhibit 4.2.1. Higher values, such as four and five ratings, indicate worse infrastructure quality. Infrastructure components receiving the greatest share of combined four and five scores were dairy equipment sales and service, 41.4 percent of respondents assigned a four or five; manure/lagoon spreading contractors, 25 percent of respondents assigned a four or five; and milk hauling, 24.1 percent of respondents assigned a four or five. The exhibit also shares average scores, which represent the mean score computed for a given infrastructure resource. Those with the highest average scores were dairy equipment sales and service, manure/lagoon spreading contractors and dairy quality forage contractors. Note that no stakeholders gave dairy quality forage contractors an "excellent" rating, denoted by a "1" score. Infrastructure resources with the lowest average scores and share of combined four and five ratings were general farm supplies and fertilizer and veterinary service with dairy expertise.

Compared with the producer survey results, the greatest infrastructure needs identified by stakeholders have some differences. For the most part, producers didn't identify milk hauling as a problematic infrastructure resource, but it ranked third for share of combined four and five scores in the stakeholder survey results. For the remaining top infrastructure resources, the order of the infrastructure quality ratings was somewhat different between the producer and stakeholder surveys. For example, manure/lagoon spreading contractors ranked first in the producer survey results based on combined share of four or five scores but ranked second behind dairy equipment sales and service based on combined share of four or five scores in the stakeholder survey results. As another example, producers ranked veterinary service with dairy expertise as fourth based on share of combined four and five scores, but the stakeholders ranked veterinary service with dairy expertise as eighth based on combined share of four and five scores.

Exhibit 4.2.1 – Dairy Infrastructure Quality Ratings in Stakeholder Respondents' Areas*



** N = 29 for veterinary service with dairy expertise, dairy equipment sales and service, dairy nutrition/ration consulting, dairy quality forage contractors, milk hauling, cooperative field service and general farm supplies and fertilizer; N = 28 for manure/lagoon spreading contractors and extension dairy advice*

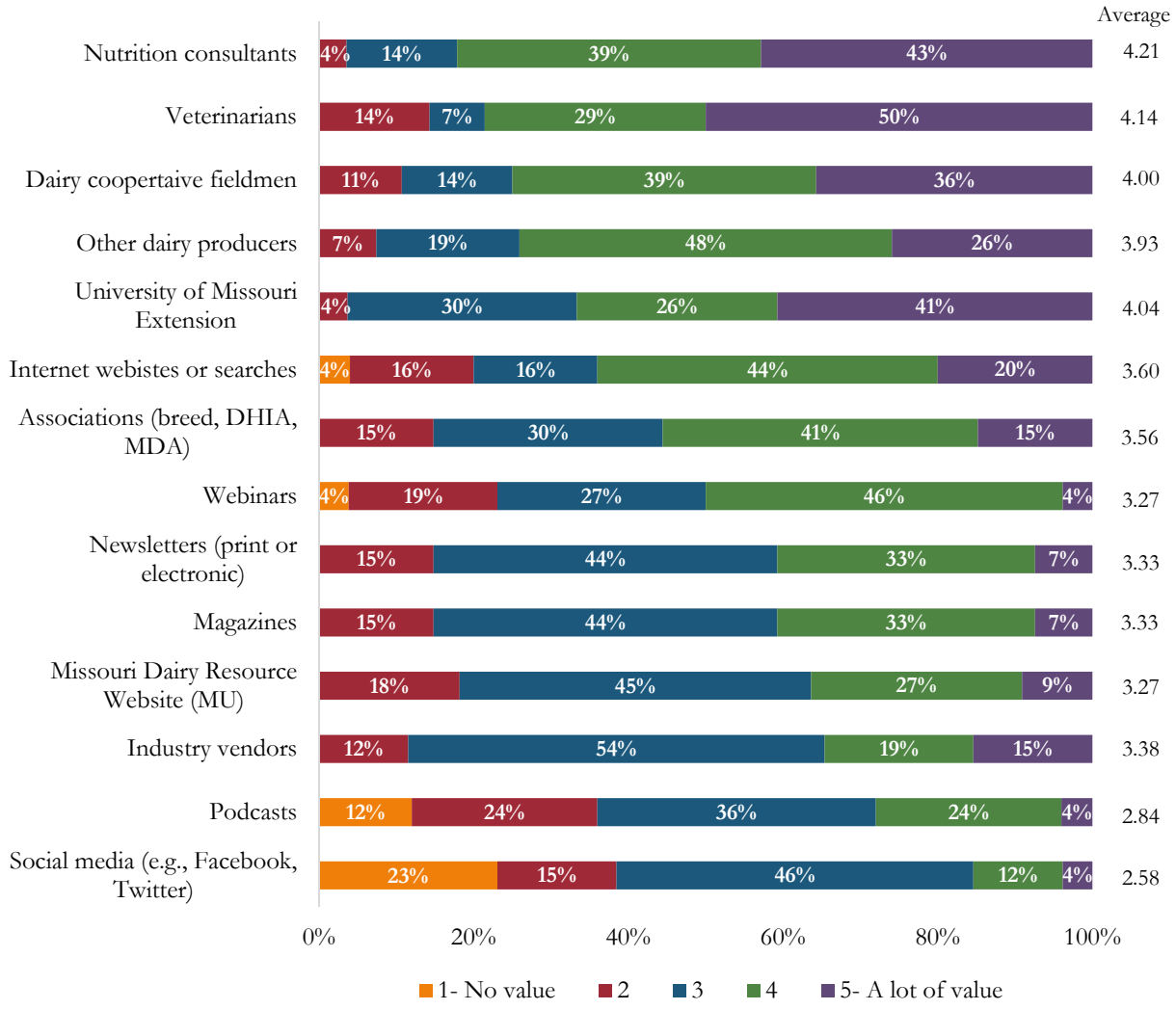
Source: University of Missouri, Commercial Agriculture Program

4.3 Stakeholder View – Information Use and Needs

Like in the producer survey, the stakeholder survey also asked respondents about information source use. Using a one-to-five scale, greater numbers signify that a source provides more value to dairy producers. Thus, a "5" score would indicate that a source has a lot of value, and a "1" would mean that the source has no value. Exhibit 4.3.1 shares the results, and it lists information sources given the share of combined four or five scores awarded, meaning that sources present higher in the list had a greater combined percentage of fours and fives awarded. Based on this analysis, stakeholders view nutrition consultants, veterinarians and dairy cooperative fieldmen as having the most value for dairy producers, and social media, podcasts and industry vendors have the least acceptance as valuable information sources for producers. In the producer survey, the three information sources receiving the greatest share of combined four and five scores were somewhat different: veterinarians, other dairy producers and University of Missouri Extension. Thus, stakeholders and producers tend to place slightly different value on sources for dairy producers.

The table also shares average scores for each information source. The average conveys the mean score awarded to a given information source based on the one-to-five ratings provided by respondents. A higher average would indicate that more respondents noted that a particular information source has value. On average, the three information sources with the highest average scores were nutrition consultants, veterinarians and University of Missouri Extension. Social media, podcasts, webinars and the Missouri Dairy Resource Website averaged the lowest scores relative to the other information sources. For producers, the information sources with the highest average scores were veterinarians, other dairy producers and nutrition consultants.

Exhibit 4.3.1 – Stakeholder Respondents' View of Information Sources for Dairy Producers*

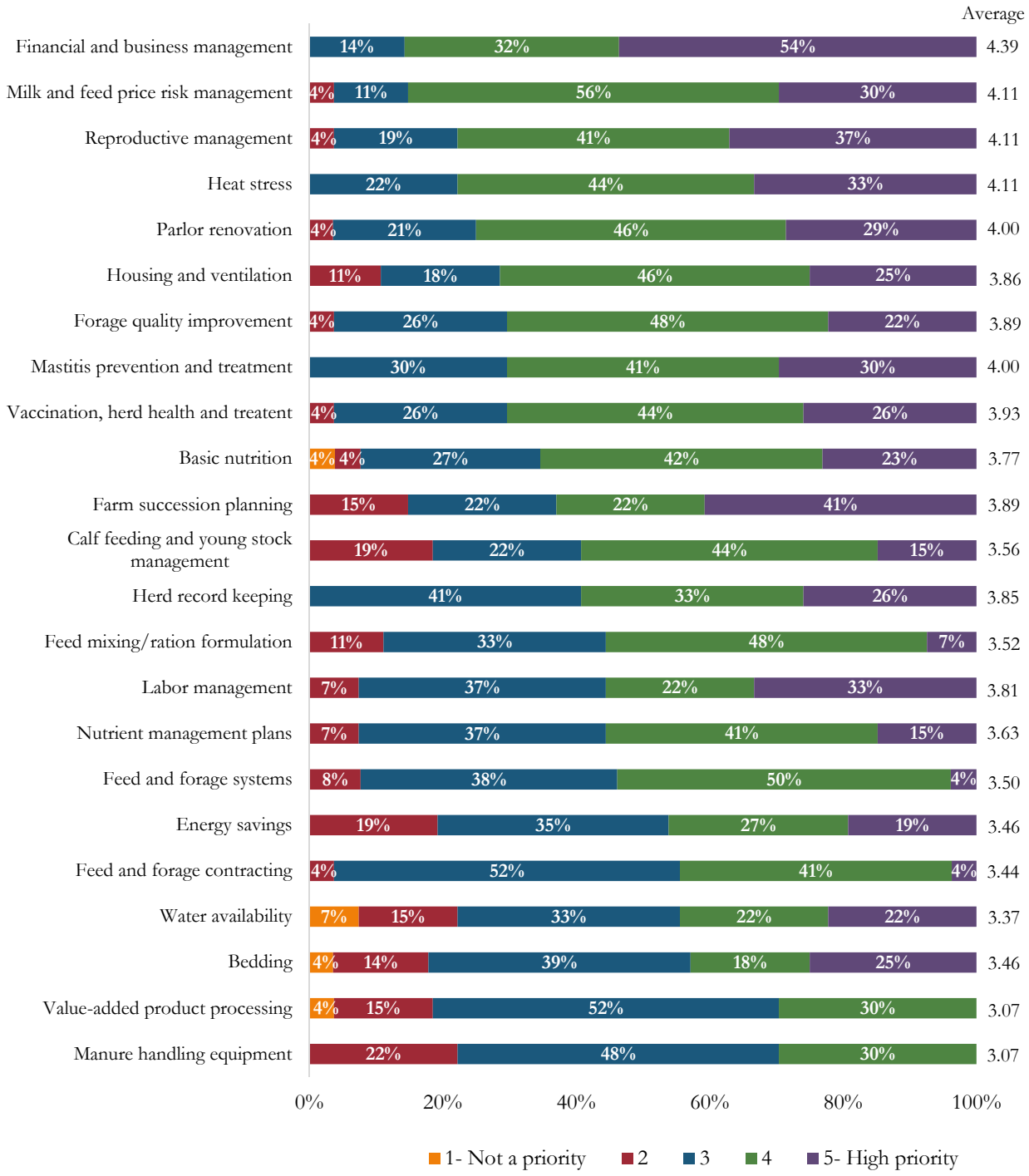


** N = 27 for University of Missouri Extension, other dairy producers, newsletters (print or electronic), magazines, associations (breed, DHIA, MDA); N = 28 for veterinarians, nutrition consultants, dairy cooperative fieldmen; N = 26 for industry vendors, social media and webinars; N = 22 for Missouri Dairy Resource Website (MU); and N = 25 for Internet websites or searches and podcasts*
Source: University of Missouri, Commercial Agriculture Program

Again, using a one-to-five scale, dairy industry stakeholders were asked to select information and training topics that represent the greatest needs in Missouri. Based on the combined share of respondents providing a four or five response, Exhibit 4.3.2 shares that stakeholders identified financial and business management, milk and feed price risk management and reproductive management as the greatest information and training priorities for the state. The average scores, which represent the mean of scores provided by stakeholders, indicate that financial and business management ranks as the highest priority, and three topics tied for second: milk and feed price risk management, reproductive management and heat stress. Based on the combined share of four and five scores provided, manure handling equipment, value-added product processing and bedding were the information and training topics with the lowest priority, and based on average scores, the three topics with the lowest priority were manure handling equipment, value-added product processing and water availability.

Again, the producer and stakeholder surveys produced somewhat different results. Producers who responded to the survey shared that reproductive management, mastitis prevention and treatment and forage quality improvement were the highest priority information and training topics based on both average scores and combined share of four and five scores.

Exhibit 4.3.2 – Stakeholder Respondents' Views of Training and Information Topic Needs



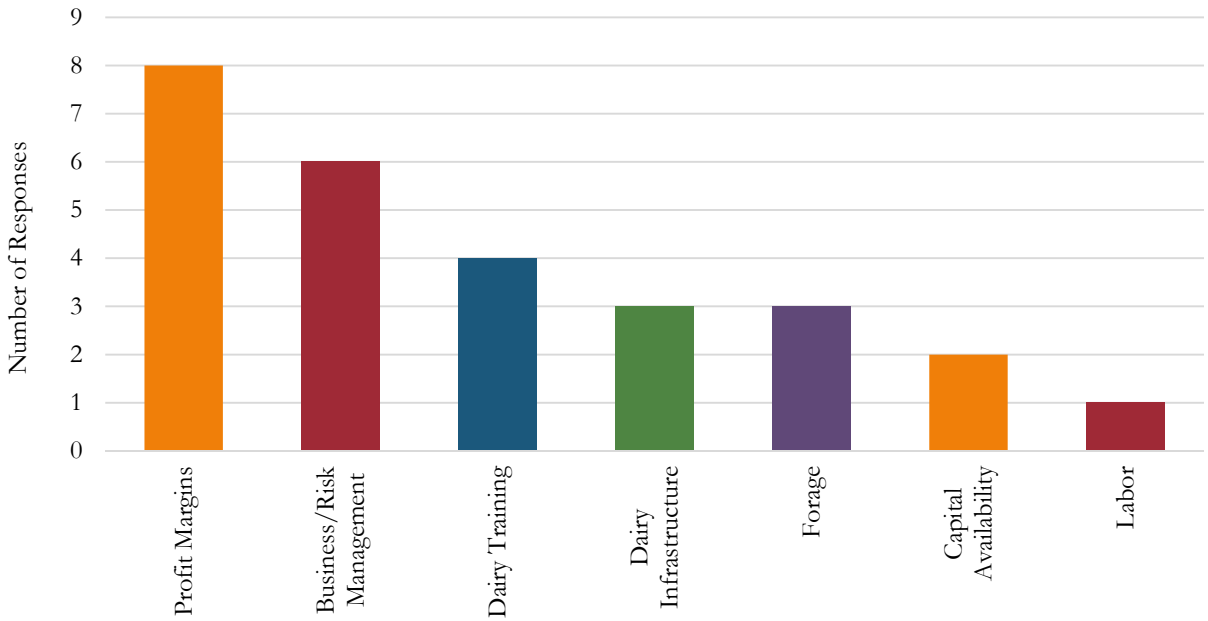
** N = 26 for basic nutrition, feed and forage systems and energy savings; N = 27 for feed mixing/ration formulation, feed and forage contracting, forage quality improvement, calf feeding and young stock management, mastitis prevention and treatment, reproductive management, vaccination, herd health and treatment, water availability, heat stress, herd recordkeeping, farm succession planning, labor management, milk and feed price risk management, value-added product processing, manure handling equipment, nutrient management plans; and N = 28 for housing and ventilation, bedding, parlor renovation and financial and business management.*

Source: University of Missouri, Commercial Agriculture Program

4.4 Stakeholder View – Industry Needs and Greatest Challenges

To assess stakeholders' perceptions of dairy producer needs, the stakeholder survey used an open-response format to encourage each respondent to identify a need that Missouri dairy producers must satisfy to be successful. Like in the producer survey, coding the open-ended responses involved counting just one response from each respondent. Based on responses from the dairy industry stakeholders surveyed, they most identified profit margins, business/risk management and dairy training as the three top needs of Missouri dairy producers. Of the 27 stakeholders who answered this question, eight, six and four respondents, respectively, noted these three needs. Exhibit 4.4.1 shares the number of responses for all seven needs mentioned by industry stakeholders. The remaining dairy producer needs that dairy industry stakeholders shared were dairy infrastructure, forage, capital availability and labor. The producer survey included a similar question, and the producer-respondents shared the following top three needs based on number of responses: higher milk prices and profit margins, more dairy infrastructure and more competitive milk markets.

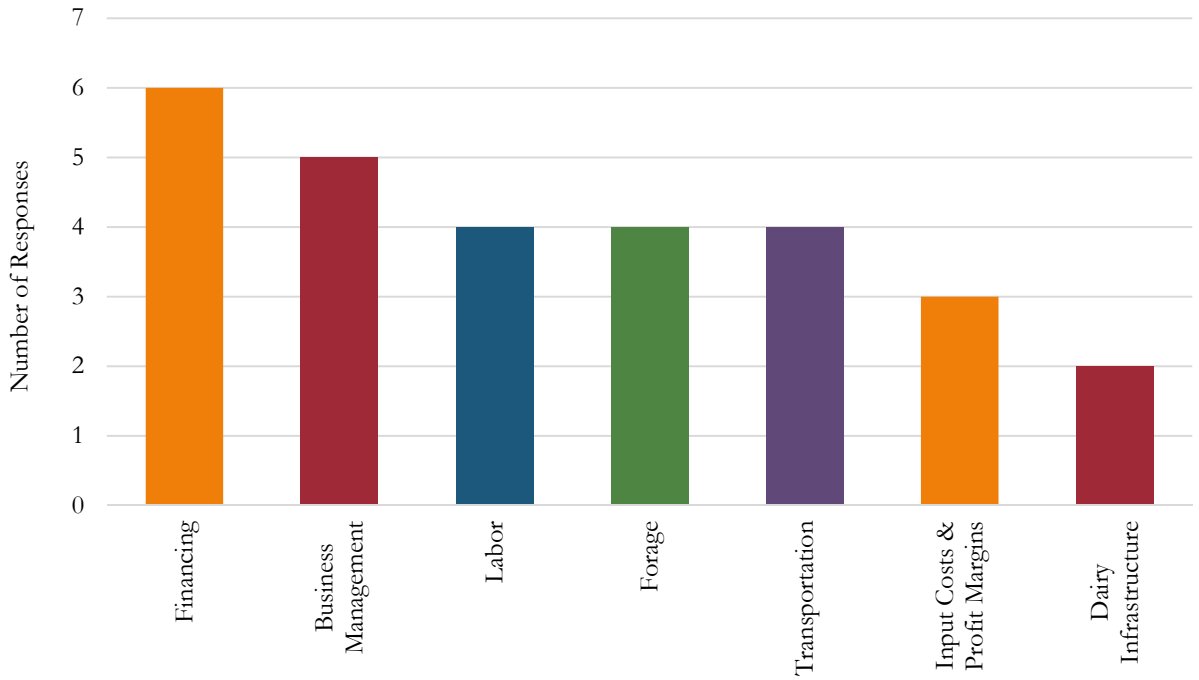
Exhibit 4.4.1 – Stakeholder View of Dairy Producer Needs to Be Successful (N = 27)



Source: University of Missouri, Commercial Agriculture Program

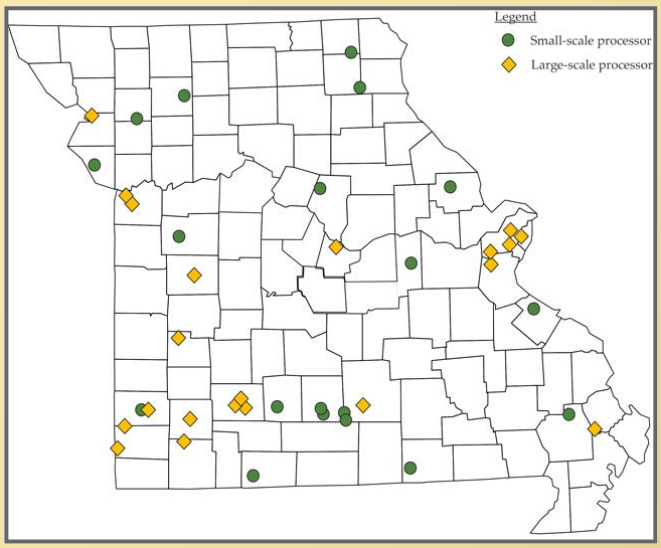
In an open-response question, dairy industry stakeholders also had an opportunity to share their ideas about the greatest challenges facing Missouri dairy producers. Exhibit 4.4.2 presents the greatest challenges identified by the 28 stakeholders responding to the question and the number of responses that mentioned each challenge. The top two greatest challenges noted were financing and business management. Labor, forage and transportation tied for third. The other two greatest challenges mentioned by industry stakeholders were input costs and profit margins and dairy infrastructure. When producer-respondents answered a similar question in their survey, the greatest challenges that they recorded based on number of responses were labor, animal health and forage issues. Thus, the producer and stakeholder groups again have some differences in their responses.

Exhibit 4.4.2 – Stakeholder View of Greatest Challenges for Missouri Dairy Producers (N = 28)



Source: University of Missouri, Commercial Agriculture Program

January 2015



Missouri Dairy Industry Revitalization Study

Section 4:

Value Chain, Marketing and Processing

UNIVERSITY OF MISSOURI
Extension
Commercial Agriculture Program

Missouri Dairy Industry Revitalization Study –
Section 4: Marketing, Processing and Value Chain

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Other publications from this study include:

Executive Summary
A comprehensive overview of the overall Missouri Dairy Industry Revitalization study.

Section 1: Historical Perspective
Section 1 provides an in-depth discussion about Missouri's dairy industry historical trends concerning its dairy cow inventory, farms, production, prices, production economics and processing industry.

Section 2: Economic Contribution
Section 2 discusses what the economic contributions such as jobs, value-added and industry sales are from Missouri dairy farms and the Missouri dairy product manufacturing industry.

Section 3: Needs Assessment
A survey was conducted in fall 2014 to Missouri Grade A dairy farms and industry stakeholders. This survey was intended to gather their perspectives on producers' needs and characteristics of Missouri dairy farms. Section 3 provides a summary of all survey responses received.

Section 5: Comparative Analysis to Identify Gaps
What is the competiveness of Missouri's dairy industry versus other U.S. states? Section 5 seeks to create a common understanding of the Missouri dairy industry's competitive position, benchmark Missouri's dairy industry and environment against other states and look at ways that other states have attempted to revitalize their dairy industries.

Complete copies of all publications can be found at http://dairy.missouri.edu/revitalization/.

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Missouri Dairy Industry Revitalization Study
Section 4: Marketing, Processing and Value Chain

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Introduction

This section of the Missouri Dairy Industry Revitalization Study concentrates on emerging dairy marketing and processing opportunities. At present, many of the market opportunities discussed in this report are niches. Some market niches, such as those for local foods, may be small enough to create an opportunity for just one farmstead dairy processor. Other markets for new products may be large enough to attract interest from existing bargaining or processing cooperatives. Between these two market sizes is an opportunity for collective entrepreneurship, which would involve collaboration among a small group of like-minded dairy farmers. Note that the marketing and processing opportunities articulated in this section are general trends. Before proceeding with any of these markets, interested parties should confirm that the opportunities exist in the planned target markets. Market preferences and opportunities may vary by geography and consumer subsets.

At the niche market level, serving a given market may involve a relatively small number of passionate, entrepreneurial people committed to developing dairy brands that resonate with consumers and producing and delivering dairy products that complement their brands. To pursue niche markets, market participants may incur great capitalization costs and risks. To organize and operate, small firms may take the form of producer-owned limited liability companies or closed-member "new-generation" cooperatives. Small-scale, farmer-owned firms with adequate planning and a good business plan may be able to attract additional state and federal resources.

Ideally, a new dairy farmer-owned processing firm would be able to create and capture value for itself by tying an on-farm production protocol to a demanded trait, creating a brand and product offerings that fit with the brand and securing a marketing channel. Examples exist of virtual cooperatives that have developed product brands and co-packing agreements with existing dairy processors in order to reduce capital needs and rely on existing processing infrastructure. Within the organic segment, the Organic Valley Cooperative has used the virtual cooperative concept.

As niche or emerging markets develop, they may grow into larger market opportunities that create potential for more entities to participate in the market and operate on a greater scale. However, existing dairy marketing cooperatives may be reluctant to risk member capital and pursue higher risk new products, especially in a region with declining milk production. If existing cooperatives lack a request from food companies or retailers, then they may be further averse to pursue new markets. Even if a profitable product can be added, existing cooperatives may not pursue the opportunity because the niche product may not have significance for all members. In addition, because most Missouri milk is in a federal milk marketing order with more than 75 percent going toward Class I or fluid use, which is the highest value of milk in the federal classified pricing system, diverting more milk into manufacturing usage would lower the monthly blend price for producers in the region.

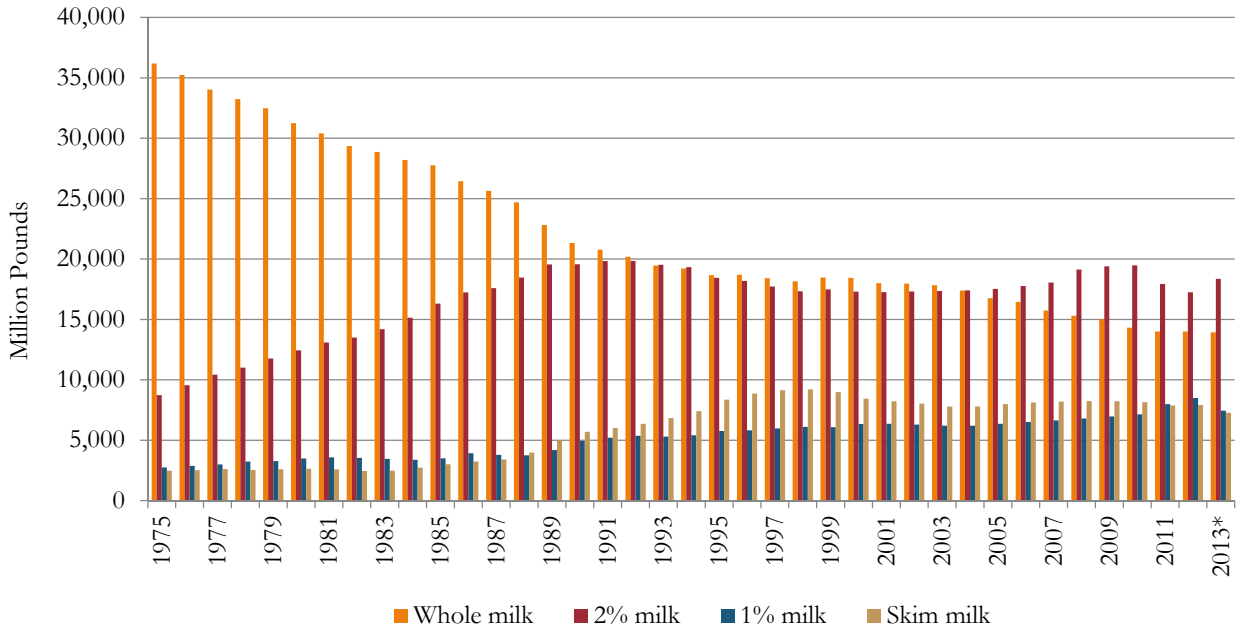
Existing dairy marketing cooperatives should not be discounted in the future value-added landscape for Missouri, however. With their processing and marketing knowledge and ability to balance milk supplies, cooperatives may complement entrepreneurial ventures. Value-added ventures that leverage resources from both new ventures and existing players – this may include arrangements such as co-ownership – may create profitable opportunities and lower the risk incurred for developing and serving new dairy markets.

1. Dairy Product Demand

1.1 Fluid Milk

Over time, the fluid milk category has lost traction with U.S. consumers. Total beverage milk sales decreased from 54.8 billion pounds in 1990 to 51.9 billion pounds in 2013. That is a 5.2 percent reduction. Within the fluid plain milk market, Exhibit 1.1.1 illustrates several well-defined sales trends and consumer preferences. Note that these data measure sales in million pounds. Overall, these data suggest decreasing interest in higher fat milk. From 1975 to the early 1990s, whole milk sales and 2 percent milk sales had an inverse relationship. Whole milk sales declined, and 2 percent sales increased. During the 1990s, Americans consumed whole milk and 2 percent milk at nearly the same levels. In this same decade, 1 percent milk and skim milk gained popularity. Beginning in the mid-2000s, whole milk sales began another decline, 2 percent milk sales showed improvement, 1 percent milk sales trended upward, and skim milk sales were relatively stagnant. As a share of total 2013 plain fluid milk sales in pounds, whole milk represented 29.6 percent of the total, 2 percent milk represented 39 percent of the total, 1 percent milk represented 15.8 percent of the total, and skim milk represented 15.5 percent of the total. Between 1990 and 2013, total plain fluid milk sales, measured in pounds, dropped 8.8 percent (USDA Economic Research Service).

Exhibit 1.1.1 – Fluid Plain Milk Sales in Pounds, 1975 to 2013



* 2013 data are preliminary.
Source: USDA, Economic Research Service

American attitudes toward breakfast have influenced milk sales. The dairy industry has a history of promoting milk as a breakfast food. However, U.S. consumers have increasingly decided to not eat breakfast, or they've chosen breakfast foods that they can consume while they're on the move. Reduced cereal sales have corresponded with reduced white milk sales. One recent effort between the dairy industry and Quaker Oats involves Quaker promoting oatmeal consumption with milk. In this

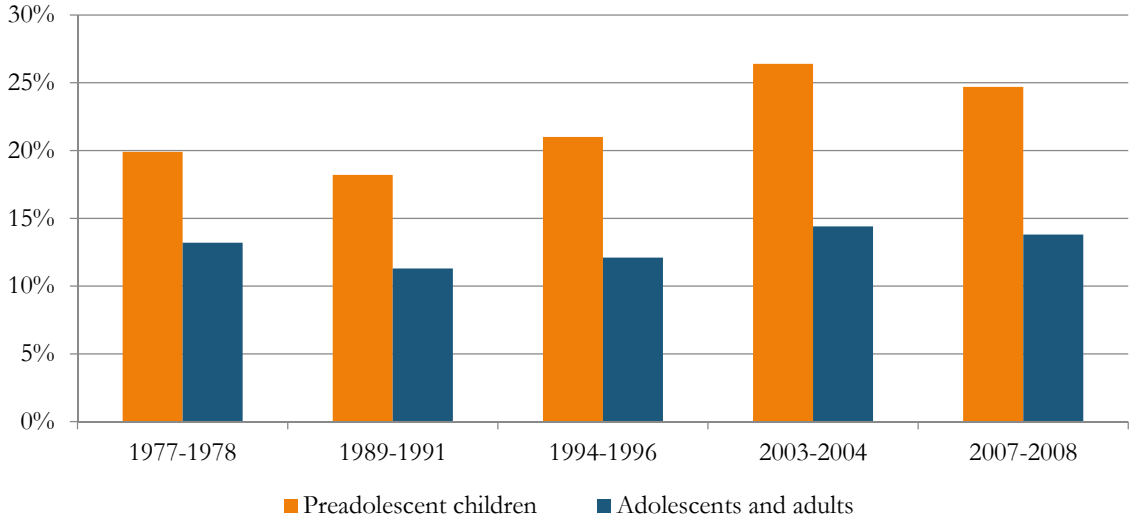
promotion, Quaker suggests preparing oatmeal with milk, not water, and drinking a glass of milk with an oatmeal breakfast. The effort may brand oatmeal and milk as complements much like consumers have the perception that cereal and milk are complements. If just 1 percent of oatmeal breakfasts adopted milk and displaced water use when making oatmeal, then that change would boost milk consumption by 30 million pounds (Carper 2014b).

Consuming milk at breakfast varies by generation. In 1977-1978, 71.3 percent of preadolescents consumed milk at their morning meal. That share dropped to 55.6 percent in 2007-2008. Among adolescents and adults, 38.8 percent consumed milk with a morning meal in 1977-1978, but only 28.2 percent did during 2007-2008 (Stewart, Dong and Carlson 2013).

Throughout the day, milk consumption is increasingly becoming less common. In 1977-1978, just 12 percent of preadolescent children didn't consume milk at all during the day. That share increased to 24 percent for 2007-2008. The percentage of adolescents and adults that didn't consume milk at all during the day rose from 41 percent in 1977-1978 to 54 percent in 2007-2008. Milk consumption frequency has also evolved. Among preadolescent children, 62 percent consumed milk more than once a day in 1977-1978, but by 2007-2008, that share had decreased to 45 percent. During 1977-1978, 30 percent of adolescents and adults drank milk more than once a day, but by 2007-2008, that share had dropped to 14 percent (Stewart, Dong and Carlson 2013).

Based on milk consumption data by daypart, like at morning meals, preadolescent children and adolescents and adults consuming milk at a mid-day meal and night meal also dropped from 1977-1978 to 2007-2008. However, the share of preadolescent children consuming milk as a snack has followed an upward trend. See Exhibit 1.1.2. The share of preadolescent children that consumed milk as a snack increased from 19.9 percent in 1977-1978 to 24.7 percent in 2007-2008, though the share reached its highest level, 26.4 percent, in 2003-2004. Adults didn't significantly increase milk consumption at snacking occasions, based on these data (Stewart, Dong and Carlson 2013).

Exhibit 1.1.2 – Percentage of Americans Consuming Milk as a Snack



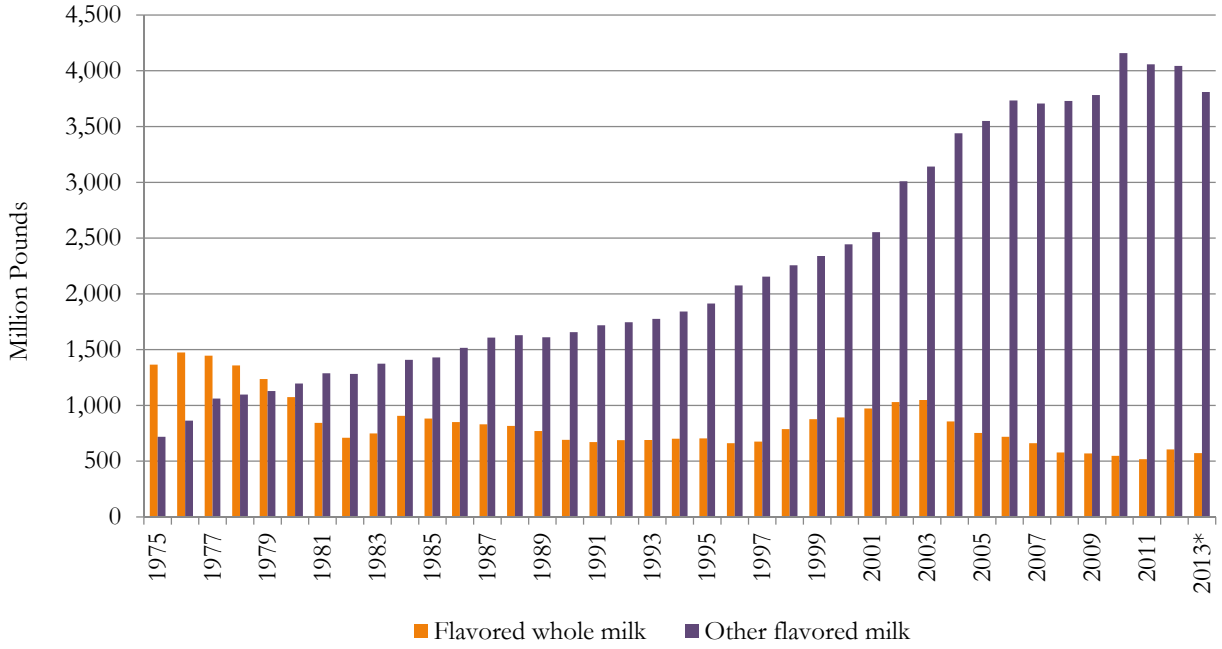
Source: USDA, Economic Research Service

Competition from products such as tap water, bottled water, carbonated soft drinks, tea, fruit juice and coffee has also stressed milk sales. When consumers choose a beverage, their selection depends on various consumption drivers. In order of their likelihood in driving beverage consumption occasions, consumers look to beverages for satisfying thirst, treating themselves, accompanying food, optimizing nutrition, increasing energy, counting calories and promoting relaxation. Research from the Innovation Center for U.S. Dairy indicates that milk ranks first for beverages that accompany food and second for beverages that provide nutritional benefits. However, thirst and treating themselves are the top two macro beverage consumption occasion drivers. "Accompany food" and "nutrition" rank third and fourth, respectively, as beverage consumption occasion drivers. To quench thirst, consumers most likely fulfill that need with tap water, bottled water and carbonated soft drinks. When treating themselves, consumers are most likely to choose carbonated soft drinks, coffee and tea (Innovation Center for U.S. Dairy 2011).

Additionally, nondairy milk products have presented a challenge for dairy. Plant-based milks are sourced from crops such as soybeans, rice, almonds and coconut. Mintel reports that milk alternatives represent 8 percent of all U.S. milk sales. Although this share is small, the category's growth indicates that milk alternatives will increasingly represent fierce competition for animal-sourced milk. Between 2011 and 2013, milk alternative sales increased 30 percent, and almond milk performed especially well. By comparison, total milk sales grew only 1.8 percent. Until at least 2018, nondairy milk sales growth is projected to exceed growth for dairy milk. Consumers have started to consider nondairy milk alternatives as they seek products claiming features such as no lactose, little sugar and few calories. Although some plant-based milk alternatives may offer some nutritional advantages, some lag cow's milk in calcium and vitamin D content (Van Allen 2014).

In the flavored milk category, some consumption trends have varied from those in the plain milk category. Exhibit 1.1.3 charts flavored whole milk and other flavored milk sales, measured in pounds, from 1975 to 2013. Although flavored whole milk sales have shrunk like in the plain milk category, other flavored milk sales have generally performed quite well. Between 1990 and 2013, flavored whole milk sales decreased by 17.1 percent, yet other flavored milk sales increased by 129.9 percent. In 2013, flavored whole milk represented 13.1 percent of all flavored milk sales, and other flavored milk sales represented 86.9 percent of total flavored milk sales. Although flavored milk sales, especially in non-whole fat varieties, has performed well relative to plain fluid milk sales, note that other flavored milk sales peaked during 2010 (USDA Economic Research Service).

Exhibit 1.1.3 – Fluid Flavored Milk Sales in Pounds, 1975 to 2013



* 2013 data are preliminary.
Source: USDA, Economic Research Service

A factor contributing to recent weakened flavored milk sales possibly links to school lunch programs. As the U.S. has focused attention on curbing childhood obesity, some school districts removed flavored milk as an option for their students, or they sought flavored varieties sweetened with ingredients other than conventional sweeteners such as high-fructose corn syrup. Some processors have adopted beet sugar, Truvia and chicory as sweeteners to appeal to stakeholders who want more "natural" sugar to appear in flavored milk products. As some districts have eliminated flavored milk as an option that they make available to their students, many industry groups have promoted that drinking flavored low-fat or skim milk would be better than risking that children forgo milk when they don't have a flavored option and, thus, could become deficient in nutrients like calcium, vitamin D and protein that they'd otherwise source from flavored milk. The Milk Processors Education Program reports that milk intake decreases 35 percent after students lack flavored milk as an option. Schools represent a significant market for flavored milk, too. Of the milk consumed at school, close to 70 percent has been flavored (Hoag 2011).

Because flavored milks are usually sweet, consumers choose them as desserts or treats. When marketing flavored milk, common flavors have included chocolate, strawberry and vanilla. Recently, introducing seasonal flavors has worked well for milk processors. For example, a jelly bean flavor works well in the spring. During the fall, pumpkin is a seasonal flavor option (Carper 2014b).

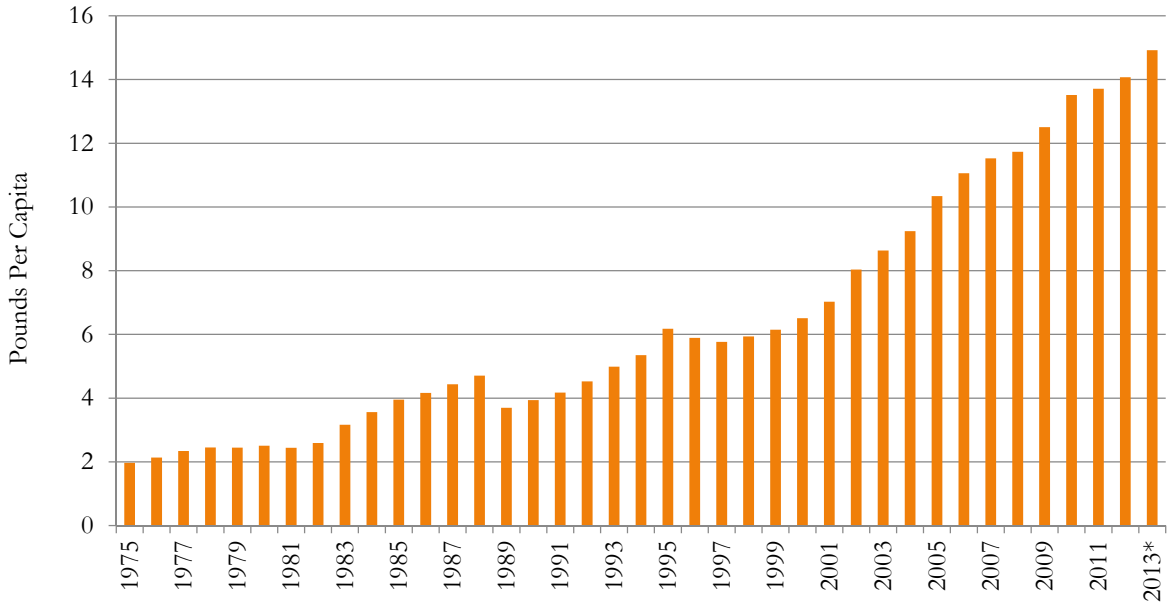
The dairy industry has started marketing chocolate-flavored milk to adults who exercise. The protein and sugar found in chocolate milk may help with post-workout recovery. Reaching active adults and promoting flavored milk at athletic events has been a marketing strategy employed by milk processors. For example, milk sponsorships have been seen at events like those for Ironman, Iron Girl and USA Hockey, and the industry seeks to target anyone who exercises (Carper 2014b).

Milk-derived protein drinks are another trend. To make these products, processors can choose to increase protein content by supplementing the drinks with protein powder or concentrating protein using a filtration process. Dairy-based coffee drinks, such as those that blend milk and coffee, are another product trend within the fluid milk category. Looking into the future, dairy processors may best position themselves in the fluid milk category by offering both commodity milk products, such as cartons of plain milk, and value-added dairy products, such as the flavored and specialty milk products shared in this section (Carper 2014b).

1.2 Yogurt

U.S. yogurt consumption has increased substantially during the past several decades. Based on per capita consumption data, the average American consumed more than seven times more yogurt in 2013 than in 1975. Exhibit 1.2.1 illustrates the trend in U.S. yogurt consumption per capita. In 1975, per capita yogurt consumption averaged 2 pounds, and by 2013, per capita consumption had risen to 14.9 pounds. Note that the yogurt consumption started its most substantial growth early in the 2000s (USDA Economic Research Service).

Exhibit 1.2.1 – U.S. Yogurt Consumption per Capita, 1975 to 2013



* 2013 data are preliminary.
Source: USDA, Economic Research Service

In terms of value, U.S. yogurt sales total an estimated $8 billion per year (Gasparro and Josephs 2013). Euromonitor International estimated that yogurt and sour milk product sales totaled $8.5 billion during 2013. The company also projects future growth for the yogurt category. During the next five years, Euromonitor projects 10 percent sales growth (Thornton 2014). Other estimates more conservatively estimate that annual yogurt sales total more than $7 billion (Hennessy 2014a).

Of all yogurt consumed, Greek varieties quickly have gained acceptance. In 2008, Greek yogurt represented 4 percent of all yogurt sales. One estimate suggested that Greek varieties had captured 44 percent of all yogurt sales by 2013 (Hennessy 2014a). In another projection, a brokerage firm estimated that Greek yogurt has grown to a 45 percent market share (Gasparro and Josephs 2013). The high protein levels found in Greek yogurt may have motivated consumer interest in the product. Within the Greek yogurt category, the market has become "increasingly crowded." Firms like Chobani, General Mills, Fage, Dannon and ConAgra Foods all offer Greek yogurt product lines. Chobani leads the group. Estimates suggest that Chobani sells more than one-third of Greek yogurt (Hennessy 2014a).

After Greek yogurt gained popularity during the 2000s, companies began introducing other international, country-specific yogurt products. Consumers may choose from multiple varieties, including Icelandic, Australian, Asian, Bulgarian, Swiss, French and Russian yogurts (Anderson 2014 and Pierce 2013). The new selections resolved boredom that Americans likely felt with the traditional yogurt that had been available to them. Each variety requires slightly different production practices. For example, Greek and Icelandic yogurt processors boost protein and calcium levels and reduce carbohydrates by removing whey, lactose and natural sugar. To make Asian yogurt, the process involves caramelizing milk sugar with heat. The product has smooth, creamy attributes, which make it resemble a dessert pudding (Pierce 2013).

Named for the town where its recipe was created, noosa is a whole-milk, Australian-style yogurt. Americans first had access to noosa in 2010 after a firm already selling the yogurt in Australia agreed to U.S. expansion at the urging of a native Australian who lived in Colorado. Since then, the product's distribution has grown to include many retail stores, including Target, Kroger, Whole Foods and Safeway. Relative to traditional yogurt, noosa contains more protein. It has a thick, creamy texture, and it balances sweetness and tartness. The company sources its milk from a family-owned Colorado dairy and processes yogurt at a facility built adjacent to the dairy farm. In the future, noosa foresees considering a second processing plant in the eastern U.S., and it would like to again work with a family-owned dairy to supply milk to the production facility (Watson 2014b).

As a fermented milk beverage, kefir is another trend. Although it's not identical to yogurt, the two have similarities. To produce yogurt and kefir, lactobacillus bacteria process the milk's lactose and generate lactic acid. Unlike in yogurt production, however, producing kefir involves yeast, and kefir grains facilitate fermentation. Adding yeast creates carbon dioxide and ethanol and, ultimately, carbonation and alcohol, which is typically removed from commercial kefir. As a final product, kefir has probiotic activity and has been known for its digestion and overall well-being benefits. However, it also has a sour taste. To improve acceptability among consumers, vanilla extract or pureed fruit can complement kefir, or it can be incorporated into products such as muffins, pancakes and bread (Reinagel 2014). Several companies market kefir products, including Lifeway Foods, Wallaby Organic, Greek Gods and Redwood Hill Farms. Growth opportunities for kefir include products targeted to kids and frozen products (Hennessy 2014b).

During 2012, most U.S. households – 83 percent – reported that they had purchased yogurt sometime during the year (Cheese Reporter 2014). In its "Eating Patterns in America" report, the NPD Group's National Eating Trends group quantified the extent to which Americans have integrated foods and beverages into their diets. To make its estimates, the NPD Group bases its research on a 2,000-

household sample. Between February 2004 and February 2014, yogurt was the top-ranked food or beverage for becoming part of American diets (Watson 2014a).

Flavor selection is an important factor in dairy product development. Only 10 percent of U.S. sales are for plain yogurt (Pierce 2013). Of the extensive flavors available, the 10 most popular flavors represent 25 percent of all flavors. In the U.S. spoonable yogurt category, the best-selling flavors are strawberry and blueberry. Other top flavors, ranked in order of their sales, have been vanilla, peach, plain, raspberry, honey, banana-strawberry, black cherry, berry, pineapple, cherry, key lime, lemon and banana. Berry flavors alone make 13.54 percent of sales. Increasingly, tropical flavors – for example, mango, coconut, guava and passion fruit – are gaining popularity. Other trends are dessert-like flavors including caramel and chocolate (Cassell 2013). In 2014, Chobani introduced its pumpkin spice Greek yogurt, made with pumpkin puree and spices as part of a "limited batch." Consumers quickly accepted the product, and it became the fastest growing SKU since the company started (Watson 2014c).

Savory yogurt is an emerging trend that includes flavored dips made with Greek yogurt and non-Greek savory flavors. Dannon markets Oikos Greek Yogurt Dips with flavors such as French onion and vegetable herb. Blue Hill, a New York company, introduced non-Greek savory yogurt last winter. Its flavors include tomato, carrot and beet (Hennessy 2014a). Innovation hasn't stopped at flavors. The yogurt category has seen interest in mix-in products like whole grains and nuts. Mix-in possibilities include chia seed, flax seed, pistachios, chocolate flakes and chocolate chunks (Cassell 2013). Although low-fat and nonfat versions have been most popular, full-fat and whole-milk products are gaining appeal (Pierce 2013 and Kennedy 2014b).

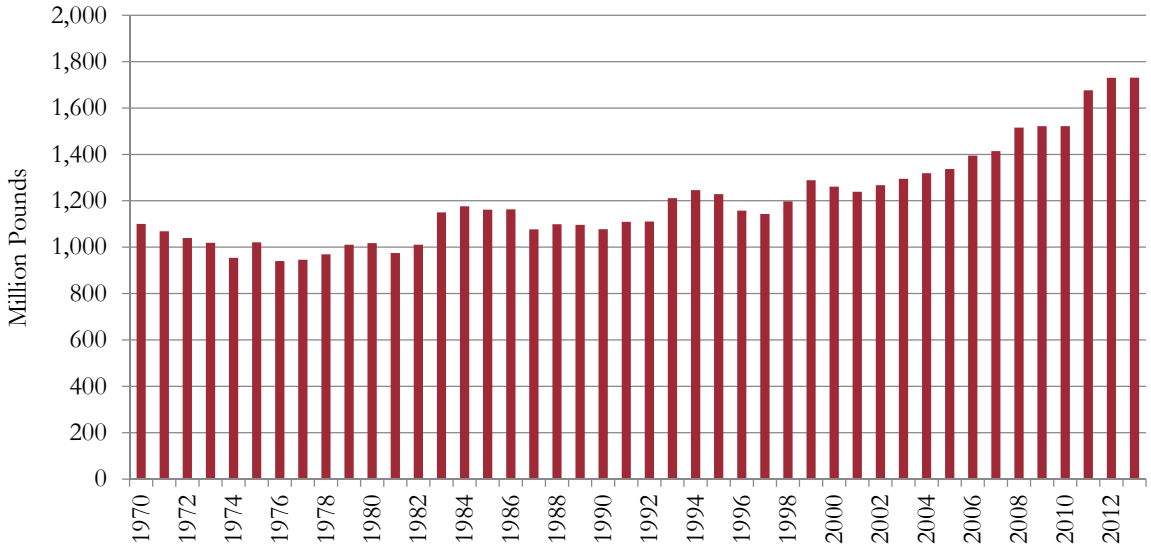
Typically, women have more commonly been recognized as a target audience for yogurt (Cassell 2013). Of the consumers who ate yogurt at home during 2012, 52 percent were women, 25 percent were men, and 23 percent were children and teenagers (Cheese Reporter 2014). High-protein yogurt works well with a male audience, however (Cassell 2013). After Greek yogurt products began to launch, the two main audiences consuming Greek yogurt were women who transitioned from traditional yogurt to Greek varieties and men who could use Greek yogurt for sports nutrition purposes and displace protein supplement consumption (Cheese Reporter 2014).

Regarding when Americans consume yogurt, the product works well at breakfast, lunch or dessert (Pierce 2013). It may also be a morning or afternoon snack (Kennedy 2014b). Its versatility works to its advantage, and its packaging and ready-to-consume characteristic make it a convenient choice (Pierce 2013). Chobani is attempting to encourage yogurt consumption at different dayparts (Watson 2014c). Mintel reports that more than 25 percent of yogurt consumers choose to consume the product as a dessert, and as such, they're seeking indulgent flavors that still reduce the calorie load relative to other desserts (Kennedy 2014b).

1.3 Butter

Recently, Americans have increased their butter consumption. Exhibit 1.3.1 illustrates the trend in U.S. total domestic butter utilization. Between 2000 and 2013, total U.S. butter utilization increased 37.3 percent. During this period, U.S. butter utilization reached its lowest level during 2001 at 1.24 billion pounds. In 2013, domestic butter utilization totaled 1.73 billion pounds. On a per capita basis, the average American consumed 5.5 pounds of butter in 2013, based on preliminary per capita consumption data (USDA Economic Research Service).

Exhibit 1.3.1 – Total U.S. Domestic Butter Utilization, 1970 to 2013



Source: USDA, Economic Research Service

Butter competes with margarine and spreads, and within the past decade, nutrition news and other food industry trends have supported growth in U.S. butter consumption and spending. Since 2011, U.S. butter sales have exceeded margarine sales. During 2013, IRI reported that butter sales totaled $2 billion, and by comparison, margarine and spread sales totaled $1.8 billion (Gee 2014).

From a nutrition perspective, consumers at one time had migrated from butter because it contains cholesterol and saturated fat that had been attributed to heart disease, and as they reduced their butter consumption, they chose margarine. This trend began reversing when the food industry and consumers recognized that many margarine products contained trans fat, which has negative implications for cholesterol and overall health. Additionally, U.S. consumers have increasingly begun understanding that eliminating fat from their diets may not be the ultimate goal (Gee 2014).

Historically, companies began producing oil-based margarine during the early and mid-20th century, and butter rations implemented during World War II benefited margarine and increased its popularity. Margarine was also cheap to make. Recently, spreads have struggled with their image as manufactured, processed goods. Butter has benefited from such views because it's perceived as a natural, simple product. Cooking at home and the emergence of food-focused TV channels have benefited the butter

category. When consumers watch the Food Network or the Cooking Channel, they see many TV personalities using butter (Gee 2014).

When choosing butter products, U.S. consumers usually prefer salted versions (Yonkers 2014). In 2013, flavored butters – both sweet and savory – were a category trend. Butter manufacturers had added several types of ingredients to butter: sea salt and cracked pepper, olive oil, canola oil, ginger, sesame and maple syrup. Blending butter and oil produces a spreadable butter, which has gained popularity because it's convenient and flavorful. Spreadable butters also may be more healthful alternatives. To flavor foods, Land O'Lakes introduced a sauté starter product. It blends butter and other flavorings, and consumers may use it to sauté chicken, fish, pork and vegetables. Half-stick butter packaging is another trend (Carper 2013).

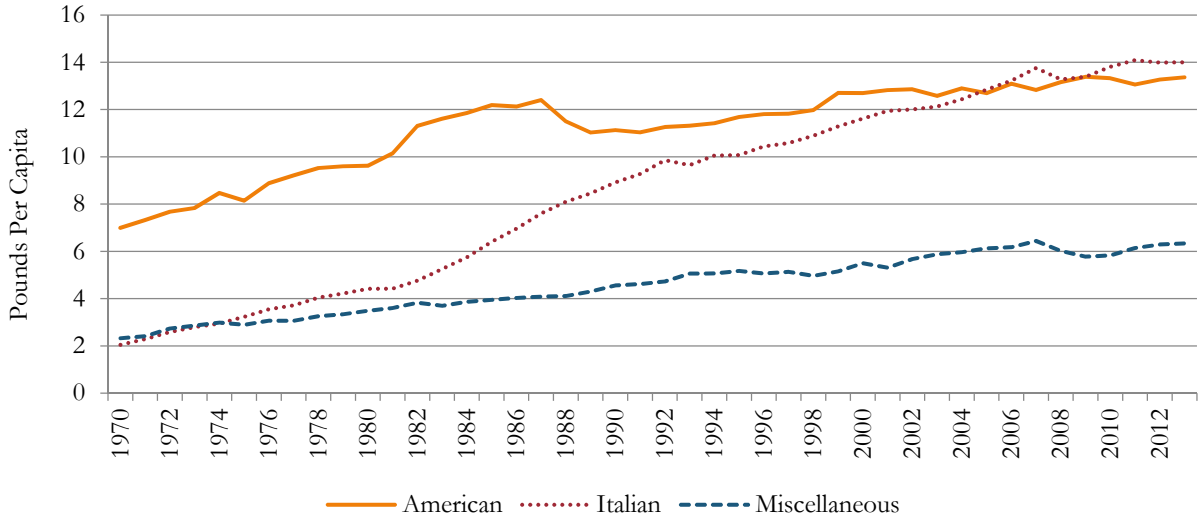
Seasonality influences butter sales. During the calendar-year fourth quarter, butter manufacturers record half of their annual sales. The holiday season and baking that occurs during that time drive sales (US Foods 2014).

As a new use for butter, Bulletproof Coffee has popularized mixing coffee and butter (Bratskeir 2014). The Bulletproof founder, who launched the concept during 2010, first tried butter added to a hot beverage when he traveled to Tibet and tried yak butter tea (Salahi 2014). In coffee, the butter would compete with other add-ins like cream and sugar (Bratskeir 2014). When Bulletproof makes butter coffee, it also supplements the drink with medium-chain triglycerides (Salahi 2014). Anecdotally, butter coffee drinks claim that blending high-fat butter in their coffee causes the body to metabolize caffeine more slowly and contributes to sustained energy (Bratskeir 2014). Mixing butter in coffee may also have satiety benefits. Among the consumers who add butter to their coffee, a subset prefers grass-fed butter (Salahi 2014).

1.4 Cheese

Between 1970 and 2013, total per capita cheese consumption increased by 196.5 percent. The USDA Economic Research Service classifies cheese into three main groups: American, Italian and miscellaneous. Exhibit 1.4.1 charts per capita cheese consumption for these categories over time. Of the three groups, Italian per capita cheese consumption increased at the greatest rate. From 1970 to 2013, Italian cheese consumption increased by 583.5 percent. During the 2000s, Italian cheese consumption per capita surpassed American cheese consumption per capita. For American and miscellaneous cheese categories, the growth totaled 91 percent and 172.8 percent, respectively (USDA Economic Research Service).

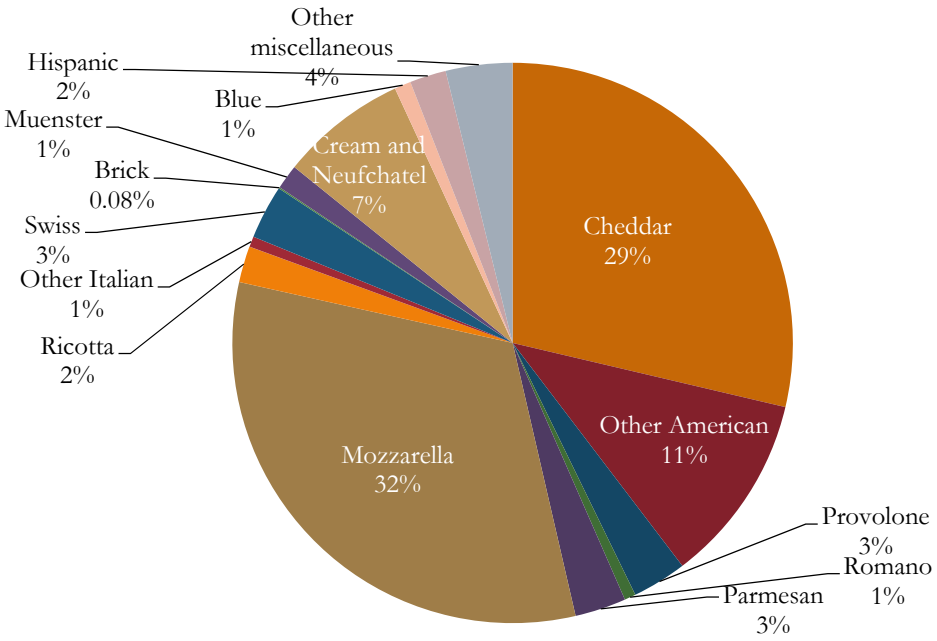
Exhibit 1.4.1 – Per Capita Cheese Consumption by Category, 1970 to 2013



* 2013 data are preliminary.
Source: USDA, Economic Research Service

The USDA Economic Research Service further subdivides per capita consumption data by cheese variety. Exhibit 1.4.2 presents the share of total per capita consumption captured by each variety for which USDA recorded data during 2013, based on preliminary data. Mozzarella, cheddar, other American and cream and Neufchatel cheeses represented the greatest shares of total per capita cheese consumption during 2013. Mozzarella and cheddar alone represented more than 60 percent of the average American's per capita cheese consumption. From 1970 to 2013, cheese varieties that experienced the greatest growth in per capita consumption were mozzarella, 811.1 percent growth; Parmesan, 499.8 percent growth; Provolone, 366 percent growth; and cream and Neufchatel, 302.2 percent growth. The only variety that experienced a per capita consumption decline between 1970 and 2013 was brick cheese (USDA Economic Research Service).

Exhibit 1.4.2 – Per Capita Cheese Consumption by Variety as Share of Total per Capita Consumption, 2013



* 2013 data are preliminary.
Source: USDA, Economic Research Service

Cheese consumption is increasing to fulfill growing demand for use in appetizers; prepared entrees; side dishes; and soups, sauces, dressings and dips, based on Mintel data. Cheese use falls into one of three categories: food processing, food service and retail. The Wisconsin Milk Marketing Board estimates that the largest category in the U.S. is food service, which absorbs about 39 percent of total cheese use. The retail channel uses 36 percent of cheese, and food processors use 25 percent. However, note that cheese used by the food processing sector reaches end-users through the retail and food service channels (Berry 2014a).

Natural cheese consumption far exceeds processed cheese consumption. In 2013, the USDA Economic Research Service projected that per capita processed product intake consumed as cheese totaled 3.63 pounds. By comparison, consumers on average consumed 28.67 pounds of natural cheese per capita (USDA Economic Research Service). To make natural cheese, manufacturers typically limit the recipe to four ingredients: milk, bacterial culture, enzymes and salt. Processed cheese has added emulsifiers and sometimes may include other ingredients, such as shelf life-, color- or flavor-related additives. Both natural and processed cheeses have slightly different attributes. For example, natural cheese properties don't lend well to melting. Melt characteristics are important to flavor and have been the source of development efforts for products such as pizza and cheeseburgers, which both require different melt characteristics (Nassauer 2014b).

Among specialty foods, cheese is the most significantly consumed product, and consumers have indicated growing interest in being adventurous in their cheese selections (Prisco 2013). Packaged Facts reports that specialty and natural cheeses collectively represent a $16 billion market, and between 2014 and 2018, the firm estimates that the market will increase by a 4 percent compound annual growth rate (The Gourmet Retailer 2014). Cheesemakers in states typically known for commodity

cheese production – such states include California and Wisconsin – have shown interest in more specialty production, typified by smaller batches, handmade practices and emphasis on style and quality (Prisco 2013).

Artisanal is also a trend driving the cheese product category. To differentiate itself, artisan cheese typically refers to cheese primarily made by hand. Artisan cheese has contributed to raising the profile for American-made cheese. It's produced in various states, even those like North Carolina and Maine that aren't typically regarded for their cheese production. Cheesemakers who adopt artisanal practices reach buyers through farmers markets, cheese shops, grocery stores and restaurants (Lippman 2014). In some cases, producing artisan cheese has enabled dairies to maintain their viability (Worthen 2011). A study from the University of Missouri measured Missouri consumer interest in artisan cheese products based on a 1,079-consumer sample size. Of the consumers that answered the question about artisan cheese purchase frequency, the study found that 42 percent purchased artisan cheese. Of those consumers, the greatest share – 44 percent – purchased artisan cheese weekly. Missouri consumers are more likely to consume cheese as a snack than at other occasions, and they noted that the most important artisan cheese attributes were taste, made with natural milk, price, package size and health or fat content (Parcell and Moreland 2013).

Cheese preferences may also vary by generation. Millennials want "exciting new flavors." This group also appreciates authenticity, short ingredient lists and smaller portions. On the other hand, protein and calcium content are important to baby boomers. Convenience continues to be important when reaching consumers. Packaging cheese as slices, shreds, spreads and sticks make consuming cheese more convenient (Finkel 2014).

Other innovation in cheese products has included reducing sodium content, eliminating artificial ingredients like preservatives and adding flavors. Kraft has attempted all three of these formulation strategies in its products (Lippman 2014). The low-sodium trend may be slowing as fewer new product launches have featured "low-sodium" labels. However, some companies have already made significant strides in sodium reduction. For example, during the past two years, Kraft decreased sodium by about 20 percent in its Singles slices. From a flavor perspective, cheese manufacturers have introduced many options including cheese flavored with jalapeno, herbs, garlic, blueberry and cranberry (Finkel 2014). Adding nuts is another option (The Gourmet Retailer 2014). Labeling to highlight cheese nutrition represents a growth opportunity. Mintel reports that a majority of consumers – 55 percent – recognize cheese as "an inexpensive source of protein" (Finkel 2014). Cheese also benefits from being a gluten-free product (Berry 2014a).

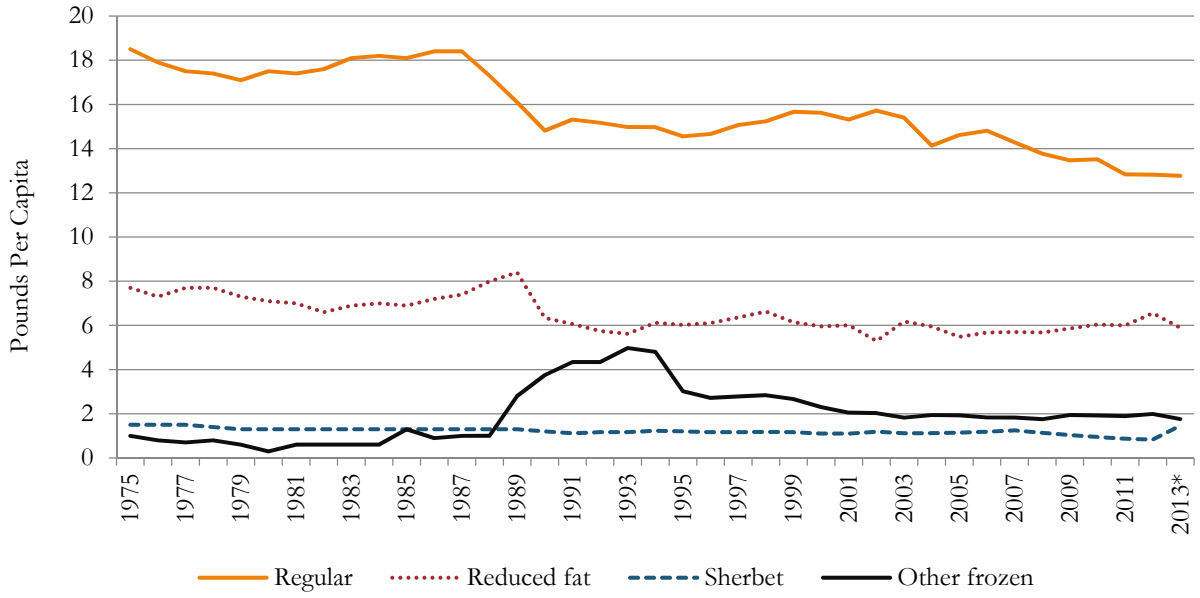
When purchasing cheese, sales have seasonality effects. Based on 2013 sales data, cheese sales were noticeably higher before Thanksgiving and Christmas. Relative to the rest of the year, IRI sales data illustrate that cheese sales were about 20 percent higher than average during the week before Thanksgiving and about 35 percent higher than average during the week before Christmas. New Year's and the Super Bowl are other popular times for cheese sales. Variety preferences may change by season, too. Near Thanksgiving and Christmas, popular varieties include brie, Edam and blue cheese gain popularity. Gruyere, cream cheese and Goumay are other cheese examples that have appeal during Thanksgiving time. During the Christmas season, many varieties see boosted sales including brick, camembert, fontina, gorgonzola and ricotta cheeses. Super Bowl cheese purchases tend to favor mozzarella and blended cheeses like cheddar/jack and Italian blends (Berry 2014c).

1.5 Ice Cream and Other Frozen Dairy

The ice cream and frozen category includes several products. For the year preceding Aug. 10, 2014, IRI reports that ice cream sales totaled $5.4 billion, frozen novelties sales totaled $4.1 billion, and frozen yogurt/tofu sales totaled $337 million (Carper 2014a). Excluding restaurant sales, NPD estimates that 2013 ice cream sales in the U.S. totaled $13.7 billion. Every two weeks, four in 10 consumers choose to consume ice cream. Per year, the average U.S. consumer ate ice cream 28.5 times in 2014. That's a drop from 41.3 times on average during 1989 (VanderMey 2014). Although ice cream sales have been challenged, IBISWorld projects that the product will "bounce back" in the future (McMillan 2014).

In the frozen dairy category, total per capita consumption decreased by an estimated 16.2 percent from 1990 to 2013. Exhibit 1.5.1 illustrates per capita consumption rates for four frozen dairy products: regular ice cream, reduced fat ice cream, sherbet and other frozen products. Of the two ice cream products, per capita consumption of both has declined. However, based on consumption data from 1990 and 2013, the drop has been more significant for regular ice cream than reduced fat ice cream. Between 1990 and 2013, regular ice cream per capita decreased by 13.8 percent, and reduced fat ice cream consumption per capita decreased by 7 percent. Sherbet consumption has maintained a relatively consistent rate per capita. For other frozen products, per capita consumption surged during the late 1980s and into the 1990s. Since then, however, per capita consumption has retreated (USDA Economic Research Service).

Exhibit 1.5.1 – Ice Cream Consumption Per Capita by Product, 1975 to 2013



* 2013 data are preliminary.
Source: USDA, Economic Research Service

Although the USDA Economic Research Service data indicate that regular fat ice cream consumption has declined more than reduced fat ice cream consumption on a per capita basis, consumers have a growing preference for premium ice cream that contains more fat than regular ice cream, according to member companies of the International Ice Cream Association that participated in a 2013 survey. The member companies produce 85 percent of U.S.-consumed ice cream and frozen desserts (Dairy Reporter 2013). Market research firm Canadean reports that 47 percent of U.S. ice cream consumption fulfills an indulgence need for consumers needing a treat (Nunes 2014).

Health factors usually don't affect U.S. ice cream intake. For consumers concerned about health, they typically decide to consume something other than ice cream, or if they choose decadent ice cream on occasion, then they limit the portion size (Nunes 2014). Despite the popularity of premium ice cream, most companies offer at least one ice cream or frozen dessert product line marketed for its healthful characteristics (Convenience Store News 2014). When making ice cream purchases, price sends certain signals. Consumers perceive that products priced too low may disappoint from a taste perspective (Nunes 2014).

Ice cream manufacturers produce ice cream with diverse flavors. However, in 2013, International Ice Cream Association members that participated in the association's member survey reported that the most popular ice cream flavors were vanilla, chocolate, pecan, Neapolitan and rocky road (Dairy Reporter 2013). The International Dairy Foods Association shares a slightly different top-flavor list: vanilla, chocolate, cookie 'n cream, strawberry and chocolate chip mint. Seasonal flavors are popular around the holidays (International Dairy Foods Association). However, ice cream can celebrate other seasonal-related experiences like a vacation (Carper 2014a). Flavor preferences vary somewhat by state. Based on Baskin Robbins sales data, most states have one of five flavors as their favorites. In Missouri, the preferred flavor is vanilla. Exhibit 1.5.2 shares the best-selling ice cream for U.S. states (Nguyen 2014). Although these data only reflect Baskin Robbins sales, they do indicate that ice cream flavor preferences may change by geography.

Exhibit 1.5.2 – Best Selling Baskin Robbins Ice Cream Flavors by State

Source: Parade Magazine (Nguyen 2014)

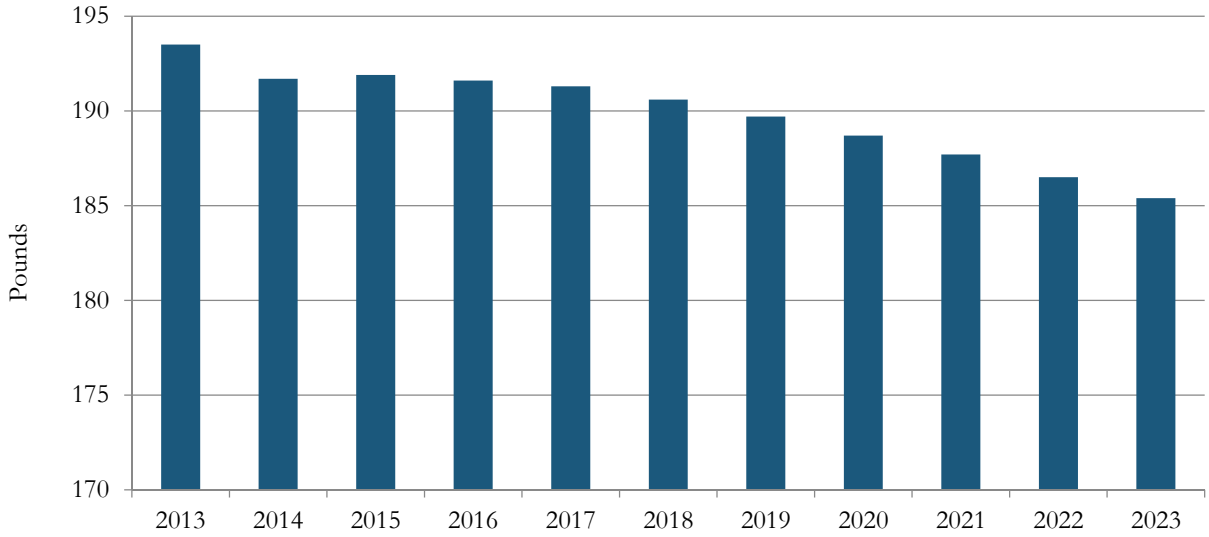
Several flavor trends have emerged recently. Coconut flavors have gained appeal because consumers associate coconut with healthfulness and its tropical origin (Convenience Store News 2014). For consumers seeking a novel product, manufacturers have created ice cream with sweet and savory flavor blends and sorbet-like textures (Nunes 2014). Several manufacturers have started blending sweet and salty flavors, and adding liquor to ice cream (Carper 2014a). Yet another trend involves combining ice cream with other dessert-like flavors such as red velvet cake, cheesecake, cobbler and tiramisu (Cassell and Fusaro 2014). Co-branding is another flavor-related trend. When manufacturers blend ice cream with branded candy, cookie, fruit or flavors, they can co-brand the ice cream brand with the add-in brand (International Dairy Foods Association).

Frozen yogurt has increasing appeal. Of the International Ice Cream Association member companies that participated in the previously mentioned survey, half noted higher frozen yogurt demand (Dairy Reporter 2013). Annual sales growth averaged 21 percent between 2008 and 2013 (VanderMey 2014). When marketing frozen yogurt, manufacturers and food service entities have emphasized the product's low fat content and probiotic levels. Recently, frozen Greek yogurt introductions have allowed manufacturers to market a high-protein frozen yogurt (Convenience Store News 2014). Despite the interest in frozen yogurt, the average U.S. consumer only ate frozen yogurt 1.2 times per year during 2014 relative to eating ice cream 28.5 times that year. By as early as 2019, the frozen yogurt category is projected to start contracting (VanderMey 2014). Gelato has also been a recent source for many new product introductions (Carper 2014a).

1.6 Projected Dairy Product Consumption

Each year, the Food and Agricultural Policy Research Institute at the University of Missouri releases its baseline briefing book of long-range agricultural forecasts. The briefing book published in March 2014 shares projections for 2013 to 2023. From a dairy consumption perspective, FAPRI projects that U.S. dairy processors will require gradually less fluid milk each year. Exhibit 1.6.1 shares projected fluid milk demand. Between 2013 and 2023, FAPRI projects that end-users will decrease their total fluid milk consumption by 4.2 percent or 8.1 pounds per capita (Westhoff et al. 2014).

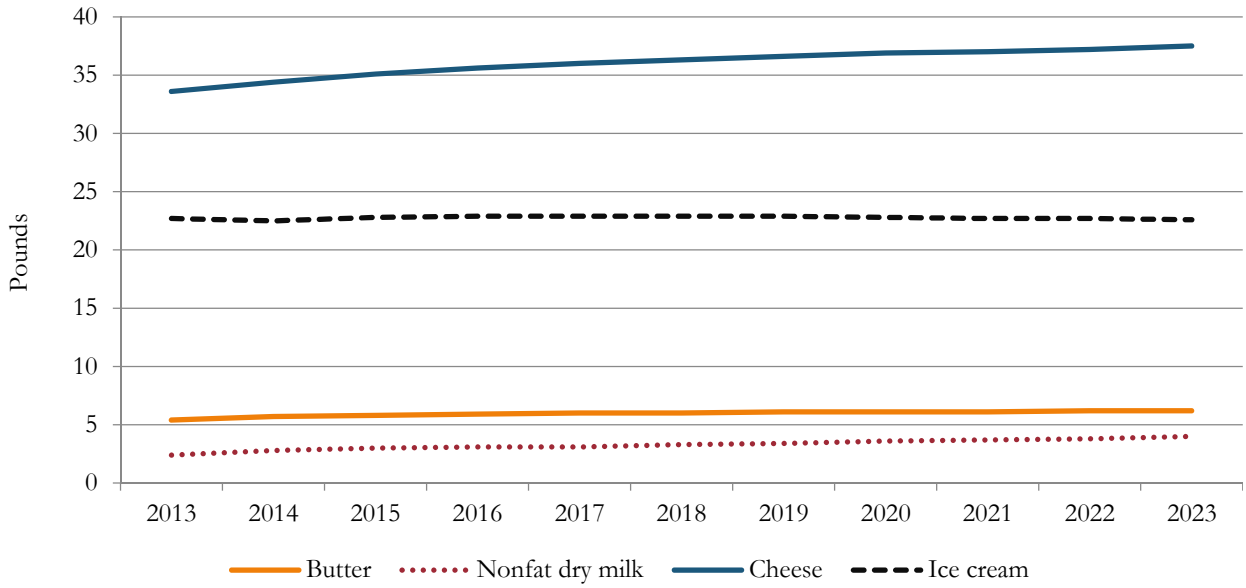
Exhibit 1.6.1 – Projected Total Fluid Milk Consumption per Capita, 2013 to 2023



Source: University of Missouri, Food and Agricultural Policy Research Institute

During the next decade, FAPRI projects that average consumers will increase consumption of nonfat dry milk, butter and cheese. On the other hand, the projections suggest that ice cream consumption per capita will change slightly. Exhibit 1.6.2 presents projected per capita consumption changes for these four dairy product categories. Between 2013 and 2023, FAPRI forecasts that consumers will increase nonfat dry milk consumption by 66.7 percent or 1.6 pounds. During 2023, FAPRI projects that U.S. consumers on average will eat 3.9 more pounds of cheese and 0.8 pounds more of butter than they consumed on average during 2013. Note that the FAPRI projections don't articulate projected yogurt or other milk product consumption changes (Westhoff et al. 2014).

Exhibit 1.6.2 – Projected Dairy Product Consumption per Capita, 2013 to 2023



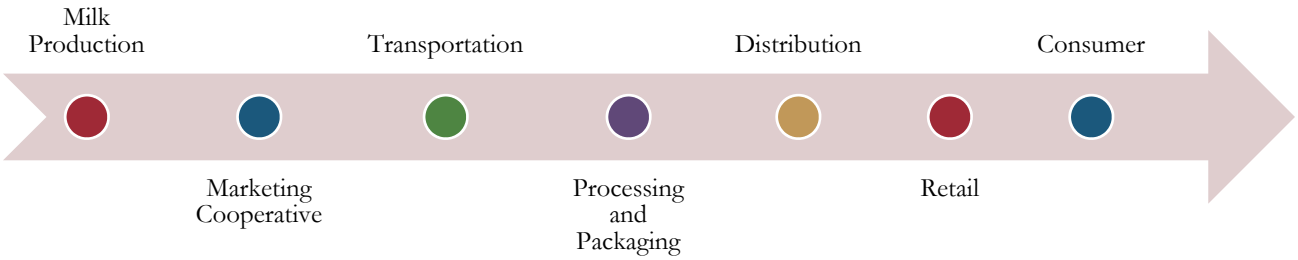
Source: University of Missouri, Food and Agricultural Policy Research Institute

2. Missouri Dairy Value Chain

2.1 Overview of Value Chain

Value chains are a way to explain a complex set of inputs, outputs, activities and operations for a product or industry. They demonstrate all steps, from the raw input stage to becoming a final product and reaching consumers. For the dairy industry, a diagram of the entire industry can be found in Exhibit 2.1.1. The value chain begins in the production of milk at the farm level and follows various stages until the creation and selling of various dairy products. Note that some stages may be bypassed or occur together, depending on the specific path used for a certain product. A key point to understand is that products add value throughout each stage of production until they reach the final consumer.

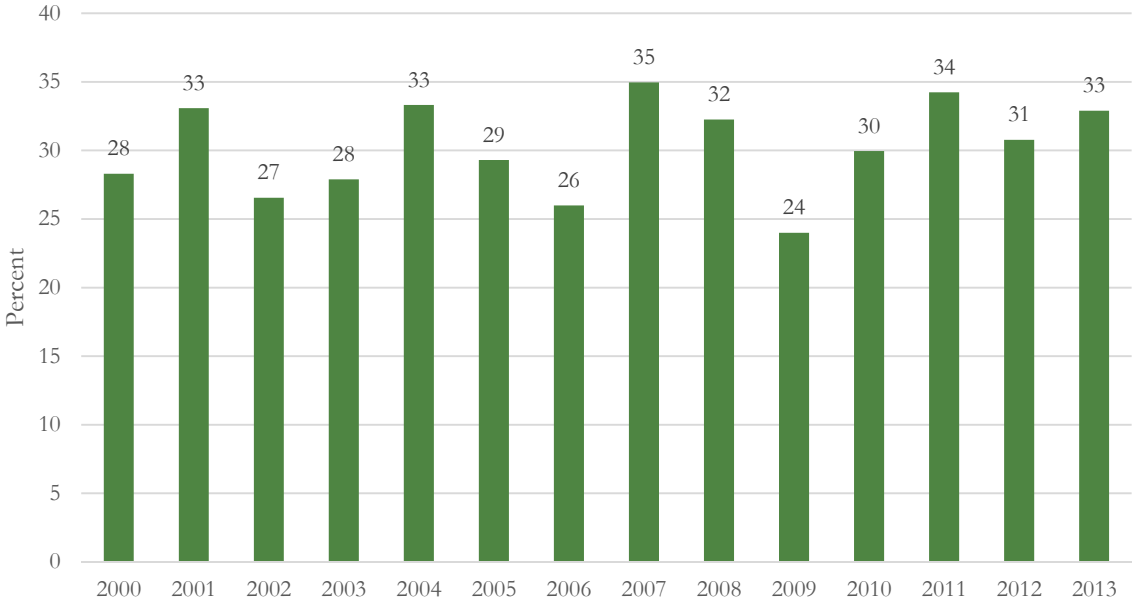
Exhibit 2.1.1 – Dairy Industry Value Chain



Historically, most dairy farmers have only captured a limited amount of value out of the final dairy products that are produced for consumers. Exhibit 2.1.2 illustrates the farm value share for dairy products over time. Dairy products represent the basket of dairy products that U.S. households purchased for at-home consumption during the base year (2003) in the analysis. The basket would include retail foods such as butter, cottage cheese, cream, ice cream, skim/low-fat/whole milk, cheese and yogurt. Farm receipts were based on the average all-milk price received by producers that was reported by USDA-National Agricultural Statistics Service. Retail prices and quantities purchased were reported through the Bureau of Labor Statistics based on its survey and Neilsen Homescan data.

For every dollar spent on the milk/dairy basket in 2013, dairy producers received approximately 33 percent in farm value share. From 2000 to 2013, a slightly increasing trend and much year-to-year volatility in the farmer value share are noticeable from this data series.

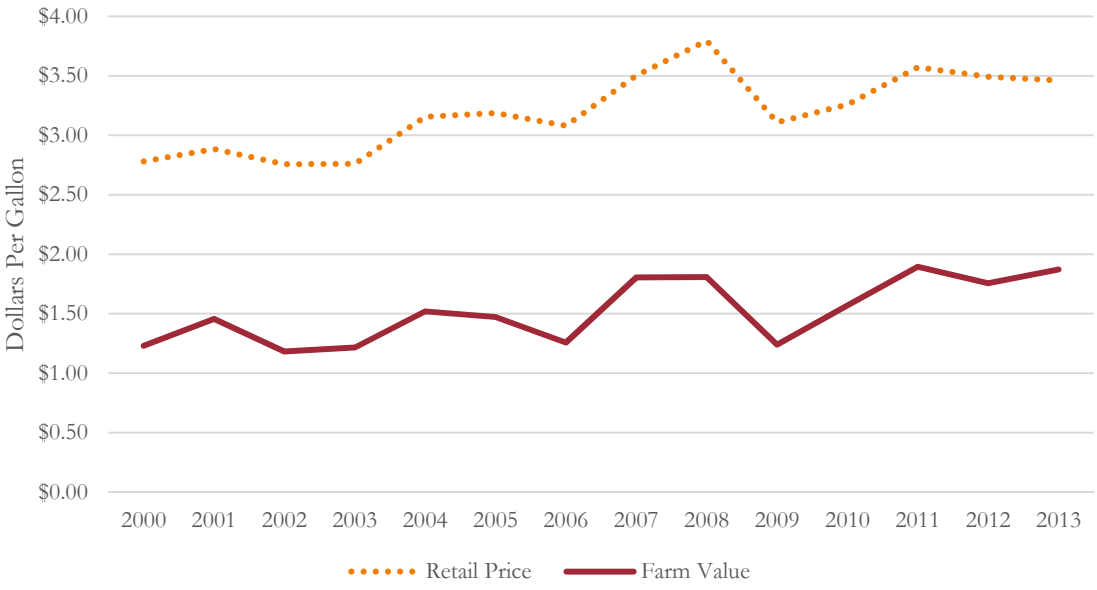
Exhibit 2.1.2 – Farm Value Share of the Milk and Dairy Basket, 2000 to 2013



Source: USDA – Economic Research Service

Various dairy products report varying spreads from the farm value to retail sectors. A look at whole milk on a per gallon basis is reported in Exhibit 2.1.3. U.S. city average retail prices for whole milk peaked in the year 2008 at $3.80 per gallon. Farm value reached its high in the year 2011 at $1.90 per gallon. Note both the farm and retail prices have trended upward over the past 14 years. Whole milk represents one of the simplest value chain routes from the farm to a fluid milk manufacturing plant that processes and packages products for retail sales.

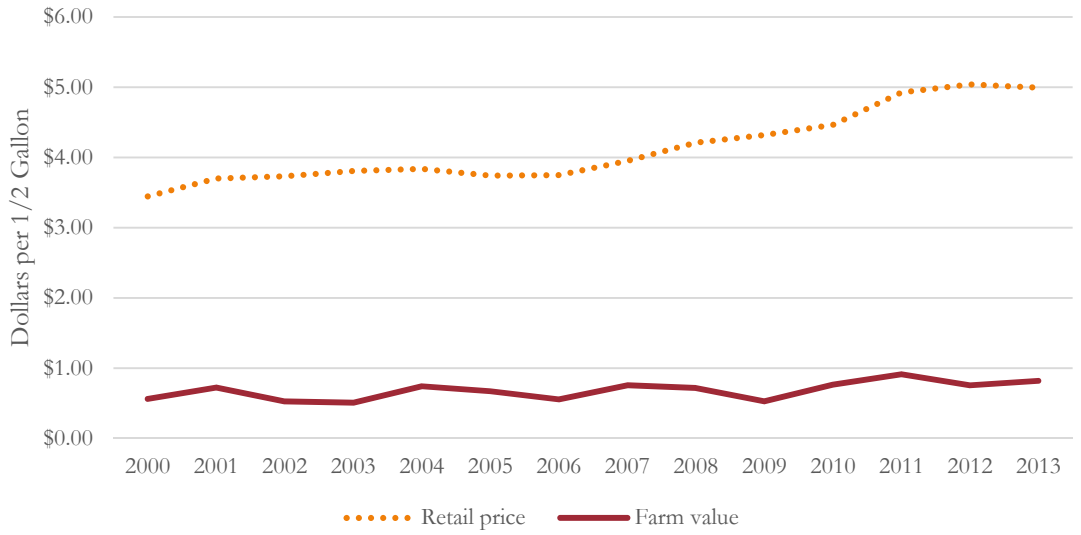
Exhibit 2.1.3 – Whole Milk, Farm Value and Retail Prices, per Gallon, 2000 to 2013



Source: USDA – Economic Research Service

Exhibit 2.1.4 looks at ice cream in farm and retail prices per half gallon from the years 2000 to 2013. Note that the spread between farm and retail is a much wider than the spread for whole milk, which may be due to further processing and steps needed in creation of ice cream. Additionally, the farm value of ice cream has not increased as dramatically as the retail prices have. Only in one year analyzed has the farm share percent been at 20 percent or higher of the retail price.

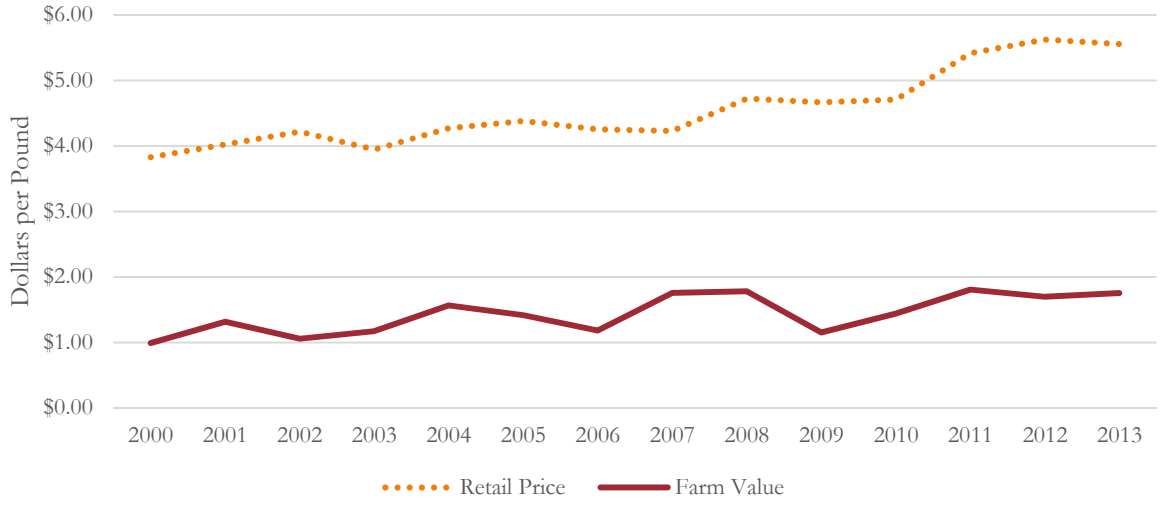
Exhibit 2.1.4 – Ice Cream, Regular, Farm and Retail Prices, per Half Gallon, 2000 to 2013



Source: USDA – Economic Research Service

Farm value and retail prices for cheddar cheese can be found in Exhibit 2.1.5. For the year 2013, retail prices for cheddar cheese per pound were $5.56, and the farm value of this retail price represented $1.76 per pound.

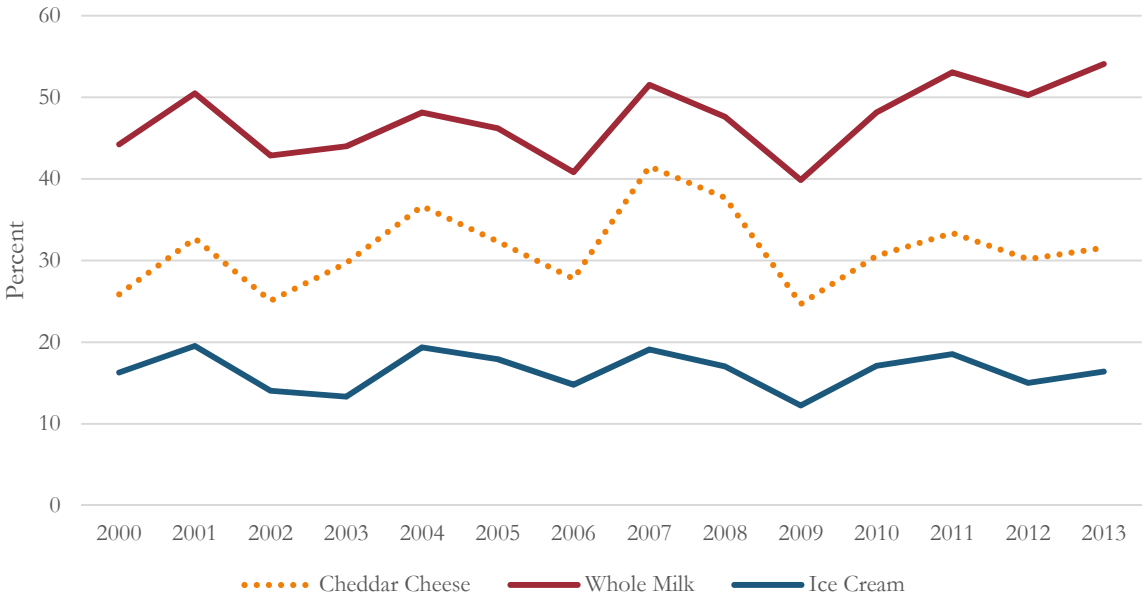
Exhibit 2.1.5 – Cheddar Cheese, Farm and Retail Prices, per Pound, 2000 to 2013



Source: USDA – Economic Research Service

As noted before in the previous exhibits, each dairy product has a different farm share of the retail price. Exhibit 2.1.6 displays the farmer's share of whole milk, cheddar cheese and ice cream prices. Dairy products with more levels of complexity due to further processing, storage and transportation result in a lower farmer share of the retail price.

Exhibit 2.1.6 – Various Dairy Products, Farm Share Percent of Retail Price, 2000 to 2013



Source: USDA – Economic Research Service

2.2 Milk Production Stage

In Missouri, the Grade A and manufacturing-grade dairy farms represent the first stage with their farm-level production of milk. Exhibit 2.2.1 shows an overview of the milk production stage. Primary inputs used in the creation of milk would include breeding stock, feed, land, equipment, facilities, water, utilities and supplies. Outputs from milk production would include milk, dairy beef, dairy replacements and manure. Although milk is the primary output, dairy farmers generate additional income from selling dairy bull calves, raising/selling dairy replacements not needed on their operations and selling purebred stock. Supporting services to the milk production stage would include financial/banking sector, veterinarians, nutritionists, professional services (insurance, accounting, herd testing, etc.), facility/equipment/farm supply providers, custom operators and heifer raisers. Each service provider provides an important function and indirect benefit to dairy farmers.

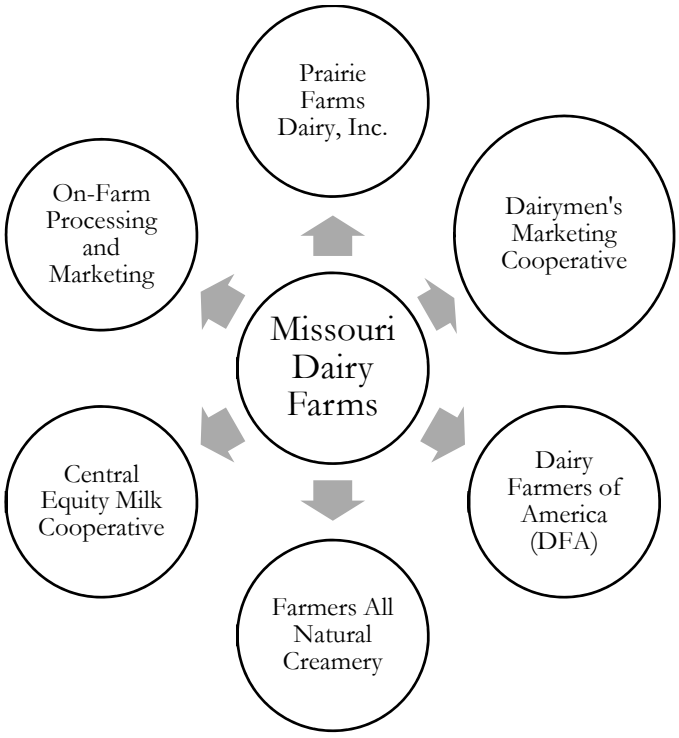
Exhibit 2.2.1 – Dairy Industry Value Chain – Milk Production Stage

Supporting Services	Inputs	Outputs
• Financial/banking • Veterinarian • Nutritionist • Professional services (acct., ins., herd testing) • Facility/equipment providers • Farm supply providers • Custom operators • Heifer raisers	• Breeding stock • Feed • Land • Equipment • Facilities • Water • Utilities • Farm supplies	• Milk • Dairy beef • Replacement heifers • Purebred stock

2.3 Marketing Stage

In Missouri, as in most of the U.S., dairy producers market almost all their milk through milk marketing cooperatives. By choosing to be a member, a milk cooperative producer has elected to be a commodity producer rather than seek to capture value individually by further processing milk from his or her own cows. Milk cooperatives typically are classified as bargaining cooperatives or processing cooperatives or a combination. In Missouri, Prairie Farms would be an example of processing cooperative; DFA would be a combination bargaining and processing cooperative; and Central Equity would be a bargaining cooperative. Milk marketing cooperatives play an important role in balancing supply and demand for processing plants. Exhibit 2.3.1 details current marketing options for Missouri dairy producers. Dairy Farmers of America (DFA), Prairie Farms Dairy, Dairymen's Marketing Cooperative, Central Equity, Organic Valley and Farmers All Natural Creamery all have existing Missouri dairy producers as suppliers. Additionally, a few Missouri dairy producers have elected to process and market their own milk to retail outlets or niche markets. According to the Missouri State Milk Board, as of December 2014, a total of 11 farmers operated small-scale processing facilities that were using cow's milk as a feedstock.

Exhibit 2.3.1 – Market Outlets for Missouri Dairy Farms, December 2014



Two of the marketing cooperatives serving Missouri dairy producers are ranked in the top 25 by milk volume. Exhibit 2.3.2 details the nation's top dairy cooperatives based on milk volume. DFA is the largest cooperative. It is based out of Kansas City, Missouri, and it had 39.4 billion pounds of milk marketed through 7,711 members in the year 2013. They market Grade A milk throughout Missouri and a bit of manufacturing-grade milk in certain Amish areas of Missouri. As of 2014, No. 8 ranked Dairylea Cooperative merged with No. 1 ranked DFA. Prairie Farms Dairy, Inc. is headquartered in Carlinville, Illinois, and ranked 20th in 2013. Missouri producers marketing through Prairie Farms are typically located in the eastern region of Missouri. Prairie Farms and Dairy Farmers of America are distinct cooperatives, but they operate joint ventures in bottling plants in Missouri in an effort to more efficiently use producer-owned processing facilities.

Exhibit 2.3.2 – Nation's Top Dairy Cooperatives, 2013

Rank	Dairy Cooperative	Milk Volume (Billion Lbs.)	Members
1	Dairy Farmers of America, Inc. (DFA)	39.4	7,711
2	California Dairies, Inc.	17.6	470
3	Land O'Lakes, Inc.	12.9	2,261
4	FarmFirst Dairy Cooperative	11.0	4,662
5	Northwest Dairy Association	8.1	504
6	Foremost Farms USA	5.9	1,689
7	Associated Milk Producers, Inc.	5.8	2,600
8	Dairylea Cooperative, Inc.	5.5	1,200
9	Dairy Business Marketing Cooperative	5.2	387
10	Select Milk Producers, Inc.	4.4	60
11	Michigan Milk Producers Association	4.3	1,269
12	United Dairyman of Arizona	3.8	66
13	Lone Star Milk Producers	3.5	192
14	Maryland & Virginia Milk Producers Coop.	3.2	1,521
15	Agri-Mark, Inc.	2.8	1,201
16	Southeast Milk, Inc.	2.4	162
17	Continental Dairy Products, Inc.	2.0	34
18	Upstate Niagara Cooperative, Inc.	2.0	360
19	First District Association	1.9	682
20	Prairie Farms Dairy, Inc.	1.8	797
21	National Farmers Organization	1.5	1,377
22	Organic Valley/CROPP	1.5	1,787
23	Swiss Valley Farms Company	1.4	529
24	St. Albans Cooperative Creamery, Inc.	1.3	416
25	Magic Valley Quality Milk Producers, Inc.	1.0	31

Source: National Milk Producers Federation

In the U.S., dairy cooperatives are a relatively common form of collective ownership. They "provide members an assured market for their milk." In some cases, these cooperatives also process dairy products. USDA Rural Development classifies dairy cooperatives into two main groups. The first exclusively negotiates price and trade terms for raw milk on behalf of members. The second type processes milk and provides more control over managing milk supply and demand. Among the cooperatives that manufacture products, USDA Rural Development further subdivides them into four groups: those that manufacture bulk commodity products like butter, nonfat dry milk powder and

cheese; those that produce specialty, niche products such as cheese; those that specialize in fluid milk bottling and may also produce ice cream and soft products like yogurt, sour cream and dips; and those that diversify to include milk bottling, commodity and differentiated dairy product production and milk sales to other handlers (Stafford, Ling and Liebrand 2005).

In 2012, 132 dairy cooperatives operated in the U.S. Dairy cooperatives handled 84.1 percent of all U.S. milk. Of all milk handled by cooperatives, 96.2 percent originated from cooperative member-producers during 2012. The U.S. west north central region, which encompasses Missouri, Kansas, Nebraska, Iowa, Minnesota, South Dakota and North Dakota, had 42 dairy cooperatives in 2012 that operated in the region and 8,165 producers who were cooperative members. In the west north central region, milk volume handled by cooperatives represented 97 percent of the region's total milk volume marketed during 2012 (Ling 2014).

During 2012, cooperatives used 34 percent of milk that they marketed for processing or manufacturing purposes at their facilities. Exhibit 2.3.3 shares the number of cooperatives that participated in marketing various dairy products in 2007 and 2012. Of all products listed, more cooperatives sold bulk raw milk than any other product in 2012. Other popular products marketed by dairy cooperatives include natural cheese other than cottage cheese, nonfat dry milk and butter.

Exhibit 2.3.3 – Number of Cooperatives Marketing Dairy Products, 2007 and 2012

Product	2007	2012
Bulk raw milk	136	114
Butter	19	15
Nonfat dry milk	14	16
Skim milk powder*	--	9
Dry whole milk	5	7
Dry buttermilk	10	13
Natural cheeses other than cottage cheese	31	25
American cheese	18	16
Italian cheese	6	8
Swiss cheese	4	4
Other (specialty) cheese	15	14
Cottage cheese	6	6
Sour cream	8	6
Packaged fluid milk products	13	10
Yogurt	6	6
Dry whey	11	12
Whey protein concentrates and isolates	6	11
Lactose	4	6

* Separately counted for 2012.
Source: USDA, Rural Development (Ling 2014)

The number of cooperative-owned and -operated plants marketing dairy products varies by region. Exhibit 2.3.4 shares the total number of U.S. cooperative plants that participated in several dairy marketing-related functions during 2012, and it breaks down the location of those plants by region. In total, U.S. cooperatives operated the most plants to package fluid milk, conduct other dairy-related activities, make dry products and make American cheese (Ling 2014).

Exhibit 2.3.4 – Number of Cooperative Plants by Region, Marketing Function, 2012

Function	Atlantic	Central	Western	Total
Receive and ship milk*	0	10	3	13
Churn butter	5	8	11	24
Make dry products	8	10	17	35
Make American cheese	3	23	6	32
Make Italian cheese	1	13	3	17
Make other cheeses	0	18	0	18
Package fluid milk	8	34	7	49
Make cultured products	3	8	4	15
Make ice cream	0	7	1	8
Make condensed products**	1	1	0	2
Make dry whey products	2	16	6	24
Other dairy-related activities	7	28	12	47
Total	26	119	39	184

* Facilities that only performed milk receiving and shipping functions.
** Plants that only condensed milk as final products without further processing on site.
Source: USDA, Rural Development (Ling 2014)

By region, the central region comprises Missouri and 19 other states: South Dakota, North Dakota, Minnesota, Nebraska, Iowa, Kansas, Oklahoma, Texas, Louisiana, Arkansas, Alabama, Mississippi, Tennessee, Kentucky, Ohio, Indiana, Illinois, Michigan and Wisconsin. The western region encompasses states that lie west of the central region, and the Atlantic region consists of states that lie east of the central region. Relative to the other regions, the central region supports more fluid milk packaging plants and milk receiving and shipping plants. It also has more plants that make American cheese, Italian cheese, other cheeses, cultured products, ice cream and dry whey than any other region. In total, 119 cooperative plants operated in the U.S. central region in 2012 (Ling 2014).

U.S. cooperatives produce a significant share of several dairy products. Exhibit 2.3.5 lists dairy product output from cooperatives and all U.S. manufacturers, and it also shares cooperatives' share of total production in 2012. For several products, dairy cooperatives marketed more than half of the total U.S. production: nonfat and skim milk powders, 91 percent; dry buttermilk, 89 percent; butter, 75 percent; dry whole milk, 68 percent; milk protein concentrates, 63 percent; and dry whey and reduced lactose and minerals, 62 percent. As a share of total U.S. production, dairy cooperatives tend to produce little of niche-type products like Hispanic and Muenster cheeses (Ling 2014).

Exhibit 2.3.5 – Dairy Product Output Marketed by Cooperatives and Total U.S. Dairy Product Production, Thousand Pounds, 2012

Product	Cooperative Production	U.S. Production	Cooperative Share of Total
Butter	1,396,363	1,859,554	75%
Dry milk products	2,168,143	2,424,495	89%
Dry whole milk	39,783	58,132	68%
Dry buttermilk	96,609	109,132	89%
Nonfat and skim milk powders	1,967,341	2,154,913	91%
Milk protein concentrates	64,410	102,318	63%
Natural cheeses other than cottage cheese	2,385,980	10,890,144	22%
American cheese	1,513,174	4,358,477	35%
Blue and Gorgonzola	13,701	87,940	16%
Hispanic	6,503	224,259	6%
Italian cheese	732,572	4,633,627	16%
Muenster	13,183	152,630	9%
Swiss cheese	31,363	320,599	10%
Not separately identified and all other cheese	75,484	1,112,612	7%
Dry whey products	1,125,349	2,620,581	43%
Dry whey, and reduced lactose and minerals	678,781	1,088,565	62%
Whey protein concentrates and isolates	195,878	505,890	39%
Lactose	250,690	1,026,126	24%

Source: USDA, Rural Development (Ling 2014)

From a financial perspective, Exhibit 2.3.6 shares an aggregated 2012 balance sheet for 89 dairy cooperatives. Per hundredweight, total assets averaged $10.90. Of all assets maintained by the dairy cooperatives included in this analysis, the current assets line is most significant perhaps because of dairy product inventory carried by these cooperatives. Note the magnitude of net property, plant and equipment and other assets. During 2012, the 89 cooperatives sharing data with USDA recorded $4.37 billion in net property, plant and equipment and other assets (Ling 2014). Because cooperatives have significant access to property, plant and equipment resources to handle milk and process it into dairy products, being a member of a cooperative that manufactures dairy products may be more cost-effective for producers than investing in on-farm processing capital. Processing profits from patron-supplied milk typically become member equity that is used by cooperatives to fund capital needs, but it's eventually revolved back to members.

Primarily, dairy cooperatives finance their assets with liabilities. Based on 2012 financial data from 89 dairy cooperatives, liabilities financed nearly three-quarters of the cooperatives' aggregated assets. Because cooperatives are member-owned, they also have equity as a financing component. Allocated equity represented most equity issued by dairy cooperatives in 2012 (Ling 2014).

Exhibit 2.3.6 – Aggregated Balance Sheet for 89 Dairy Cooperatives, 2012

	Thousand Dollars
Assets	
Current assets	$8,623,306
Net property, plant and equipment and other assets	$4,371,161
Investments in other coops and subsidiaries	$945,765
Total assets	*$13,940,232*
Liabilities	
Current liabilities	$6,883,584
Long-term and other liabilities	$3,499,336
Total liabilities	*$10,382,920*
Equity	
Common stock	$1,163
Preferred stock	$247,959
Allocated equity	$2,980,614
Retained earnings and unallocated equity	$270,680
Non-controlling minority interests	$56,896
Total equity	*$3,557,312*
Total liabilities and equity	*$13,940,232*
Total assets per hundredweight	$10.90
Total liabilities per hundredweight	$8.12
Total equity per hundredweight	$2.78

* 15 cooperatives reported export sales at a total of $1.5 million.
Source: USDA, Rural Development (Ling 2014)

Dairy cooperatives also may have an advantage relative to on-farm processing in earning a positive return for the members. Exhibit 2.3.7 presents an aggregated 2012 income statement for 89 dairy cooperatives that provided data to USDA. Per hundredweight, the net margin before taxes averaged $0.22 based on the 2012 aggregated income statement data.

Exhibit 2.3.7 – Aggregated Income Statement for 89 Dairy Cooperatives, 2012

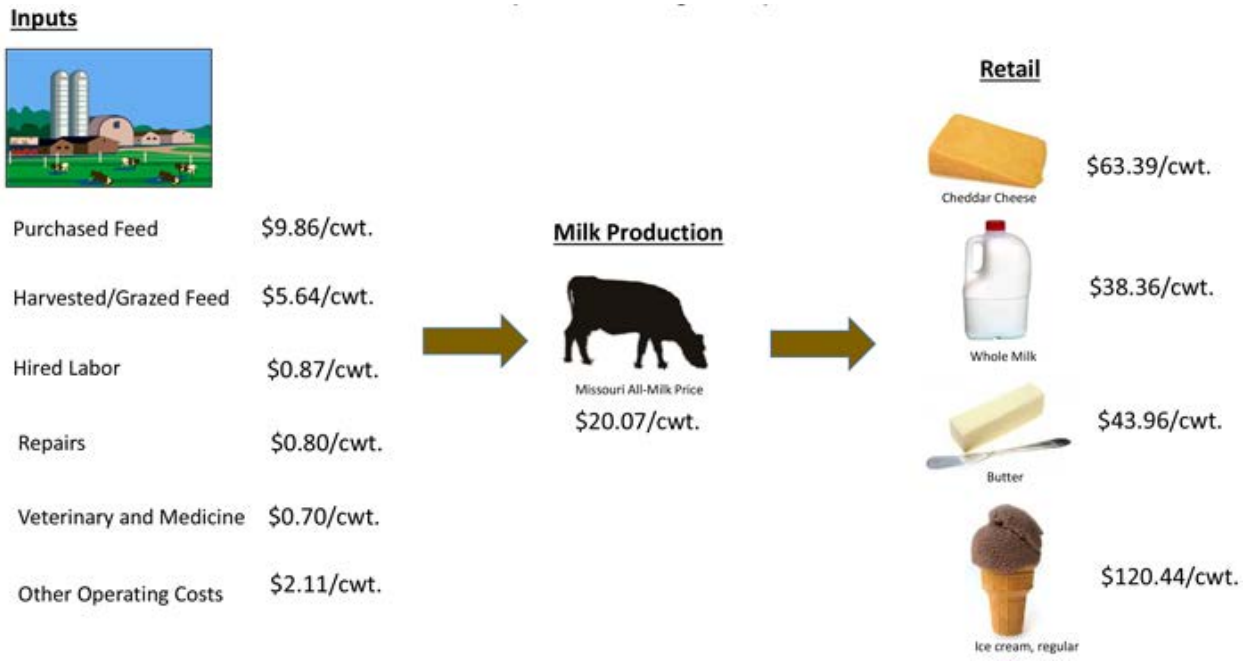
	Thousand Dollars
Revenue	
Milk and dairy product sales*	$36,963,760
Supply and other sales	$10,684,699
Service receipts, subsidiary and other income	$306,622
Total revenues	*$47,955,081*
Costs and expenses	
Cost of goods sold	$44,628,358
Expenses	$2,739,858
Non-operating income and nonrecurring losses	$301,477
Total costs and expenses	$47,699,693
Net margin before taxes	$285,388
Net margin before taxes per hundredweight	$0.22

Source: USDA, Rural Development (Ling 2014)

2.4 Opportunities for Value Chain Enhancement

Stages in the value chain that dairy producers manage and control present opportunities for them to improve their financial position. Exhibit 2.4.1 provides a snapshot of the dairy production value chain that shows the dairy production and retail stages. All prices reported were converted into farm milk equivalents. Three-year average (2011-2013) cost of production data from the USDA-Economic Research Service represent the input costs. The Missouri all-milk prices (average of 2011-2013) from USDA – National Agricultural Statistics Service represent the farm value for milk production. Farmer's share of the dairy product retail prices as reported by USDA – Economic Research Service were used to extrapolate what the total value of cheese, whole milk, butter and ice cream was based on the Missouri all-milk price.

Exhibit 2.4.1 – Dairy Production Value Chain, in Farm Milk Equivalents (Cwt.)



Source: Derived from USDA – Economic Research Service and USDA – National Agricultural Statistics Service Data

If dairy producers were to pursue value-added dairy product production, there are significant financial enhancement opportunities that could be captured by selling cheese, whole milk, butter, ice cream or other products. On the retail side, dairy products varied on a farm milk equivalent basis of as low as $38.86/cwt. for whole milk to $120.44/cwt in selling ice cream. But each opportunity also encompasses more risk than most dairy farmers have currently as just commodity producers of milk. Learning how to market/distribute their products and operate/manage a dairy product plant are just a few of the new skill sets that dairy producers would encounter along with their continuing milk production operations. Additionally, these new products have to displace other existing dairy products in the consumer marketplace. While dairy farmers could venture into further wholesale/retail stages in the value chain, there are already existing opportunities available to them for improving their position in the value chain. Controlling costs and managing their milk margins are other ways farmers can improve their profitability and compete with others in the marketplace.

3. Processing Opportunities

3.1 On-Farm Processing

On-farm processing involves bottling milk and processing products like cheese and ice cream on farms and selling those products at venues such as farmers markets, retail shops, community-supported agriculture programs or on-farm stores. Dairy producers may consider on-farm processing to improve income consistency or provide consumers with local, homegrown food products (Goodnow et al. 2012). Alternatively, if family members have an interest in farm employment or enjoy the food business, then on-farm processing may be an option to engage those family members and provide employment opportunities for them (Moynihan 2006).

Choosing the right product mix will depend on factors such as the market conditions, competitors, estimated demand, operator preferences and resource availability. Regardless of the product, each has benefits and drawbacks. See Exhibit 3.1.1. For example, cheese production yields a product less perishable than fluid milk and produces byproducts that have animal feed applications, but it also requires time to age cheese and learn the right processes. Bottling milk provides the potential to earn revenue from cream and milk sales, facilitate a close relationship with customers and supply a frequently demanded product, but on-farm bottlers may have high start-up costs and struggle with differentiating their milk products from commodity milk. Producing ice cream may boost profitability and require less start-up capital investment; however, ice cream sales have some seasonality and more complicated distribution (Goodnow et al. 2012).

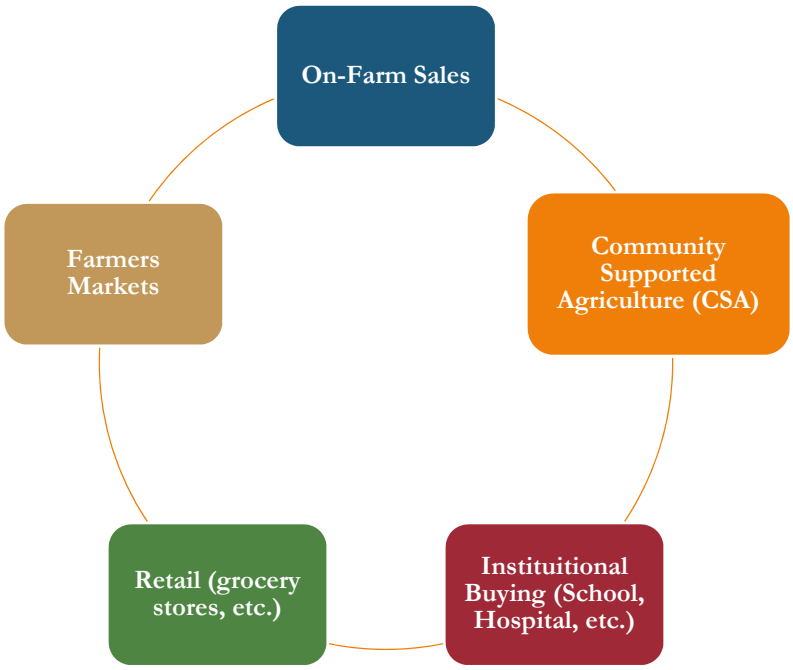
Exhibit 3.1.1 – Advantages and Disadvantages of Producing Various Dairy Products

Product	Advantages	Disadvantages
Cheeses	*Product is less perishable, making supply and demand imbalances less of an issue than with products with a shorter shelf-life *Easy interaction with consumers *Ability to catch any imperfections and control quality *By-product whey can be used as animal feed	*Time required for some aged cheeses *Art required to produce a good cheese is difficult to master. It may take years to produce a truly quality product.
Milk	*More personal connection with consumers *Price maker rather than price taker *Receive payment from cream and skim milk *High-demand product	*High start-up costs ($500,000+) *Heavy demands on labor, time, and variable costs *Quality control is essential *Can be difficult to differentiate from commodity milk
Ice Cream	*Can be very profitable *Can offset losses on a dairy enterprise at different times of the year *Less capital and equipment are needed to start, particularly when using a purchased mix	*Somewhat seasonal product *High input costs *More challenges with distribution *Product differentiation

Source: Goodnow et al. 2012

When marketing products, on-farm processors need to identify methods to differentiate their products from others available and target a specific audience (Moynihan 2006). Market channels are also important to consider. In other words, where should your products be sold? See Exhibit 3.1.2. In addition to product-related decisions, dairy producers interested in on-farm processing must also consider regulations with which they'd need to comply, financing options, communication needs with various stakeholder groups and labor requirements for the farm and processing businesses (Goodnow et al. 2012). Cost-related considerations include the necessary capital investment for the facility and equipment, costs for making the products and consumers' willingness-to-pay for the farm's processed products (Moynihan 2006).

Exhibit 3.1.2 – Market Channel Options for a New Dairy Processor



Source: Goodnow et al. 2012

On-farm dairy processing has a high failure rate (Goodnow et al. 2012). A study presented at the 2007 American Agricultural Economics Association Annual Meeting evaluated financial performance for 27 on-farm processors, and the findings indicate that on-farm processing ventures may have challenges when attempting to profitably produce and process milk. Because the study assessed financial data for just 27 businesses located in New York, Vermont and Wisconsin, the authors caution that the findings may not be generalizable. However, their conclusions and observations may help producers considering on-farm processing (Nicholson and Stephenson 2007). Moss (2012) presented financial budgets for value-added milk/yogurt/cheese production and they can be found in Exhibits 3.1.3 and 3.1.4. It is important for farmers to understand if the economic rewards justify the investments, time and risk involved in on-farm dairy processing.

In evaluating on-farm processor financial data for the farm and processing operations, the Nicholson and Stephenson (2007) study found that cow's milk processors tend to not only process some milk

but also sell some milk into traditional channels. From an expenses perspective, cow's milk processors tend to incur the greatest expense for materials and supplies. Marketing, hired labor and milk were the other major costs. After accounting for each on-farm processor's revenue and expenses, average processing net income indicated a loss. Even after removing a highly unprofitable outlier, the remaining processors still averaged a net processing loss. Just one of the 27 study participants earned profit for both producing milk and processing it. Cow's milk on-farm processors tended to perform better from a profitability perspective in their milk production business units relative to their processing business units.

Based on the study's findings, Nicholson and Stephenson (2007) made several conclusions. Among them, they recommended that low milk production income should not solely motivate decisions about entry into on-farm processing. Although on-farm processing does provide diversification, it also creates a more complex operation that needs more resources like time and management skills. Operators need to study processing capital investment requirements because many study participants made more investments than they could sustain, and some ex ante feasibility studies may not realistically estimate milk production and processing costs. To profitably operate a milk production and processing operation, the study's analysis suggests that operations must earn at least $100 per hundredweight for their products. Keep in mind, though, that this estimate is based on data that are more than seven years old, and evolving revenue and cost assumptions may change the viability of this estimate.

The following insights, shared in a publication from the National Sustainable Agriculture Information Service, from farmers who've successfully pursued food product sales are other ideas to consider. Their recommendations included start with a small operation and scale it "naturally," keep good records to inform decision-making, focus on quality, consider consumer demand, encourage participation from all family members or partners, assess the business on a regular basis and ensure the business has the necessary capital resources (Born 2001 and Moynihan 2006).

For farmers interested in on-farm processing, they have some resources available to them. For example, smalldairy.info is an online resource that hosts a marketplace for sourcing animals and equipment; lists educational opportunities for learning about dairy processing and products; and links to information about procuring supplies, ingredients and equipment needed for processing (smalldairy.com).

Exhibit 3.1.3 – Value-Added Milk & Yogurt Production Estimated Costs and Returns

ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	TOTAL	PER COW
REVENUE						
Milk Sales	1 year	Quart	223836	2.25	50631.00	5036.31
Milk Sales	1 year	½ Gal	111918	2.75	307774.50	3077.75
Milk Sales	1 year	Gal	55959	3.75	209846.25	2098.46
Yogurt Sales	1 year	Quart	95930	4.00	383720.00	3837.20
Butter Sales	1 year	Pound	32228	4.25	13969.00	1369.69
Total Revenue					1541940.75	15419.41
VARIABLE EXPENSES						
Fluid Milk	100 Cows	Cwt	165.00	16.75	276375.00	2763.75
Vitamin A Palmitate		Kg	67	60.00	4029.05	40.29
Vitamin D3		Kg	67	200.00	13430.16	134.30
Cocoa		Pound	525	6.75	3541.16	35.41
Sugar		Pound	2098	0.75	1573.85	15.74
Starch		Pound	174	5.00	870.86	8.71
Salt		Pound	174	0.63	109.73	1.10
Carrageenan		Pound	7	43.00	297.77	2.98
Evaporated Cane Juice		Pound	14090	1.75	24657.01	246.57
Cultures		Pound	222	2.00	443.68	4.44
Puree		Pound	47965	1.25	59956.25	599.56
Pectin		Pound	881	3.00	2644.07	26.44
Inhibitor Testing		Test Kit	9	65.00	585.00	5.85
Petrifilm Testing		50 Pack	5	70.00	350.00	3.50
Pasteurization Check		Test Kit	3	40.00	120.00	1.20
PH & Acidity Checking		50 Pack	5	20.00	100.00	1.00
Direct Microscopic Slides		70 Pack	4	5.00	20.00	0.20
Utilities		Month	12	2500.00	30000.00	300.00
Cleaning Supplies		Day	156	33.62	5243.94	52.44
Jugs-Quart		EA	319766	0.31	99127.46	991.27
Jugs-1/2 Gal		EA	111918	0.35	39171.46	391.27
Jugs-Gal		EA	55959	0.38	21264.42	212.64
Caps		EA	487643	0.03	14629.29	146.29
Labels		EA	51871	.03	15596.13	155.96
Butter Packaging		EA	32228	0.02	644.56	6.45
Cardboard Boxes		EA	46524	0.75	34892.81	348.93
Supplies		Month	12	2083.33	24999.96	250.00
Transportation		Month	12	25000.00	300000.00	3000.00
Waste and Water Treatment		Month	12	94.58	1134.96	11.35
Lot Improvements		Month	12	75.00	900.00	9.00
Advertising/Marketing		Month	12	5000.00	60000.00	600.00
Product Loss/Samples		Month	12	6424.75	77097.04	770.97
Phone and Internet		Month	12	1000.00	12000.00	120.00
Credit Card Transaction Fees		Month	12	152.59	1831.05	18.31
FICA		Month	12	1107.46	13289.58	132.90
Insurance		Month	12	888.56	10662.72	106.63
Worker's Comp		Month	12	684.75	8217.00	82.17
Unemployment Taxes		Month	12	213.75	2562.00	25.65
Licenses, Permits, and Fees		Month	12	25.00	300.00	3.00
Secretarial/Bookkeeping/Accounting		Month	12	2083.33	24999.96	250.00
Legal Costs		Month	12	833.33	9999.96	100.00
Total Variable Expenses					1197670.72	11976.71
Return Above Variable Expenses					344270.03	3442.70
DEPRECIATION AND REPAIRS						
Depreciation	Equip & building				89210.00	892.10
Repairs	Equip & building				27715.00	277.15
Total Fixed Expenses					116925.00	1169.25
Total Variable & Fixed Expenses					1314595.72	13145.96
Return to Land, Labor, Capital, Management, Risk					227345.03	2273.45
INTEREST						
Equipment					71013.00	710.13
Total Interest Expense					71013.00	710.13
Total Variable, Fixed, Interest Expense					1385608.72	13856.09
Net Return to Land, Labor, Management, Risk					156332.03	1563.32
LABOR EXPENSES						
Labor		Hour	14872	10.00	148720.00	1487.20
Total All Expenses					153432.72	15343.29
Return to Land, Management, Risk					7612.03	76.12

Source: Moss (2012)

Exhibit 3.1.4 – Value-Added Cheese Production Estimated Costs and Returns

ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	TOTAL	PER COW
REVENUE						
Cheese Sales	1 year	½ lb	104000	5.00	520000.00	5200.00
Total Revenue					520000.00	5200.00
VARIABLE EXPENSES						
Fluid Milk		Cwt	5200	16.75	87100.00	871.00
Coloring		Ounces	520	0.50	260.00	2.60
Salt		Pounds	1482	0.63	933.66	9.34
Calcium Chloride		Ounces	1560	0.38	596.70	5.97
Starter Cultures		Pounds	3	1.84	1148.16	11.48
Rennet		Ounces	2	2.00	3120.00	31.20
Inhibitor testing		Test Kit	1	65.00	195.00	1.95
Petrifilm testing		50 Pack	2	70.00	140.00	1.40
Pasteurization Check		Test Kit	1	40.00	40.00	0.40
PH & Acidity Checking		50 Pack	12	20.00	40.00	0.40
Direct Microscopic Slides		70 Pack	52	5.00	5.00	0.05
Utilities		Month	104000	1375.00	16500.00	165.00
Cleaning Supplies		Day	104000	11.63	604.76	6.05
Packaging		EA	12	.02	2080.00	20.80
Labels		EA	12	.03	3120.00	31.20
Supplies		Month	12	833.33	9999.96	100.00
Transportation		Month	12	4583.33	54999.96	550.00
Waste & Wastewater Treatment		Month	12	31.35	376.25	3.76
Lot Improvements		Month	12	75.00	900.00	9.00
Advertising/Marketing		Month	12	2500.00	30000.00	300.00
Product Loss/Samples		Month	12	1666.66	19999.92	200.00
Phone and Internet		Month	12	1000.00	12000.00	120.00
Credit Card Transaction Fees		Month	12	1029.17	12350.00	123.50
FICA		Month	12	391.17	4694.04	46.94
Insurance		Month	12	846.24	10154.88	101.55
Worker's Comp		Month	12	356.75	4281.00	42.81
Unemployment Taxes		Month	12	95.00	1140.00	11.40
Licenses, Permits, and Fees		Month	12	25.00	300.00	3.00
Secretarial/Bookkeeping/Acct.		Month	12	1250.00	15000.00	150.00
Legal Costs		Month	12	413.66	4999.92	50.00
Total Variable Expenses					297079.21	2970.79
Return Above Variable Expenses					222920.79	2229.21
DEPRECIATION AND REPAIRS						
Depreciation	Equip & building				67570.00	675.70
Repairs	Equip & building				21123.00	211.23
Total Fixed Expenses					88693.00	886.93
Total Variable & Fixed Expenses					385772.21	3857.72
Return to Land, Labor, Capital, Management, Risk					134227.79	1342.28
INTEREST						
Equipment					61342.50	613.43
Total Interest Expense					61342.50	613.43
Total Variable, Fixed, Interest Expense					447114.71	4471.15
Net Return to Land, Labor, Management, Risk					72885.29	728.85
LABOR EXPENSES						
Labor		Hour	6136	10.00	61360.00	613.620
Total All Expenses					508474.71	5084.75
Return to Land, Management, Risk					11525.29	115.25

Source: Moss (2012)

3.2 Co-Packing

Co-packers are firms that offer manufacturing capabilities to other companies. Most of the time, co-packers not only provide manufacturing services to other companies, but they also manufacture and brand their own products. For these co-packers, manufacturing products on other companies' behalf allows them to more efficiently use resources and provide consistent work for their employees. However, sometimes, co-packers exclusively manufacture products for other companies. In addition to manufacturing products for their clients, co-packers may also advise those clients about research and development, product formulation and quality control (Berry 2014b).

Engaging a dairy co-packer can have several benefits. For companies new to the dairy industry, hiring a co-packer can postpone immediate capital investment needs and enable a start-up to focus more energy on marketing and less on operations. However, co-packers may assist established companies, too. For example, if a co-packer's facility presents a logistical advantage when distributing products and serving a given market, then a company may entertain producing dairy goods at that co-packer's location. Because dairy production and processing has some seasonality effects, a co-packer may extend a firm's manufacturing capabilities when that firm's own facilities are operating at capacity. Additionally, co-packers have much production-related experience, so they can be referred to as experts in their given specialties (Berry 2014b).

Co-packers can assist dairy companies in many ways, but when choosing a co-packer, companies should target creating a good business relationship centered on trust. Before committing to a given co-packer, factors to consider include confidentiality, ingredient sourcing and segregation, quality control, packaging, product traceability, sustainability and regulatory considerations, sanitation and record keeping (Berry 2014b).

Prairie Farms is one firm that offers co-packing and contract manufacturing services. About half of the company's sales originate from products branded with a name other than Prairie Farms. Its resources enable the company to manufacture products including fluid milk, dips, sour cream, cottage cheese, yogurt, ice cream, sherbet, frozen novelties and frozen yogurt. Within the Midwest and mid-South regions, Prairie Farms has access to 24 of its own plants, and it works with 13 other facilities through other types of arrangements. At these locations, Prairie Farms works with clients including McDonalds, Dairy Queen, Steak n' Shake and Dippin' Dots (Prairie Farms).

A few industry resources may help Missouri dairy farmers to identify and reach prospective dairy co-packers. Berry on Dairy, a dairy industry blog, recently started a database that lists finished product co-packers and other firms that provide product development services. To access the list, producers may go to http://www.berryondairy.com/DairyCoPackers.html (Berry on Dairy).

Exhibit 3.2.1 lists dairy plants located within Missouri. Some of these facilities may entertain co-packing arrangements with other companies. For dairy producers who are interested in engaging a co-packer and who live close to the state's borders, they may consider whether identifying a co-packer in a neighboring state could be an alternative.

Exhibit 3.2.1 – Possible Dairy Co-Packers for Missouri Dairies

Plant	City	Website
Baetje Farms	Bloomsdale	www.baetjefarms.com/
Belfonte	Kansas City	www.belfontedairy.com
Borgman's Dairy Farm	Holden	www.borgmansdairyfarm.com/
College of the Ozarks	Point Lookout	www.cofo.edu/page/students/academic-programs/agriculture/farms-work-stations.383.html
Dairiconcepts	Eldorado Springs	www.dairiconcepts.com/
Danisco	St. Joseph	www.danisco.com/
DFA - Cabool	Cabool	www.dfamilk.com/
DFA - Springfield	Springfield	www.dfamilk.com/
Goatsbeard Farm	Harrisburg	www.goatsbeardfarm.com/
Golden L Creamery	Silex	www.goldenlcreamery.com/
Green Dirt Farm	Weston	www.greendirtfarm.com/
Heartland Dairy	Newark	heartlandcreamery.com/
Hiland Dairy (formally Roberts Dairy)	Kansas City	www.hilanddairy.com/
Hiland Dairy	Springfield	www.hilanddairy.com/
Homestead Dairy	Jamesport	
International Food Products Corp. (formerly Dairy House)	St. Louis	ifpc.com/
Ice Cream Specialties	St. Louis	www.prairiefarmsdairy.com/index.php?p=534
Jasper Products	Joplin	www.jasperproducts.com/
Kraft, Inc.	Springfield	www.kraftfoodsgroup.com/
M & T Farms	Owensville	http://www.coolcowcheese.com/
Madison Farms	St. Louis	www.prairiefarmsdairy.com/index.php?p=540
Marlee's Creamery	Carthage	www.agrilicious.org/Marlees-Creamery
Memory Lane Dairy	Fordland	www.memorylanedairy.com/
Milnot	Seneca	www.milnot.com/
Oakridge Goat Dairy & Creamery	Advance	
Ozark Mountain Creamery	Mountain Grove	ozarkmtncreamery.com/
Pacific Valley Dairy	Pacific	www.pvdairy.com/
Prairie Farms (Central Dairy)	Jefferson City	www.centraldairy.biz/
Real Farm Foods	Norwood	http://www.realfarmfoods.net/
Sanitary Dairy Foods	St. Louis	
Schreiber Foods	Mount Vernon	www.schreiberfoods.com/
Schreiber Foods	Carthage	www.schreiberfoods.com/
Schreiber Foods	Monett	www.schreiberfoods.com/
Schreiber Foods	Clinton	www.schreiberfoods.com/
Shatto Milk Company	Osborn	www.shattomilk.com/
Springhill Dairy	Mountain Grove	
Terrell Creek Farm	Fordland	terrellcreekfarm.com/
Trickling Springs Creamery	Koshkonong	www.tricklingspringscreamery.com/
Unilever Ice Cream	Sikeston	www.unileverusa.com/
Weiler Dairy	Rutledge	

Source: Missouri State Milk Board

3.3 Processing Technologies

New dairy processing plants have opened and new technologies have been adopted to meet end-consumer demands and the needs of other processors sourcing ingredients. Processing milk into its components has had potential to meet growing needs of active and aging consumers and create new marketing opportunities for milk. USDA has identified two technological advances that would influence dairy processing's future. First, filtration technology separates milk into various compounds. Depending on the process, filtration may remove water during reverse osmosis; monovalent ions during nanofiltration; minerals, nonprotein nitrogenous compounds and lactose during ultrafiltration; or lactose, minerals and small proteins during microfiltration. Nanofiltration retains solids other than the monovalent ions; ultrafiltration retains protein and fat; and microfiltration retains fat, large proteins and other particles. In milk, ultrafiltration may be the best-suited technology, and its resulting product can decrease shipping costs and reduce whey yield during cheese production. Drying ultra-filtered milk yields powdered milk protein concentrate, which helps in standardizing milk protein levels in cheese-making ingredients. It also has application in sports drinks, sports bars, nutraceuticals and other health foods (Ling 2005).

Second, the report projected adopting more technology that uses dairy-based ingredients and relatively little fresh milk when manufacturing dairy products. Using dry ingredients at dairy facilities can reduce needs for refrigerated storage at final product processing facilities and doesn't necessitate that the final product processing facilities be located near fresh milk sources (Ling 2005).

Several recent examples illustrate the industry's progress in technology innovation. For example, the Upstate Niagara Cooperative markets its members' milk to two New York yogurt production facilities: Alpina Foods and Muller Quaker Dairy. To make Greek yogurt using traditional methods, manufacturers must strain the product to get the right protein content and texture. However, the Upstate Niagara Cooperative adapted facilities at another cooperative facility it owns – the O-At-Ka Milk Products Cooperative – to produce liquid protein concentrate. Although the concentrate would have application in several products, it can remove the need for straining Greek yogurt yet achieve the optimal product protein levels and thickness. Also serving the yogurt category, Dairy Farmers of America and a group of New York dairy farms also are pursuing innovative processing technologies to serve Greek yogurt processors. At a York, N.Y. facility, the collective will cold process milk to separate it into cream and skim milk. The group sees potential for the skim milk being attractive to companies that process Greek yogurt (Carter 2013).

Producing Greek yogurt generates a large volume of acid whey – for every 100 pounds of milk entering Greek yogurt processing, the process yields approximately 66 pounds of acid whey – that has largely been considered a waste product. To add value to the acid whey, Denmark-based Arla Foods Ingredients created a process that uses a special dairy protein to convert the whey into an ingredient suitable for beverage, drinkable yogurt, cream cheese or dessert applications. The special protein controls the off-taste associated with acid whey and improves the product's protein content (Decker 2014).

In the fluid milk business, several innovative technologies enable processors to deliver products that meet consumer needs. For example, Core Power, a high-protein beverage, uses a membrane-filtration process to increase protein, decrease fat and eliminate lactose (Salter 2014). The process isn't the only interesting feature of Core Power drinks. Fairlife involves Coca-Cola and Select Milk Producers, a

dairy cooperative (Cross 2013). Coca-Cola acquired equity in Fairlife and facilitated national Core Power distribution efforts (Salter 2014). Created using a process similar to that used when making Core Power, Fairlife milk planned to debut during late December 2014. It uses a cold filtration process to reduce the fat and sugar content found in commodity milk and increase the protein and calcium content (Peterson 2014). During filtering, the process segregates water, butterfat, protein, vitamins and minerals and lactose found in milk. To fit the Fairlife specifications, the process then reassembles the milk components in the desired proportions (Astley 2014).

Aseptic packaging is an alternative processing and delivery option for fluid milk. In an aseptic system, milk undergoes processing that gives it shelf-stable characteristics and packaging in juice box-like containers. Distributing a shelf-stable product introduces cost efficiencies because it wouldn't require refrigeration during transportation. Aseptic packaging is part of a recently announced Dairy Management Inc. campaign to revitalize the dairy industry (Barrett 2014).

Tetra Pak has a "Milk Unleashed" campaign centered on teaching moms about shelf-stable milk benefits and use occasions. The campaign suggests that moms purchase multiple single-serve, shelf-stable milk containers. They can refrigerate them immediately before use; however, because the milk doesn't necessitate refrigeration, moms can bring along one or two cartons when they leave the house and need a convenient beverage option other than soft drinks and sport drinks for their kids. Tetra Pak has identified another processing-related opportunity for the industry. By packaging attribute-specific milk products in package sizes smaller than one gallon, consumers may purchase different products for each family member given his or her specific needs. For example, milk products could be differentiated based on fat, lactose, fiber, plant sterol, omega-3 or calcium content (Carper 2012). In a family with two kids, parents with high cholesterol may purchase the plant sterol-supplemented milk for themselves. However, one lactose-intolerant child would need a lactose-free variety, and another child would benefit from a variety with added calcium.

Despite opportunities for aseptic packaging, not all dairy industry participants envision aseptic packaging as a move to improve the dairy industry's viability. The president and CEO of The Ice Cream Bar Inc. has said that movement to aseptic packaging would harm milk because the product would no longer be displayed prominently in cases familiar to all consumers. Instead, milk could be shelved among thousands of other products and essentially become "lost" in stores. He did note, however, the potential that aseptically packaged U.S. milk could have in export markets (Orris 2012).

As health initiatives have focused on educating consumers about heart health and encouraging them to consume less sodium, food companies have attempted to control sodium in processed foods, and this trend has influenced dairy processors. The Mayo Clinic and other health groups recommend consuming no foods that contain more than 200 sodium milligrams per serving. Some processed cheese and dairy dips and spreads have contained sodium at levels higher than this benchmark. Thus, dairy processors have experimented with technologies that would control sodium levels in such products. In cheese, salt gives the product an appealing flavor and texture and desirable shelf life. By adjusting the cultures and enzymes used in natural cheese processing, Chr. Hansen A/S discovered that it could use less salt because selected cultures provide the desirable flavor and selected enzymes control product bitterness and texture. Accommodating the different ingredients would require process changes, but the extent of the changes necessary would vary depending on the desired sodium content (Berry 2013).

For salt reduction, the Center for Dairy Research at the University of Wisconsin-Madison has researched another option. Adding whey permeate, which is derived from milk during a whey membrane filtration process, creates a salt-like flavor that could work in cheese, sauces, dips and spreads (Berry 2013). Processing technologies related to salt reduction – like the two described here and others that have been developed – may maintain dairy products' viability in consumer diets formulated to reduce sodium and maintain heart health.

To assist industry in developing new technologies and product applications, the Dairy Research Institute supports National Dairy Foods Research Centers. Housed at universities throughout the country, these centers "provide industry with dairy product and ingredient research and technical resources to help industry innovate to address unmet consumer demand for dairy and dairy-based products." Centers have a presence at California Polytechnic State University-San Luis Obispo, the University of Minnesota, South Dakota State University, Iowa State University, Cornell University, North Carolina State University, Mississippi State University, Utah State University, Oregon State University, Weber State University, Brigham Young University and the University of Wisconsin-Madison. At these facilities, the resources, services and capabilities will vary. However, each center has facilities, processing equipment, analytical equipment and experts that can assist with research and development efforts. These centers may also host conferences and workshops throughout the year that educate participants about processing dairy products (Dairy Research Institute).

3.4 Processing Trends and Outlook

Dairy processors have several challenges looking into the future. Based on 2013 research insights collected by The Association for Packaging and Processing Technologies, top North American dairy processors and other industry representatives shared four industry concerns that have emerged since the last report released in 2009: satisfy sanitation, product safety and worker safety expectations; control costs; improve production efficiency with available human resources; and address shrinking fluid milk, frozen product and certain cultured product intake. The four trends identified in 2009 that may be still relevant were persisting industry concentration, increasing farm size and geographic farm movement to the West, growing dairy product intake and choosing sustainable packaging (The Association for Packaging and Processing Technologies 2013).

The interaction with processors and dairy industry professionals also revealed top-of-mind improvements that the dairy processing industry may emphasize in the future. The following items were ranked as the top five identified improvement opportunities: enhancing productivity, adhering to Food Safety Modernization Act provisions, maintaining safety of machine operators, introducing automated packaging solutions; and conducting preventative maintenance (The Association for Packaging and Processing Technologies 2013).

Within the dairy industry, the processors and professionals participating in the study from The Association for Packaging and Processing Technologies identified several upcoming trends that will impact the dairy industry at the farm and manufacturer levels. Those included regulations like the Food Safety Modernization Act; preferences for safe, healthy and high-quality dairy products; government role in global milk procurement and prices; convenient, sustainable packaging; potential for marketing non-refrigerated dairy in the U.S.; attempts to boost milk intake; farm and processor consolidation; need for skilled equipment operators; and stand-up pouch packaging (The Association for Packaging and Processing Technologies 2013).

4. Dairy Niche Marketing Opportunities

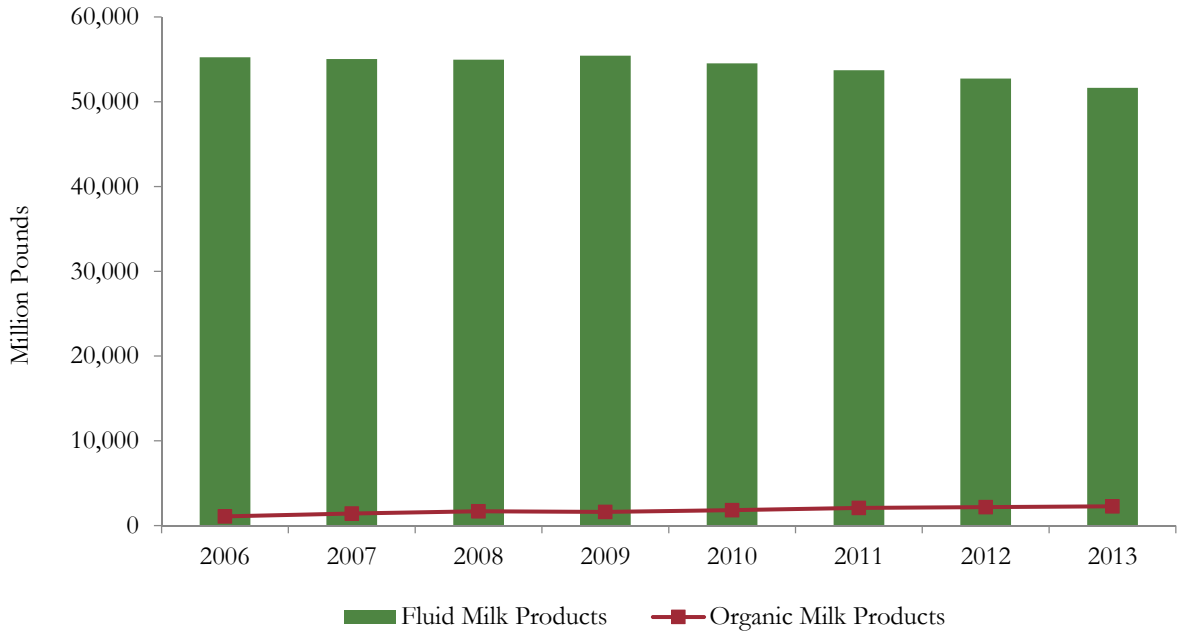
4.1 Organic

To qualify for an organic label, organic products must meet standards set by the National Organic Program. For dairy, these standards require that cows only consume 100 percent organic feed and acceptable vitamin and mineral supplements; have been in an organic system at least 12 months; be treated with approved medication; graze at least 120 days per year and during the whole grazing season; record at least 30 percent of dry matter intake from pasture; have year-round access to the outdoors; and receive no growth-promoting hormones or antibiotics. Organic products need at least 95 percent of their ingredients to be organic to be eligible for the USDA organic seal. For products that contain at least 70 percent organic ingredients, they may use a "made with organic" label to signify that select ingredients have been produced organically (National Organic Program 2011). Exhibit 4.1.1 presents the seal that certified organic products may bear.

Exhibit 4.1.1 – USDA Certified Organic Seal

During 2013, organic dairy sales totaled $4.9 billion, which was 8 percent growth (Organic Trade Association 2014). Although U.S. consumers have gradually consumed less fluid milk and cream over time, organic milk sales have grown. Exhibit 4.1.2 charts total U.S. organic fluid milk and total fluid milk product sales data. Organic milk sales represent a relatively small portion of total fluid milk sales, but organic's share of total fluid milk sales increased from 1.92 percent in 2006 to 4.38 percent in 2013 (USDA Economic Research Service).

Exhibit 4.1.2 – U.S. Organic and All Fluid Milk Sales, 2006 to 2013*



* These figures are based on the consumption of fluid milk products in Federal milk order marketing areas and California, which represents approximately 92 percent of total fluid milk sales in the U.S.; an estimate of total U.S. fluid milk sales is derived by interpolating the remaining 8 percent of sales from the Federal milk order and California data. Total fluid milk products include the products listed plus miscellaneous products and eggnog. Note that total fluid milk products sales volume is adjusted for calendar composition for all years but 2013.
Source: USDA, Economic Research Service

In the cheese category, Packaged Facts estimates that organic cheese sales will total $750 million by 2018 and grow by double digits to achieve those sales (Watrous 2014). As fresh and frozen prepared food demand has grown, more bulk organic cheese is needed as an ingredient. Organic cheddar and Monterey Jack varieties are especially demanded, and buyers have limited organic Swiss options. For an aged cheese like Swiss, producing it with organic milk makes the product very expensive. Not only does the product include high-priced organic milk and need segregation from non-organic products, but storing the cheese as it ages further adds cost (Berry 2014a).

Some dairy processors lack adequate access to organic milk to allow them to convert their products to be organic. As an example, Chobani intended to introduce its first organic product during summer 2014. However, after failing to source enough organic milk, the company postponed those plans until 2015 (Watson 2014c).

4.2 Natural

In 2012, Mintel found that 51 percent of U.S. consumers look for "all natural" food when they buy food. For the year preceding November 2013, Nielsen recorded $40 billion in retail sales for "natural" food. Only products with labels featuring low-fat claims garnered greater sales (Esterl 2013). Based on July 2011 research conducted for the HealthFocus International Natural Study, consumers have five top descriptions for food and beverage products that are "natural." Those were 1) "foods with no additives, chemicals or artificial ingredients;" 2) "no added preservatives;" 3) "not processed;" 4) "comes from nature or nothing added;" and 5) "grown with no pesticides, chemicals or hormones." Consumers also like products that include few ingredients and ingredients that they recognize, according to the Innovation Center for U.S. Dairy. When natural and organic food and beverage purchasers buy products with those claims, 69 percent buy milk, 67 percent buy yogurt, and 65 percent buy cheese (Miller 2012).

The Food and Drug Administration technically hasn't created standards for products bearing a natural label. The agency has recognized "natural" to mean that "nothing artificial or synthetic (including all color additives regardless of source) has been included in, or has been added to, a food that would not normally be expected to be in the food" (Esterl 2013).

Increasingly, firms are forgoing natural labels on their products because of lawsuits being filed to challenge whether labeled products are truly natural. Many suits claim false advertising. Brands like Ben & Jerry's, Kashi and Skinnygirl have been affected. Fewer companies are also adding the natural labels when they launch products. For the first half of 2013, 22.1 percent of newly launched U.S. food products and 34 percent of newly launched U.S. beverages had a "natural" claim. By comparison, 30.4 percent of new U.S. food products and 45.5 percent of new U.S. beverages had "natural" claims when launched in 2009 (Esterl 2013). Some companies have retained the natural claims, however. For example, Chobani continues to use such claims. The company has said that a commitment to natural ingredients promotes trust among its customers, and it perceives that natural claims have credibility and believability (Watson 2014c).

Natural's effectiveness may depend on the product. For example, natural cheese is outperforming processed cheese. In the year preceding Jan. 26, 2014, the value of natural cheese sales increased 2.9 percent and totaled $11.7 billion. Natural cheese unit sales increased 2.5 percent. During the same time period, processed cheese sales value decreased 1.5 percent and totaled $3.1 billion. By units, processed cheese sales dropped 3.3 percent (Kennedy 2014a). Perhaps unlike other products, natural cheese has generally accepted ingredients that differentiate natural products from those considered to be further processed. Natural cheese usually includes just milk, bacterial culture, enzymes and salt. Processed cheese has added emulsifiers and sometimes may include other ingredients focused on changing the product's shelf life, color or flavor (Nassauer 2014b).

4.3 Grass-Fed

Grass-fed is another label claim creating interest within the dairy products sector. Currently, no federal guidelines outline requirements for using dairy product grass-fed marketing claims (Nassauer 2014a). In October 2007, USDA approved a marketing claim standard for grass-fed beef products, however (Agricultural Marketing Service 2007). As an alternative to government oversight, the Pennsylvania Certified Organic group, a third-party certification organization, created a program with standards for PCO 100% Grassfed certification. Exhibit 4.3.1 shares the label that certified firms may use on their eligible grass-fed products. To apply, an operation must also seek or have sought USDA National Organic Program certification (Pennsylvania Certified Organic 2014). Dairy producers who raise animals in a grass-based system encouraged the third-party certification's creation because no regulations exist to uphold grass-fed dairy claims (Dairy Foods 2014b).

Exhibit 4.3.1 – PCO Organic 100% Grassfed Certification Label

Several firms have entered into grass-fed dairy production. About five years ago, Whole Foods encouraged Organic Valley to consider marketing grass-fed milk because the store had received inquiries from customers looking for grass-fed dairy. In response, Organic Valley started marketing lightly pasteurized grass-fed milk that has cream on top. Today, Organic Valley sells more grass-fed whole milk at Whole Foods than any other Organic Valley product. The sales data indicate that some consumers are willing to pay the premium associated with grass-fed milk. Relative to the average organic milk, Organic Valley grass-fed milk, marketed as Grassmilk, has a $1 premium per half gallon. Relative to traditional milk, the Grassmilk is more than twice as expensive. Despite Grassmilk's success, most mainstream stores don't offer the product. Instead, it now has limited distribution. In addition to its grass-fed milk, Organic Valley has also started producing and marketing Grassmilk organic cheddar cheese. The company hasn't added other grass-fed products to its Grassmilk product line because the whole milk sells well enough that Organic Valley lacks the cream needed for manufacturing products such as butter and half-and-half (Nassauer 2014a).

Another firm pursuing grass-fed dairy products, Maple Hill formed during 2009, and since 2013, it has produced yogurt at its Stuyvesant, N.Y., facility (Maple Hill Creamery LLC 2014). The company produces full-fat, organic, grass-fed yogurt (Nassauer 2014a). In addition to its whole milk creamline and drinkable yogurts, Maple Hill added Greek yogurt during fall 2014 (Dairy Foods 2014b).

During 2014, the company started distributing nationally at Whole Foods stores, and it's added Kroger Co. as another retailer for its yogurt. In the future, Maple Hill intends to expand its grass-fed product line to include organic butter. To grow its business, Maple Hill is seeking more locally sourced grass-fed milk (Nassauer 2014a). As of 2015, Maple Hill Creamery sources milk from several dozen farms, including Amish operations, located within 150 miles of the company's processing facility (Maple Hill Creamery LLC 2015). Maple Hill was the "first national dairy brand" to certify its grass-fed products with the 100% Grassfed Organic program available from Pennsylvania Certified Organic (Dairy Foods 2014b).

Rather than distribute product nationally, some dairies that adopted grass-fed practices market their products locally or regionally. Cedar Summit Farm, a family farm located in New Prague, Minn., started as a dairy farm. Over time, the family gained interest in grass-based production, and it also diversified to include beef, poultry and pork production. Today, the farm continues to produce beef and pork. The farm also operates a creamery to process the milk from its dairy cows. Today, about 130 dairy cows at the farm produce milk for the creamery's plain milk, chocolate milk, cream, half-and-half and drinkable yogurt products. Additionally, the farm sells milk to the Alemar Cheese Company, which processes the milk into two cheeses. Cedar Summit Farm serves customers throughout the Minneapolis-St. Paul area, and its distribution also reaches consumers in Wisconsin, Michigan and Minnesota communities outside of the Twin Cities (Cedar Summit Farm 2014).

In the South, Dreaming Cow has produced grass-fed, full-fat yogurt since 2009, but its family operators have maintained grass-fed dairy production for more than 20 years. Located in Pavo, Ga., the family business produces milk in a New Zealand-style model, characterized by rotational grazing and open-barn milking. The farm's location in southern Georgia enables year-round grazing for the Jersey, Holstein, New Zealand Friesian, Dutch Belted and Brown Swiss cows that call the farm home. Dreaming Cow yogurt is made using non-homogenized milk, which produces a cream-top product. Consumers may choose from plain Dreaming Cow yogurt or one of the six flavored varieties available. The company distributes product in six southern states: Florida, Georgia, Alabama, South Carolina, North Carolina and Tennessee (Dreaming Cow).

Among a consumer subset, grass-fed products have appeal because of the perception that grass-fed products contain healthy fats that promote health. In some cases, research supports these thoughts. For example, some research has quantified higher omega-3 fatty acid concentrations in milk produced by cows that graze relative to milk from those that consume feed-based rations. Consumers may also perceive that grass-fed contributes to a more natural product (Nassauer 2014a).

4.4 Non-GMO

Nielsen data indicate that 2013 non-GMO food sales totaled $3 billion, which was 28 percent growth, in the U.S. (Gasparro 2014). Consumer concerns about genetically modified organisms (GMOs) are motivating interest in non-GMO products. NPD measured the extent to which consumers noted being very or extremely concerned about GMOs. The share of consumers indicating these attitudes increased from 15 percent in 2011 to 20 percent in 2013 (Malone 2014). Unlike organic products, non-GMO products don't have government-issued requirements to meet. Instead, certifying non-GMO products involves verifying products with a third-party such as the Non-GMO Project, which provides a "Non-GMO Project Verified" seal to products that fulfill the program's expectations (Thornton 2014).

Within the dairy case, several companies have expressed interest in supplying non-GMO dairy products. For two years, Ben & Jerry's Homemade Inc. has attempted to convert its ice cream products to non-GMO ingredients. Already, the company – the fifth largest U.S. ice cream brand by sales – has worked to source non-GMO ingredients for its add-ins, such as caramel and cookie dough. By fall 2014, it anticipated finishing this portion of the switch to non-GMO ingredients. Ben & Jerry's has shared that non-GMO ingredients typically are 5 percent to 20 percent more expensive than the GMO alternatives. Accessing adequate non-GMO milk supplies to produce its ice cream has thus far eluded the company, which estimates an additional five- to 10-year timeline for sourcing enough non-GMO milk. Sourcing non-GMO milk has been a challenge because most dairy feed contains corn, soybeans or alfalfa that has undergone genetic modification (Gasparro 2014).

In at least one instance, failing to adopt non-GMO ingredients has contributed to pulling dairy products from store shelves. In December 2013, Whole Foods announced that it would cease carrying Chobani Greek yogurt in early 2014. When making decisions about stocking refrigerated products, especially Greek yogurt, Whole Foods has prioritized exclusive products, new products and flavors and products eligible for non-GMO or organic label claims (Strom 2013). Proliferation of Greek yogurt brands and products prompted Whole Foods to seek novel products (Gasparro and Josephs 2013). Because Chobani currently doesn't market non-GMO products, this partially motivated the Whole Foods decision to discontinue Chobani sales; however, it has continued selling other products that haven't transitioned to using non-GMO ingredients. By 2018, Whole Foods will require companies distributing products in its stores to label products if they contain GMO ingredients (Strom 2013).

To supply enough milk to meet yogurt demand, Chobani must source milk from more than 78,000 dairy cows. Feeding non-GMO feed to all of those cows requires significant volume, and sourcing adequate non-GMO feed for these cows has been a struggle (Strom 2013). Chobani has said that it has yet to access enough non-GMO milk at a reasonable price (Gasparro and Josephs 2013).

Other brands have responded to Whole Foods' request for product novelty and exclusivity. As an example, Stonyfield created non-GMO Brown Cow yogurt in a Greek variety. It's only available at Whole Foods stores (Gasparro and Josephs 2013). Stonyfield has also committed to certifying its non-GMO products with Non-GMO Project Verified (Thornton 2014). Exhibit 4.4.1 presents the seal that products meeting the program's standards can display on their labels.

Exhibit 4.4.1 – Non-GMO Project Verified Seal

Milk processors are also attaching non-GMO claims to their products. Snowville Creamery, based in Ohio, announced in 2014 that it would label its milk with non-GMO and grass-fed labels. Producers marketing their milk to the Snowville Creamery earn a 30 percent premium if they adhere to non-GMO, grass-fed production. Snowville distributes products to certain markets in Ohio, Pennsylvania, Kentucky and Washington, D.C. (Malone 2014).

4.5 Local and Origin Location

Demand for local products has gradually increased over time. The Hartman Group, a consumer research firm, conducted a national survey that addressed factors that affected food and beverage purchases. Based on the survey findings, the share of shoppers who seek locally grown or produced food and beverages increased from 13 percent during 2007 to 25 percent during 2013 (Mayer 2014). Benefits of local foods include the products aggregating fewer food miles and theoretically being fresher and more nutritious and flavorful because they travel fewer miles. From a sales perspective, a University of Missouri agricultural economist emeritus shared that local food sales increased from $4 billion in 2002 to $11 billion in 2011(Voight 2012).

The definition of local may vary depending on different consumers and entities. Among food advocates, 100 miles is generally an acceptable distance when determining whether a food product is "local." The U.S. government considers a product to be "local" if it's sourced within 400 miles (Voight 2012). Although "local" isn't a label that conveys the same distance definition for everyone, preferences for local products are driven by growing interest in knowing where food originates. Local food markets include schools, food hubs, community-supported agriculture programs and farmers markets (Mayer 2014). Big buyers have also committed to local foods. As an example, Walmart set a goal to double locally sourced produce sales by the end of 2015. It's also invested in infrastructure necessary to source and stock fresh food more quickly (Voight 2012).

Local has been a product attribute motivating interest in dairy products. For example, within in the cheese category, artisanal cheese labels usually list the product's origin state (Lippman 2014). Specialty cheeses that include local ingredients have captured consumer interest (Prisco 2013). The International Dairy-Deli-Bakery Association notes consumer interest in "local" and "farmstead" cheese products (Finkel 2014).

A study from the University of Missouri surveyed Missouri consumers about their attitudes toward artisan cheese and clarified those consumers' expectations for local products. Exhibit 4.5.1 summarizes "local" definitions held by consumers. Of the cheese eaters and artisan cheese buyers who responded, both groups had similar thoughts about "local" products. If a product at least comes from a consumer's state, then most consider it "local." Among both groups, 36 percent of respondents noted that they consider a product to be "local" if it comes from the consumer's home county or the surrounding counties (Parcell and Moreland 2013).

Exhibit 4.5.1 – Consumer Definition of "Local" Product

When purchasing a "local" product, what do you consider local?	% of Total Cheese Eaters (N=1,040)	% of Artisan Cheese Buyers (N=440)
From within my city or town	17%	14%
From within my county or surrounding counties	36%	36%
From within my state	35%	39%
From surrounding states	9%	8%
Other (please specify)	2%	3%

Source: University of Missouri (Parcell and Moreland 2013)

Small-scale and family-operated ice cream shops – or at least shops that evoke a similar vibe – have benefited from consumer interest in local ingredients. In large cities, these small stores are performing well because their independent spirit appeals to consumers. Growth in ice cream retail has mostly benefitted smaller scale entities compared with the large-scale shops (McMillan 2014).

4.6 Other Label Claims

Other nutrition-related labels being added include those supplemented with omega-3 fatty acids, plant sterols, prebiotics and probiotics. Sterol-supplemented dairy products may help to lower cholesterol levels (Berry 2014d).

4.7 Heritage Breeds

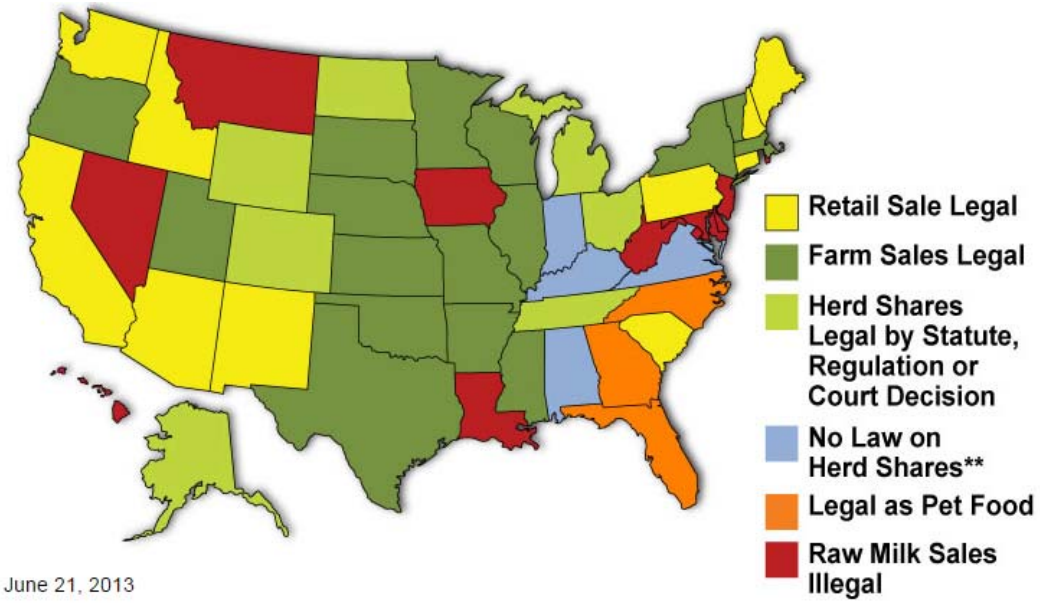
One breed dominates the U.S. dairy herd. Holstein Association USA estimates that the breed it represents – the Holstein – comprises 93 percent of all U.S. dairy cow inventory. Over time, the U.S. dairy herd has lost genetic diversity. Producers maintained about a half dozen of different breeds about 50 years ago (Estabrook 2010). Lesser-known breeds are referred to as heritage breeds. After World War II, farms started to prioritize selecting dairy cows that produced more milk and were larger because animals with these characteristics fit well in confinement systems. Breeds that didn't offer these benefits became less popular. Recently, however, niche breeds have had some regained interest, especially among smaller farms (West 2010).

Using cow, goat and sheep milk from rarer dairy breeds, some producers have created opportunities for value-added dairy production. For example, heritage cheese is one such niche market opportunity, especially if consumers have an opportunity to learn about the unusual breeds providing milk for the products. Milking heritage breeds and converting that milk into value-added products generally occurs on a small scale. For example, during 2010, Finger Lakes Dexter Creamery in New York milked just seven Dexter cows. The two kefir cheese products created from milk produced at the farm carried a premium price. Per pound, the price ranged from $26 to $28. Another farm in New York, Heamour Farm markets cheese from Ayrshire and Kerry cows and Arapawa and Saanen goats. Per pound, the cheese price ranges from $16 to $22 (West 2010).

4.8 Raw Milk

Raw milk hasn't been pasteurized, or heated to eliminate salmonella, listeria, *E. coli* or other bacteria that may be present in the milk. Since 1987, interstate milk sales have prohibited raw milk transactions. Thirty states permit raw milk sales within their borders, but 20 states fully ban such sales (Pipkin 2014). In Missouri, producers may sell and/or deliver raw milk for the buyer's individual use, but they may not market raw milk at an off-site distribution center (Missouri Department of Agriculture). Exhibit 4.8.1 shares information about raw milk sales laws in the U.S. by state on June 21, 2013. In addition to Missouri, several states permitted farm sales, such as Nebraska, Kansas, Oklahoma, Arkansas and Illinois. Relatively few states – 10 of them, which are primarily located on the coasts – allowed retail raw milk sales for milk from any animal source (Farm-to-Consumer Legal Defense Fund 2013). In 2009, more dairies in Pennsylvania had raw milk permits than any other state (Brenhouse 2009).

Exhibit 4.8.1 – U.S. State-by-State Raw Milk Laws, June 21, 2013



Source: Farm-to-Consumer Legal Defense Fund (2013)

Unlike for raw milk sales, the Food and Drug Administration allows raw milk cheese sales if the product ages at least 60 days. The aging process and acid and salt ingredients control pathogens that may have been present in the raw milk (Brenhouse 2009). In January 2014, the FDA began a testing program for raw milk cheeses aged at least 60 days. The tests were meant to measure salmonella, L. monocytogenes and E. coli O157:H7 exposure from raw milk cheeses. At the earliest, FDA would release its results in January 2015 (The Gourmet Retailer 2013).

The raw milk debate stems from concerns that raw milk may cause illness. The Food and Drug Administration shares caution about raw milk consumption considering that "non-pasteurized dairy products are 150 times as likely to cause illness as their pasteurized counterparts," based on Centers for Disease Control research. Recently, based on concern for pregnant women and children, The American Academy of Pediatrics called for a national raw milk ban. However, proponents stress that heat applied during pasteurization removes good bacteria and nutrients found in the raw milk (Pipkin

2014). Based on some research results, consuming raw milk may lead to less tooth decay, infection, allergies and asthma (Brenhouse 2009). If consuming raw milk increases illness incidence, then some dairy producers worry that such illness instances linked to raw milk will ruin milk's reputation as a safe product (Pipkin 2014).

Despite possible concern about raw milk, a consumer niche still chooses raw milk. FDA estimates suggest that less than 1 percent of U.S. consumers use raw milk. Another study indicates that 3 percent of consumers in some states had chosen raw milk in the week preceding their participation in the study (Pipkin 2014). The Weston A. Price Foundation has supported A Campaign for Real Milk since 2000. The effort started in 1999 when Sally Fallon Morell created realmilk.com. The project supports milk and dairy products that are pasture-fed, unprocessed and full-fat. On its website, the group lists farms that sell raw milk. Missouri has more than 90 listings, including those for goat and cow's milk and other products (The Weston A. Price Foundation 2014).

Consumers who purchase raw milk generally will pay more for the raw attribute, and when pasteurized fluid milk sales have been sluggish, raw milk has been considered an opportunity to capture more value from milk sales. Consuming raw milk tends to fit with consumer preferences for organic and local foods (Brenhouse 2009).

4.9 Lactose-Free Milk

In the U.S., an estimated 12 percent of consumers can't tolerate lactose. African Americans and Hispanic Americans tend to be more susceptible to lactose intolerance. Lactose-intolerant consumers lack the ability to disconnect glucose and galactose, the two sugars that comprise lactose. When the body doesn't separate the two sugars, consumers feel bloated and may have gas, loose stools and stomach pain. To stay healthy, however, lactose-intolerant consumers should try to have dairy products in their diets to avoid developing calcium and vitamin D deficiencies (Amidor 2013).

By 2016, the U.S. market for lactose-free milk is estimated to reach $650 million (Astley 2012). Lately, lactose-free milk products have done well (Berry 2014d). The predominant global brands are Lactaid, Zero Lactose and Lactofree (Astley 2012). Some companies have been hesitant to pursue a lactose-free market because addressing lactose may have given the impression that milk had something wrong with it (Astley 2013). In addition to lactose-free milk being available, the dairy industry has also created products such as lactose-free cottage cheese and ice cream. Greek yogurt contains little lactose because straining the yogurt removes a lot of lactose. Cheddar and Swiss hard cheeses also contain little lactose (Amidor 2013).

Two factors have largely influenced the lactose-free dairy sector. First, consumers have increasingly self-diagnosed themselves as lactose-intolerant and have, thus, sought lactose-free options. Second, the industry had inferior technology for some time that led to an expensive yet unpleasant-tasting product. Over time, the technology has improved. Despite improvements, however, poor U.S. innovation may limit the U.S. lactose-free dairy market opportunity (Astley 2012). To produce lactose-free milk, processors may filter milk to remove the lactose (Berry 2014d). Alternatively, adding lactase to milk triggers a reaction that manages lactose and processes it into components that the body may more easily manage (Hendrickson 2012).

4.10 A2 Beta-Casein

For some people, consuming dairy products isn't a good option because they feel discomfort as their bodies try to digest such products. Generally, choosing A2 beta-casein dairy leads to easier digestion regardless of whether a consumer has milk tolerance problems (Berry 2014d). The A2 milk also leads to less bloating (Hoard's Dairyman 2014). In addition to affecting gastrointestinal health, the A1 protein has been linked to beta-casomorphin 7, or BCM-7, levels. A1 protein consumption and BCM-7 levels have been linked to health problems such as heart disease, sudden infant death syndrome, autism and schizophrenia (Kaminski, Cieslinska and Kostyra 2007). A2 beta-casein gained attention after the book *Devil in the Milk* debuted in 2007 (Snowville Creamery).

Of the protein found in milk, about 30 percent is beta-casein. Historically, cows produced A2 beta-casein. However, a mutation that occurred over time led to some cows having a gene that programmed a different beta-casein amino acid sequence and caused cows to produce A1 beta-casein. Commonly, Holstein and Friesian breeds have the mutation. Depending on a cow's genes, it may produce only A1 beta-casein, only A2 beta-casein or a combination of the two. Guernseys typically produce more A2 beta-casein (Snowville Creamery). The A2 gene is rarer (Hoard's Dairyman 2014).

Based in North Sydney, Australia, The a2 Milk Co. has already recognized A2 beta-casein products as an opportunity to pursue. It's sold its a2 milk products in New Zealand and Australia since 2003 (Berry 2014d). In Australia, A2 milk has captured a 9 percent share of fluid milk sales (Hoard's Dairyman 2014). After experiencing success in its current markets, The a2 Milk Co. plans to launch its fresh milk products within the U.S. sometime during 2015 (Berry 2014d). This wouldn't be the first effort to introduce a2 beta-casein milk to the U.S. Prairieland Dairy, a dairy collective located in southeast Nebraska, has collaborated with The a2 Milk Co. to produce a2 milk. In 2007, Prairieland started selling a2 milk at regional Hy-Vee stores with assistance from The Original Foods Co., a distributor. Relative to commodity milk, a2 milk carries a premium to compensate producers for needing to test their cows for A2 genetics and segregating the A2 milk production stream from the A1 milk production stream (Toner 2007).

U.S. companies interested in pursuing A2 milk production as a niche market will face challenges, considering that The a2 Milk Co. has already secured 11 U.S. patents, which protect cattle genetic testing and A1-free marketing claims. Until 2034, The a2 Milk Co. will have active U.S. patents (Hoard's Dairyman 2014). Several farms, however, already promote that their milk would contain high A2 levels and educate consumers about the different beta-casein forms. Yoder Farm, which is a Pennsylvania farm that markets Golden Guernsey milk, describes a high A2 beta-casein concentration as a benefit of its Guernsey milk (Yoder's Country Market 2014). Cedar Summit Farm explains that its breeding efforts have emphasized producing milk with high A2 beta-casein levels (Cedar Summit Farm 2014).

4.11 Agritourism

Agritourism allows value-added dairies to further differentiate their farms and brands. At farms, dairy producers may choose to add pumpkin patches, corn mazes, farm tours, hayrides, farm admission or a "haunted woods" to their agritourism offerings (Wilkins 2012). Other ideas include hosting egg hunts, harvest celebrations, meet Santa holiday parties and Sundae on the Farm events. One New Jersey dairy sponsors a summer dairy day camp. At the camp, each student has a calf assigned to them, and throughout the camp experience, students are responsible for naming their calves, caring for them and learning to show them. Campers also have the opportunity to make dairy products such as ice cream, butter and milk paint; participate in hayrides; and milk a cow. During 2013, cost for a five-day camp was $425, and a three-day camp cost $300 (Epstein 2013).

Agritourism development is possible for processors, too. For example, a farmstead cheese company in Point Reyes, Calif., opened a culinary center on the farm. Using this center, the farm planned to provide farm visitors with tours and create space for cheese-making classes and other on-farm events. In areas where multiple farms produce cheese, the farms can collectively promote themselves by creating a "cheese trail" that brands the area as a cheese destination. Attracting consumers to dairy farms that produce cheese is similar to the approach taken by wineries that encourage consumers to visit the production location and sample the product (Worthen 2011). In New York, Byrne Dairy planned a 10,000-square foot agritourism center dedicated to teaching visitors about the dairy industry and agriculture. The center, planned for Cortlandville, N.Y., would provide a cow-milking viewing area, offer yogurt facility tours and include a yogurt-tasting bar (Groom 2012)

Opening a farm to the public through agritourism efforts requires some special considerations. For example, dairies would need to address parking, signage, crowd control and liability insurance. Because agritourism involves interaction with on-farm guests, producers must enjoy interacting with people, and they need to have the extra time to dedicate to the agritourism operation and not ignore the dairy operation itself (Wilkins 2012).

4.12 Protein

Despite most North Americans not being protein-deficient, consumers have interest in protein. Consumers use protein-rich products to manage weight; complement their active lifestyles; adhere to a Paleo diet; prevent losing muscle mass; support their immune systems, bones and joints; and improve muscle strength and tone. Interest in protein varies somewhat by lifestage. Protein tends to rank most important with 18- to 34-year-olds and consumers older than 65. In the year that preceded March 31, 2014, 6 percent of newly launched U.S. food and beverage products included a "high-protein" or "source-of-protein" message (Bizzozero 2014).

Based on a 2013 study from The NPD Group that surveyed adult primary grocery shoppers, most consumers recognize that "protein contributes to a healthy diet." Seventy-eight percent of the survey respondents indicated that they agreed with that statement. A relatively small niche group of consumers seek protein content information when they shop. However, when consumers incorporate protein into their diets, the survey results also indicated that "many are looking beyond the usual sources" (The NPD Group 2014).

Despite dairy products like milk, Greek yogurt and cheese being protein sources, most consumers don't collectively consider consuming dairy items to be the best way to get protein. Based on The NPD Group survey from 2013, half of consumers identified animal protein – this includes beef, chicken, fish, turkey, pork, ham, lamb, shellfish and bacon – as the best protein source. Of the various animal proteins, consumers thought that beef and chicken were the best sources for protein. Only 10 percent of the respondents indicated that dairy would be the best protein source (The NPD Group 2014). That said, "existing and novel dairy-based" protein has opportunity, according to an Innova Market Insights representative (Bizzozero 2014).

Several recent dairy product introductions have centered on protein. For example, Dean Foods piloted its TruMoo Protein Plus beverage in the West, but in September 2014, it announced that it would initiate a national launch for the product. Chocolate and vanilla flavors will be available. The product's promoted for not only its protein content but also for delivering calcium. Dean Foods makes the product with real, artificial growth hormone-free milk. TruMoo Protein Plus also doesn't include high-fructose corn syrup (Refrigerated & Frozen Foods 2014).

As another dairy protein drink, Core Power is "a high protein recovery shake" innovated by a dairy cooperative leader. Some protein shakes start as water that's later supplemented with protein and milk powder. Alternatively, Core Power production involves filtering milk and concentrating the protein and mineral content. Available in regular-calorie and reduced-calorie products, Core Power offers chocolate, vanilla, banana and strawberry banana flavors. In April 2012, Coca-Cola started distributing Core Power on a limited basis and later expanded to national distribution (Cross 2013).

In November 2014, Coca-Cola announced that it would launch Fairlife milk during December 2014. The Fairlife product trialed in Minneapolis, Denver and Chicago and experienced an "amazing" response (Astley 2014). Positioned as a premium milk, Fairlife will differ from traditional commodity milk because it undergoes a cold-filtered process that yields a final product with 50 percent more protein, 30 percent more calcium and 50 percent less sugar. Additionally, Fairlife doesn't contain lactose or added protein (Peterson 2014). Exhibit 4.12.1 shows the product's packaging. Priced twice as high as commodity milk, Fairlife milk will be packaged as 2 percent, skim and chocolate varieties

(Astley 2014). Dairy Management Incorporated has supported the product through a partnership that aims to improve the state of the fluid milk market (Meyer 2014). Coke's goal is to grow Fairlife into the milk equivalent of its Simply juice product line, which is positioned as a healthy juice that hasn't been frozen or had sweeteners added (Peterson 2014). With the same patented filtration process that leads to the Core Power beverage, the brand's expected to expand into products like smoothies, breakfast drinks, afternoon snacks and yogurt in the future (Cross 2013).

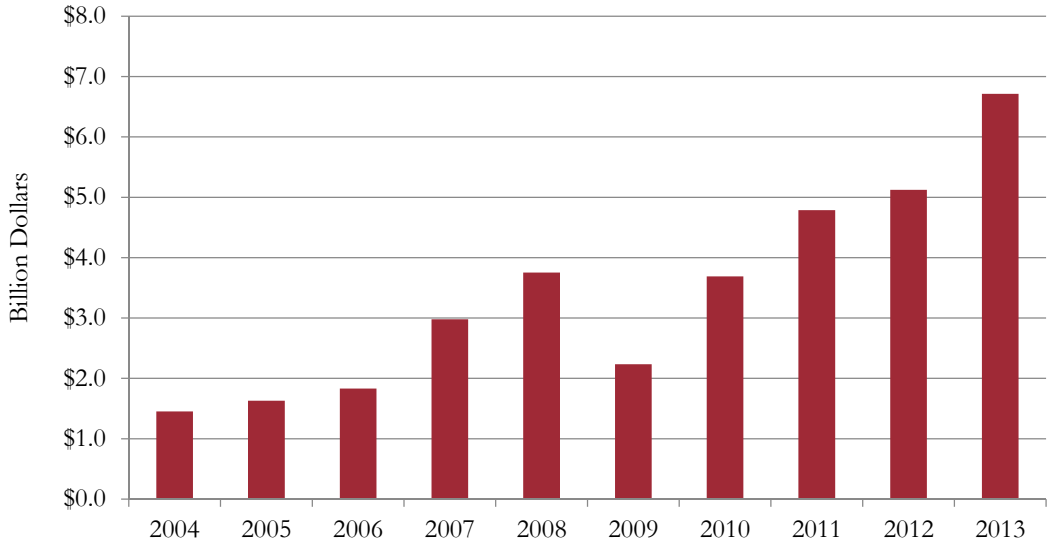
Exhibit 4.12.1 – Fairlife Milk Packaging

Source: Brownfield Ag News (Meyer 2014)

4.13 Exports

Dairy product exports are a potential niche market as foreign countries increase milk and dairy demand and seek to diversify their dairy supply. Exhibit 4.13.1 presents the growth in U.S. dairy product export value from 2004 to 2013. Dairy product export value increased more than four times during the observed period. Export value increased more than $1.5 billion between 2012 and 2013 alone. Some states are more significant contributors to total U.S. dairy product export value than others. During 2013, California added the most value – nearly 40 percent of the total – to U.S. dairy product exports. Other top states for dairy product export value were Texas, Wisconsin, Washington and Idaho. Missouri dairy product export value, which exceeded $50.7 million during 2013, caused the state to rank 20th of all states' export value (USDA Foreign Agricultural Service).

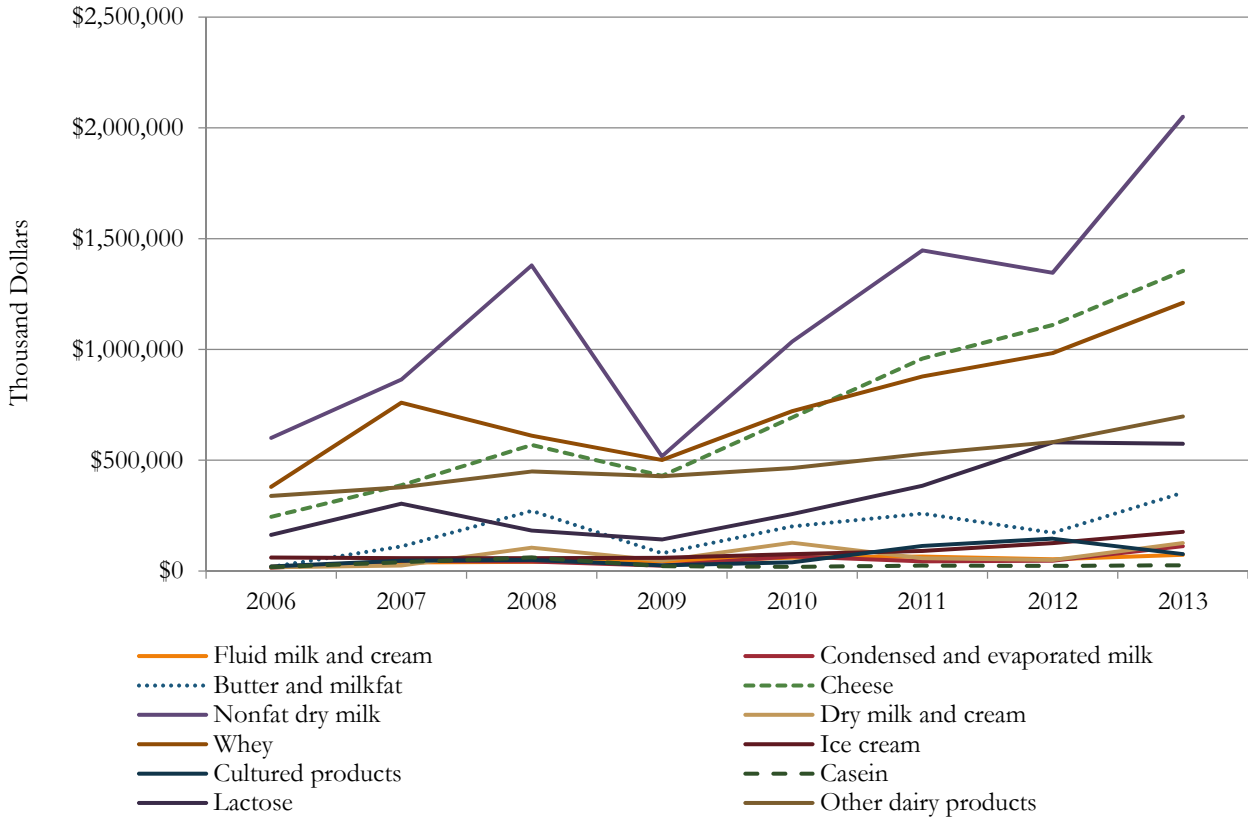
Exhibit 4.13.1 – Trend in U.S. Dairy Product Export Value, 2004 to 2013



Source: USDA, Foreign Agricultural Service, Global Agricultural Trade System

By value, U.S. dairy product exports have been greatest for nonfat dry milk, cheese and whey. During 2013, U.S. nonfat dry milk exports exceeded $2 billion. For cheese and whey, their export values totaled $1.35 billion and $1.21 billion, respectively. Of all dairy products exported during 2013, nonfat dry milk represented 30 percent of the total export value. The shares of total export value were 19.8 percent and 17.7 percent for cheese and whey, respectively. Exhibit 4.13.2 illustrates the change in dairy product export values from 2006 to 2013. During that time, export value growth was greatest for nonfat dried milk, cheese and whey. Note that casein, fluid milk and cream and cultured product exports contributed little to total U.S. dairy exports in 2013. Their shares of total 2013 U.S. dairy export value during 2013 were 0.4 percent, 1.1 percent and 1.1 percent, respectively (U.S. Dairy Export Council).

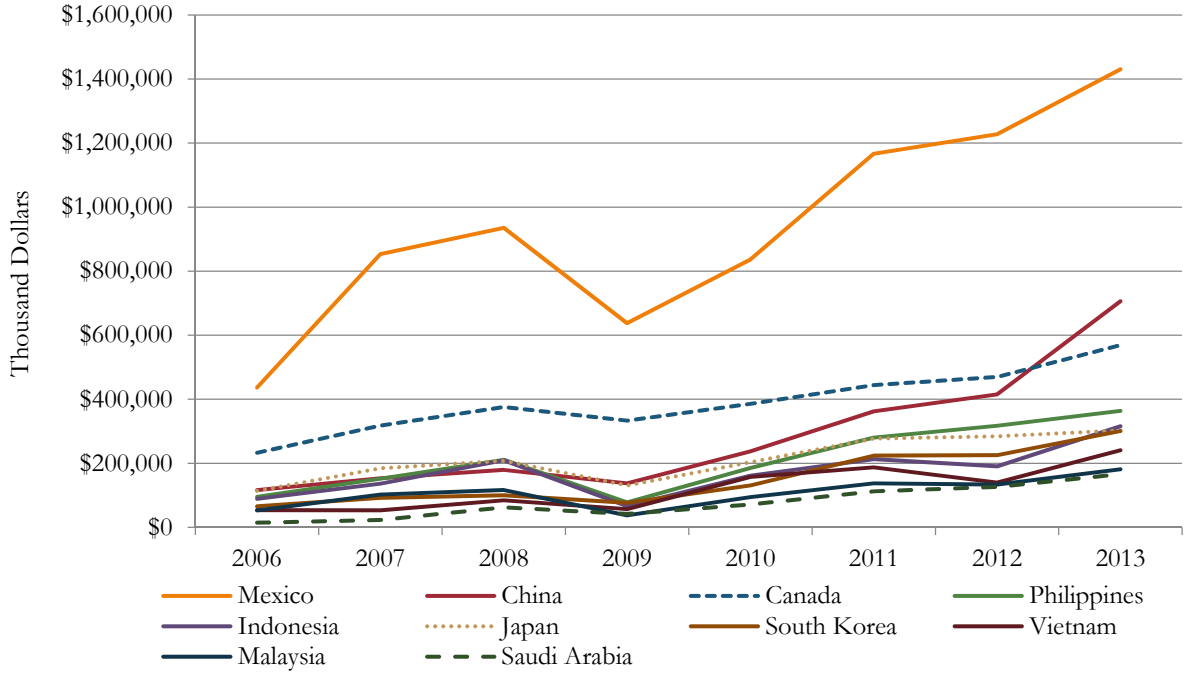
Exhibit 4.13.2 – U.S. Dairy Exports by Product Category and Export Value, 2006 to 2013



Source: U.S. Dairy Export Council

Historically, Mexico and Canada have been the primary importers of U.S. dairy products. However, within the past few years, China has emerged as a major export market. Exhibit 3.7.3 illustrates the trend in dairy product export value to the top 10 countries doing business with U.S. exporters. During 2013, Mexico, China and Canada ranked first, second and third, respectively, for U.S. dairy imports by value. Other top countries for U.S. dairy product exports in 2013 were the Philippines, Indonesia, Japan, South Korea, Vietnam, Malaysia and Saudi Arabia. Thus, seven of the top 10 countries are located in Asia. The types of U.S. dairy products being imported varies by country. For example, by value, Mexico imports a lot of nonfat dry milk with less than 1.5 percent fat and cheese. Nonfat dry milk with less than 1.5 percent fat is also the leading U.S. dairy export to China by value, but China also buys a lot of whey products (USDA Foreign Agricultural Service).

Exhibit 4.13.3 – U.S. Dairy Exports by Importer and Export Value, 2006 to 2013



Source: USDA, Foreign Agricultural Service, Global Agricultural Trade System

In November 2014, Dairy Farmers of America and Inner Mongolia Yili Industrial Group, which is based in China, announced a milk powder facility partnership. Dairy Farmers of America would provide $70 million in financing, and Inner Mongolia Yili Industrial Group would provide $30 million in financing. The facility would have capacity to annually produce 88,000 tons of milk powder. The plant's positioned to serve growing export markets, including China (Everly 2014). In April 2014, Dairy Farmers of American opened a Nevada facility that produces whole-milk powder for export. At the time, no other U.S. plant had a whole-milk powder specialization. Nonfat milk powders commonly produced at U.S. facilities aren't well-accepted in export markets (Martin 2014).

China has potential as a growing export market because a larger population and higher earnings in the country has led to more Chinese consumers choosing milk products (Everly 2014). China itself hasn't produced enough milk, and food safety has been a concern within the country (Martin 2014). Although China has historically sourced a majority of its dairy imports from New Zealand, depending too heavily on one country creates a problem if that country experiences a shortage. For example, a New Zealand drought in 2013 led to challenges in meeting demand (Everly 2014).

As more countries grow their populations and disposal income, they'll likely be positioned to consume more dairy. Vietnam is an example. The country is on the cusp of growing its foodservice sector. U.S. fast-food companies such as McDonald's, Burger King and Pizza Hut have already entered the market. As Vietnamese consumers patronize these fast-food outlets, consume cheese-containing products and acquire a preference for cheese products, Vietnam will require more cheese. Already, for the past eight years, Vietnam has increased its cheese imports annually by 17 percent on average (Hollister 2014).

4.14 Marketing by Species

In addition to marketing cow's milk and products processed from that milk, producers may consider producing and marketing milk from other dairy species as a niche opportunity. Goat milk is an example. Compared with alternatives, goat milk has higher protein levels and lower cholesterol content, and generally, consumers can digest it easily. Popular dairy goat breeds include Alpine, LaMancha, Nubian, Oberhasli, Saanen and Toggenburg (Geisler and Huntrods 2013). On Jan. 1, 2014, Missouri producers had 9,300 milk goats in inventory, and the U.S. inventory totaled 355,000 milk goats. Thus, Missouri represented just 2.6 percent of the country's dairy goat inventory (USDA National Agricultural Statistics Service).

Goat milk may be processed into products such as cheese, yogurt and ice cream. Commonly produced goat cheeses include feta, gjetost, chabichou and pyramide (Geisler and Huntrods 2013). Goat cheese works well when packaged as small-format products. In fresh varieties, goat cheese may be complemented with added oils or herbs, or the cheesemaker may wrap the cheese in leaves. Aging small-format goat cheese produces a smooth interior and more savory flavors (Dickerman 2011). To produce an appealing low-fat ice cream, using goat milk may be an opportunity. When The Wall Street Journal tested three vanilla ice creams, the Laloo's Goat's Milk Ice Cream Co.'s version prevailed over a full-fat option from Ben & Jerry's and a light option from Haagen-Daz. Although the goat milk version may be more appealing, it also cost more (Lieber 2006).

From a marketing perspective, the U.S. may have more opportunities to produce goat milk products because it sources more than half of the goat cheese that it consumes from abroad. France is the most significant supplier. However, because goat milk production is seasonal, reliably supplying products to distribute year-round may be a challenge. To reach consumers, goat dairies may consider direct marketing, farmers markets, internet sales, presence in retail stores or restaurant sales (Geisler and Huntrods 2013).

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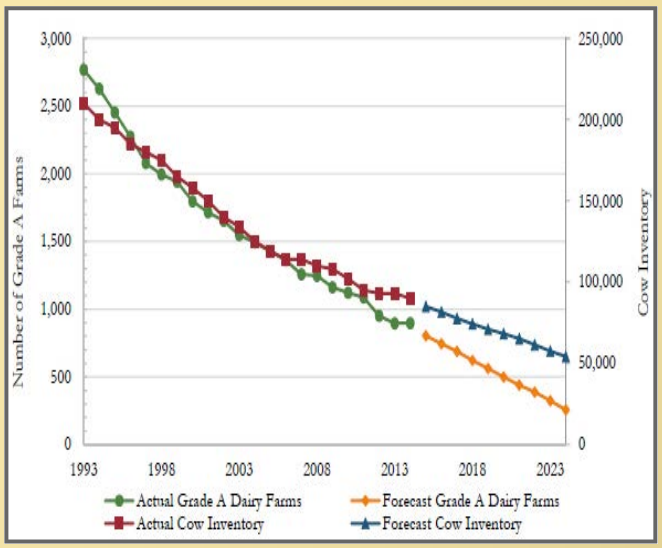

Missouri Dairy Industry Revitalization Study

Section 5:

Comparative Analysis to Identify Gaps

UNIVERSITY OF MISSOURI
Extension
Commercial Agriculture Program

Missouri Dairy Industry Revitalization Study –
Section 5: Comparative Analysis to Identify Gaps

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Teng Lim	Agricultural Engineer, Commercial Ag Program, MU Extension
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Other publications from this study include:

Executive Summary
A comprehensive overview of the overall Missouri Dairy Industry Revitalization study.

Section 1: Historical Perspective
Section 1 provides an in-depth discussion about Missouri's dairy industry historical trends concerning its dairy cow inventory, farms, production, prices, production economics and processing industry.

Section 2: Economic Contribution
Section 2 discusses what the economic contributions such as jobs, value-added and industry sales are from Missouri dairy farms and the Missouri dairy product manufacturing industry.

Section 3: Needs Assessment
A survey was conducted in fall 2014 to Missouri Grade A dairy farms and industry stakeholders. This survey was intended to gather their perspectives on producers' needs and characteristics of Missouri dairy farms. Section 3 provides a summary of all survey responses received.

Section 4: Value Chain, Marketing and Processing
Section 4 provides a discussion about dairy product demand and current opportunities to enhance the farmer's position in the value chain. Further processing opportunities and dairy niche marketing are discussed in this section.

Complete copies of all publications can be found at http://dairy.missouri.edu/revitalization/.

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Missouri Dairy Industry Revitalization Study
Section 5: Comparative Analysis to Identify Gaps

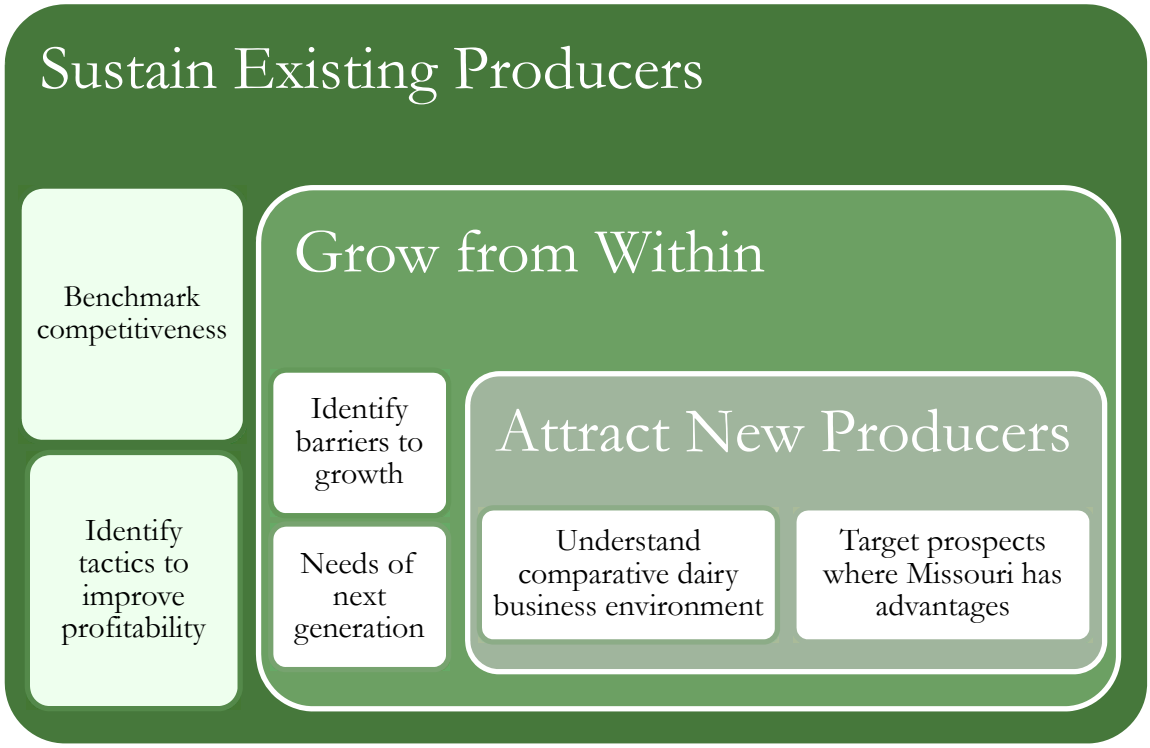
Table of Contents

1. Competitiveness of Missouri's Dairy Industry

This purpose of this report is to help create a common understanding of the Missouri dairy industry's competitive position, benchmark Missouri's dairy industry and environment against other states and look at ways that other states have attempted to revitalize their dairy industries. Thousands of jobs and hundreds of millions of dollars of economic impact in the dairy production and processing industries depend on profitable milk production.

Improving Missouri's dairy industry competiveness is important to all stakeholders. For existing producers, benchmarking against other producers helps to identify areas needing improvement, as shown in Exhibit 1.1. For producers who would like to expand or for next-generation producers, understanding growth barriers in Missouri is important. For all the stakeholders allied to the dairy industry, understanding how Missouri compares to other states trying to attract new dairies is important. For Missouri to sustain a dairy industry, all producers will be needed: existing producers, next-generation producers and new dairy farmers recruited from outside of the state.

Exhibit 1.1 – Roadmap to Improve Missouri's Dairy Industry



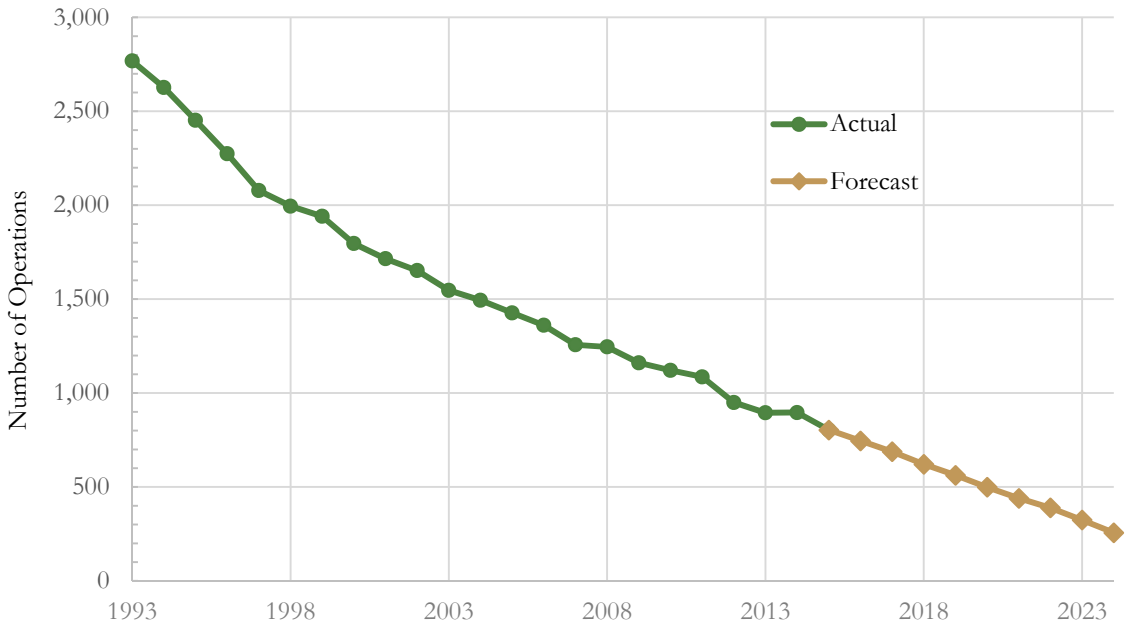
1.1 Missouri Dairy Trends and Forecast through 2024

This examination of the Missouri dairy industry's relative competitiveness begins with the simplest of measures, an examination of farm numbers and cow numbers from the past 22 years. Since 1993, the number of Grade A dairy farms in Missouri has dropped at a 5.3 percent annual compound rate. Exhibit 1.1.1 depicts the number of Grade A dairy operations in Missouri since 1993, and based on past data, it forecasts the number of dairy operations in Missouri through 2024.

Assuming that this trend continues, Missouri is forecasted to drop from 896 Grade A dairies in 2014 to 257 Grade A dairies at the end of 2024. To maintain the state's current cow numbers and, thus, continue to support the current dairy processing industry with the same amount of milk, the average dairy farm in 2024 would need to milk approximately 350 cows, assuming the same milk production per cow as of today.

Consolidation in agriculture is familiar to industry observers. Fewer, larger farms have been the trend in the U.S. for decades across most commodity sectors. Still, the stark and steady nature of long-term trends adds perspective to the competitive challenge faced by Missouri's dairy industry.

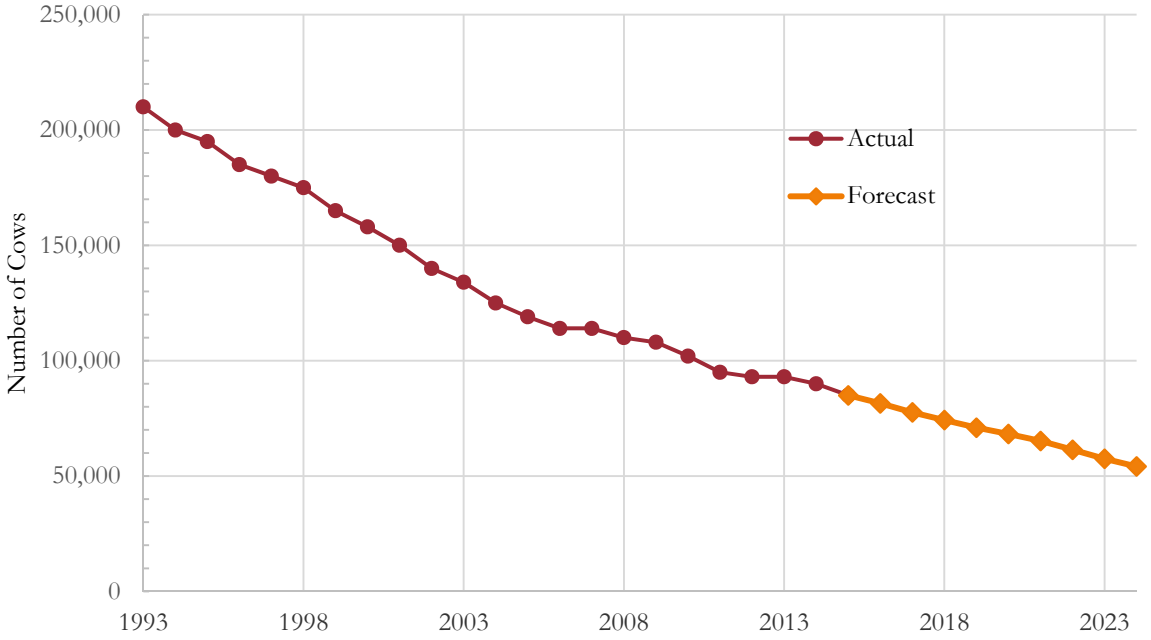
Exhibit 1.1.1 – Missouri's Grade A Dairy Operations, 1993 to 2014 and Forecast through 2024



Source: Derived from USDA National Agricultural Statistics Service Data

The number of dairy cows in Missouri also has trended downward, but at a slower trajectory. Since 1993, the number of dairy cows in the state declined at a 3.8 percent annual compound rate, as shown in Exhibit 1.1.2. If the trend of the past 22 years continues for the next 10 years, then Missouri's 2024 dairy industry will involve 257 Grade A dairies that milk 54,166 cows, and herd size would average 195 cows. In 2014, Missouri's dairy cow inventory totaled 90,000 cows.

Exhibit 1.1.2 – Missouri's Dairy Cow Numbers, 1993 to 2014 and Forecast through 2024

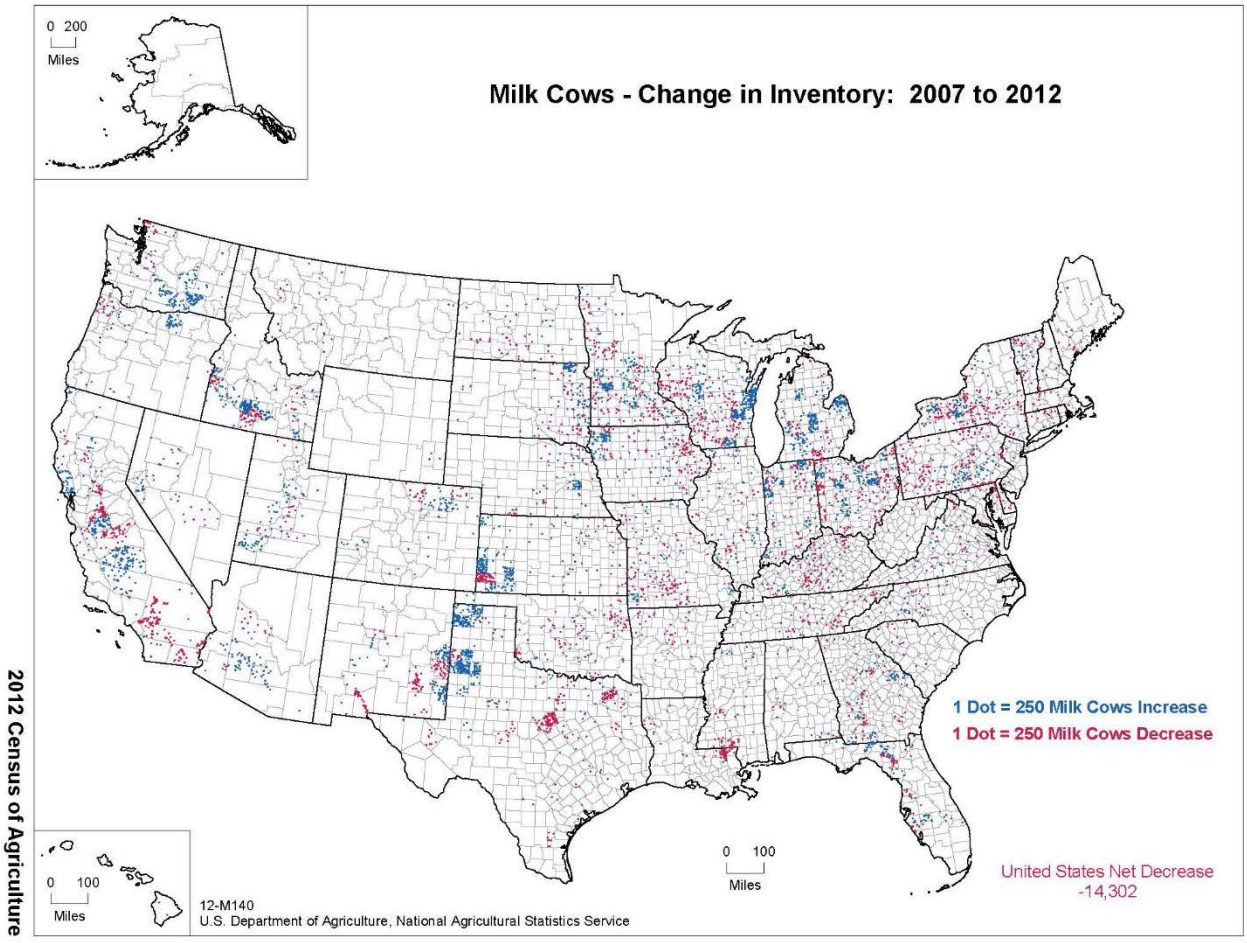


Source: Derived from USDA National Agricultural Statistics Service Data

1.2 Geographic Expansion and Decline in U.S. Dairy Cow Inventory

Exhibit 1.2.1 depicts a map of the growth and decline of dairy cow inventories between the 2007 USDA Census of Agriculture and the 2012 USDA Census of Agriculture. Two obvious questions are where is the industry growing, and what contributes to growth in those areas? Blue dots represent growth in 250-cow increments, and red dots represent decline in 250-cow increments. Areas of strong growth can be seen in pockets across western Texas; southwestern Kansas; and then north through northwestern Iowa, Minnesota, Wisconsin, Idaho, Washington, California and Michigan. In the southeast, pockets of growth appear predominantly in Georgia and Florida.

Exhibit 1.2.1 – Map of Changes in Dairy Cow Population between 2007 and 2012



Source: USDA Census of Agriculture

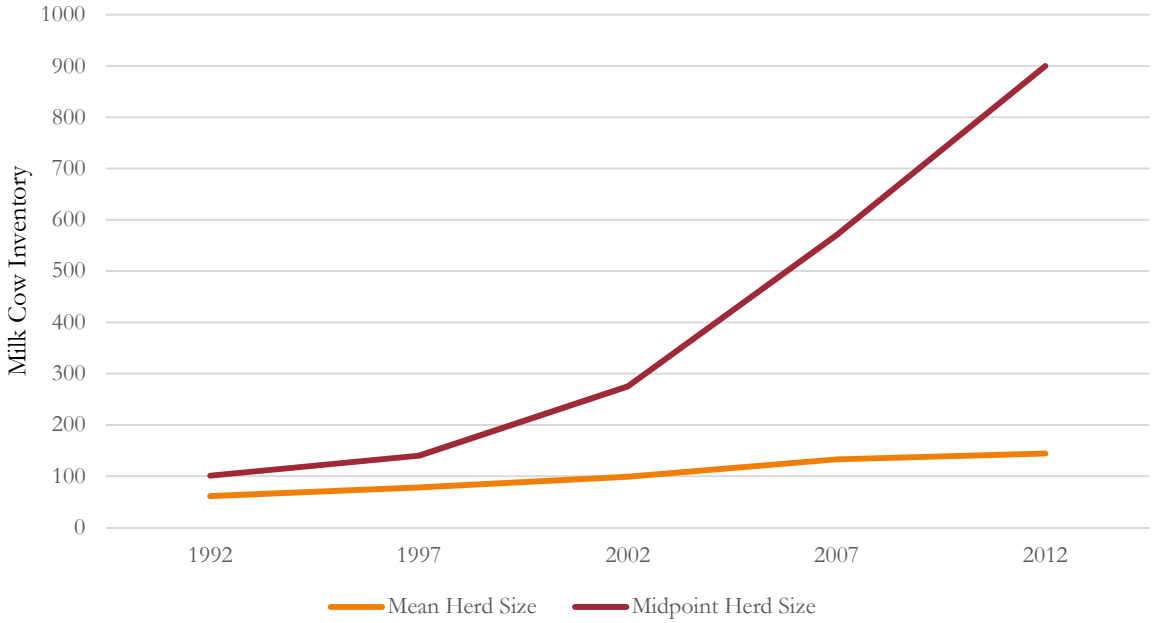
Within Missouri, a careful examination of the map for growth pockets reveals blue dots attributable to the New Zealand grazing dairies in southern Missouri as well as pockets of growth in Mennonite communities near Versailles and Memphis, Mo. A sprinkling of additional dairy growth was recorded in west central Missouri and north central Missouri. Declining dairy pockets in Missouri are centered mostly in the Ozarks, predominantly in the south central portion of the state. These areas have traditionally been the most dairy-dense areas of Missouri.

1.3 Changing Economies of Scale in the U.S. Dairy Industry

According to the USDA Economic Research Service, as shown in Exhibit 1.3.1, "The mean herd size of dairy operations rose from 61 cows in 1992 to 144 in 2012, but that shift understates the nature of the change in dairy production; most cows are now on farms that are much larger than the mean. The midpoint farm size is used to track cows; the midpoint shows the herd size at which half of all cows are in larger herds and half are in smaller herds. In 1992, the midpoint of 101 cows was not much larger than the mean, reflecting the fact that most cows were on small and mid-size dairy farms. However, the midpoint rose sharply over the next two decades, to 900 cows by 2012, over 6 times larger than the mean herd size" (MacDonald and Newton 2014).

"The shift to larger dairy farms is driven largely by the economics of dairy farming. Average costs of production, per hundredweight of milk produced, are lower in larger herds, and the differences are substantial. These costs include the estimated costs of the farm family's labor as well as capital costs, in addition to the cash expenses that are included under operating costs" (MacDonald and Newton 2014).

Exhibit 1.3.1 – U.S. Milk Production Shifting to Larger Herds



Source: USDA Economic Research Service

1.4 Emerging Consumer-Driven Expectations

Dairy producers traditionally have considered milk quality to be determined by somatic cell counts (SCC) and bacteria counts. In recent years, however, consumer expectations have started to drive additional changes. Consumers want to know that dairy products are safe, wholesome and nutritious and that animals receive the highest level of care.

Increasingly, consumers and branded food companies are requiring third-party verification that the milk they are buying is produced in a suitable manner. Because of deferred maintenance and labor scarcity, some Missouri dairy farms find it challenging to meet these increasingly stringent standards.

Milk cooperatives through the National Milk Producers Federation created the FARM Program (Farmers Assuring Responsible Management) to begin the audit process with producers to identify problem areas. As standards become more mandatory and stringent, some producers may lose their existing marketing channels unless they can adapt. Further information about this program can be found on the web at http://nationaldairyfarm.com/.

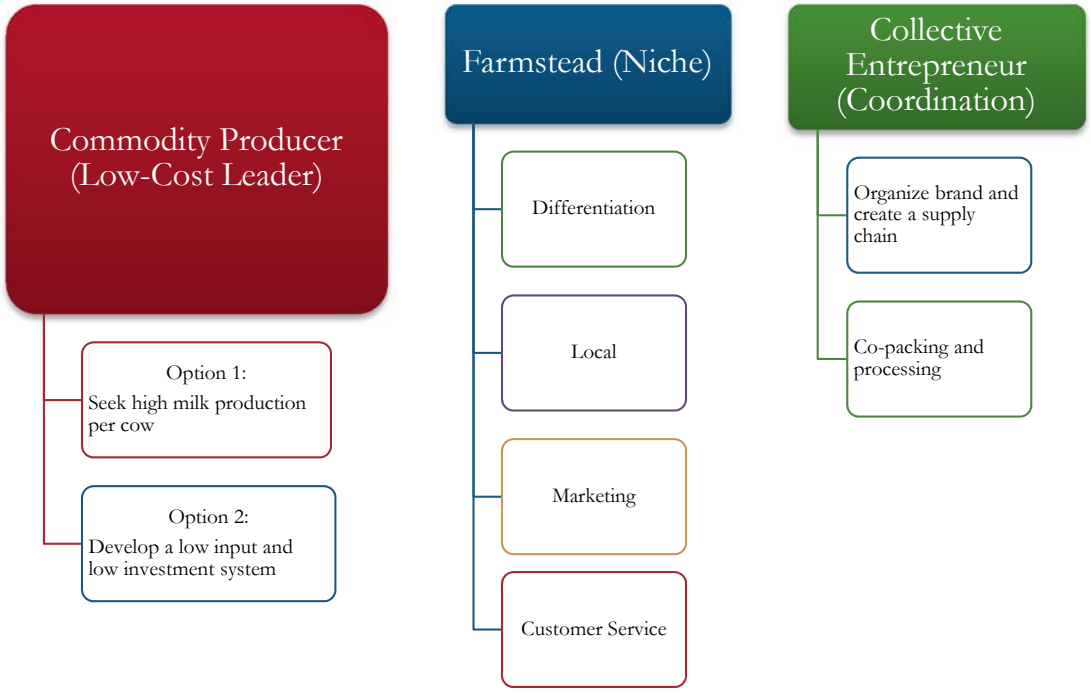
1.5 Missouri Dairy Industry Environment

It is important to understand the current environment for the Missouri dairy industry. The first step is to examine threats and opportunities within the external environment that influence the Missouri dairy industry. The second step is to understand strengths and weaknesses within the internal environment that affect the Missouri dairy industry. By analyzing these characteristics, dairy industry stakeholders and producers can look at ways to take advantage of opportunities and minimize threats by utilizing strengths and overcoming weaknesses. Threats, opportunities, weaknesses and strengths are examined for the Missouri dairy industry in Exhibit 1.5.1.

Exhibit 1.5.1 – Missouri's Dairy Industry Environment

After examining the Missouri dairy industry environment, it is important for Missouri dairy producers to choose the way they position their operations in the future. Strategic positioning is a way to determine strategic options that have potential to lead to long-term success (Boehlje et al. 2004). It seeks to provide fundamental direction and can shape farmers' ability to create value for customers and develop a long-term competitive advantage. Exhibit 1.4.2 identifies three general strategies that dairy producers can pursue. Each option must be examined by producers to align with their core competencies. Typically, dairy farmers will seek to emphasize one position that offers them a firm competitive advantage relative to other producers operating in the same industry.

Exhibit 1.4.2 – Missouri Dairy Producer Strategic Positions



Commodity dairy producers seek to use the "low-cost leader" strategic position. A majority of the existing dairy industry has this position. Dairy farms in the commodity producer category can seek to spread their investment costs over an appropriate volume of milk either by achieving high milk production per cow or milking more cows. Option one is to seek high milk production per cow, consistent with the long term evolution of the U.S. dairy industry. Option two is to develop a low-input system epitomized by the emerging seasonal grazing dairies in Missouri.

Some dairy producers could position or differentiate themselves in a farmstead niche market. Producers could seek to capture extra value by processing their milk into various dairy products and selling their dairy products to a targeted consumer base. This is a small market, but it provides opportunities to capture considerable value by offering attributes such as differentiated/innovative products, high quality, local foods, innovative marketing and/or great customer service. Other dairy producers could become collective entrepreneurs and coordinate by developing unique marketing channels. Developing a new brand and supply chain is an opportunity to participate in the marketplace and can offer a competitive advantage compared with others in the industry.

1.6 Tactics to Improve Profitability on Existing Missouri Dairy Farms

Improving profitability for Missouri's dairy farmers is a key to sustaining the industry. When asked what dairy producers needed to be more successful in a fall 2014 survey of all Grade A dairy producers in the state, the top need identified among 276 responding producers was higher milk prices and profit margins. In a commodity business where producers are price takers, there are two basic strategies for improving profitability: **1) increasing production efficiencies** and **2) increasing the scale of new or existing dairy production operations.**

The first strategy is for the Missouri dairy industry to retool and reinvest in the existing on-farm infrastructure. This reinvestment must incorporate modern dairy production facilities and concepts with technologies that complement dairy operation management. When investments in technology complement management objectives, viable opportunities to improve operational profitability result. The second strategy is to gain the benefits of efficient management of scale. Both strategies can lead to higher labor efficiency. Labor was the No. 1 challenge expressed in the 2014 Missouri survey when dairy farmers answered the question, "What is the greatest challenge on your dairy farm?"

Existing dairy production operations must invest in appropriate production technologies and implement management techniques that complement these technologies. Investing in appropriate technologies and implementing the complementary management techniques that match the particular dairy production system allow producers to improve their competitive position, increase milk production per cow regardless of the system, lower feed costs and increase profit margins.

New dairy production operations must incorporate the appropriate technologies during facility design and construction. The new operation will need to implement management techniques that complement the adopted production technologies. The following eight tactics identify specific methods for Missouri dairy producers to determine the technology areas and complementary management techniques needed to be incorporated into existing operations to accommodate the benefits of the two strategies mentioned above.

Tactic 1: Reduce summer heat stress.
Tactic 2: Address better care for replacement heifers.
Tactic 3: Focus on forage quality.
Tactic 4: Improve milk quality.
Tactic 5: Strive for better cow comfort in housing.
Tactic 6: Improve dry matter intake.
Tactic 7: Focus on better reproductive management.
Tactic 8: Develop economies of scale.

Following is an explanation of each tactic. The explanation includes a brief description, improvement possibilities and action steps to overcome the problem.

Tactic 1: Reduce Summer Heat Stress.

Milk production, due to summer heat stress in lactating cows, declines when systems to cool cows are not installed or operated effectively. Milk production reductions due to heat stress are expected in dairy herds with averages of 40 or more pounds of milk per cow per day. Dairy herds that experience decreased milk production during hot weather have a heat stress problem and will benefit from heat-reduction strategies. Heat stress can reduce milk production by 20 to 25 pounds per cow per day depending on the herd's cool weather production level. High-producing herds will normally experience the greatest production declines if heat-reduction strategies are not implemented.

Improvement Possible:
Milk production losses from heat stress can easily reach 25 pounds of milk per cow per day (or more in severe circumstances on very high producing farms). During a 120-day hot weather period, lost milk production of 3,000 pounds per cow may be realized. This calculates an income loss of $570 per cow when the milk price is $19 per cwt. Heat stress will also contribute to depressed cow health and poor reproductive performance. Heat stress is common in Missouri. Based on hourly data from 2009 to 2013 for Joplin, Missouri, 6 percent of the time dairy cows would experience moderate/severe stress (80 to 90 temperature humidity index (THI)) and 17 percent of the year they would experience mild/moderate stress (72 to 79 THI).

Action Steps to Fix the Problem:
Heat stress reduction will not increase milk production above cool weather production levels. Heat stress reduction allows a herd to maintain production during hot weather. Milk production inputs such as forage quality, dry matter intake and access to a quality ration must be properly managed to realize the benefits from heat stress reduction. Actions steps include:

Drinking Water Access
Inadequate drinking water access will depress water consumption and result in depressed milk production. Drinking water should always be available in cow feeding and resting areas. Waterer space should allow up to one-third of a cow group to drink at one time. Drinking water access should be located near the exit of the milking parlor and be large enough to allow one parlor exit group to drink at one time. Providing drinking water near a milking parlor's exit can increase milk production per cow up to 4 pounds per day.

Shade
Shade should be provided over the feed bunk, holding pen and cow resting areas. Shade blocks the sun's rays and reduces cow heat stress. Without access to shade, cows are hot and experience greater milk production declines than those recorded in cows with shade access.

Installation of Fans and Sprinklers
When outside temperatures exceed 80°F to 90°F, fans that provide supplemental air movement and sprinklers that enable increased evaporative cooling should be operated. Fans and sprinklers should first be installed in the holding pen area followed by the feeding and resting areas. An increase of 5 pounds of milk production per cow per day during the summer heat period will quickly pay the cost of purchase, installation and operation of good fans and sprinklers. Dairy operations that effectively incorporate heat stress reduction strategies,

provide quality feed rations, and ensure water access should experience only minimal milk production declines due to heat stress.

Tactic 2: Address Better Care of Replacement Heifers.

The Missouri Dairy Herd Improvement Association (DHIA) reports that the average age at first calving for Missouri dairy herds is 26.8 months. The primary factor contributing to inadequate heifer growth was a failure to provide sufficient high-quality forage rations to maintain the heifer's desired growth.

Improvement Possible:
Life-time milk yield, 305-day lactation yields and life-time profit of replacement heifers are maximized when heifers calve for the first time at 22 months to 24 months.

Heifers that calve at ages older than an average of 24 months cause the following:

- Decreased heifer productive life, which delays returns of income from milk sales.
- An increased inventory of replacements needed to maintain herd size. As age at first calving and/or cow cull rate and/or calf mortality decrease, fewer animals are required to maintain herd size. Surplus replacements can be used for herd expansion or sold for added revenue. Assuming a given cull rate and a 0 percent calf mortality rate, each month added to the 24 months for first calving of replacement heifers will increase required heifer inventory by approximately one heifer per 100 cows to maintain herd size.
- Greatest increases in 305-day lactation yields are seen in replacement heifers calving for the first time between 20 months to 26 months of age.
- Heifers ideally calve at 22 months to 24 months of age, and they should be at least 85 percent of their mature weight and the correct height for their breed.

Action Steps to Fix the Problem:

- Provide adequate bunk space and bunk management to provide access to quality feed.
- Provide adequate access to good quality drinking water.
- Group heifers according to size to avoid disparity in the size of heifers within the group.
- Provide facilities for stress free handling of heifers at critical intervention points.
- Develop and implement a planned breeding program.

Tactic 3: Focus on Forage Quality.

Many Missouri dairy operations do not have a focus on forage quality. They feed the feedstuffs that are "on hand" or buy feed as inexpensively as possible. Harvested forage is not well-preserved. Covers are not installed on bunker silos. Rations often contain moldy forages because of a failure to separate moldy silage from good silage. Low-quality forage reduces dry matter intake due to a gut-fill factor. Milk production is reduced due to the lower dry matter intake and reduced energy available in the feed consumed by the cow.

Improvement Possible:
Feeding 10 pounds of early bloom alfalfa hay with a relative feed value of 150 versus 10 pounds of full bloom alfalfa hay with a relative feed value of 100 would provide an additional 0.5 Mcal of net

energy for lactation. This is enough energy to produce an additional 1.6 pounds of milk worth about $0.30 per cow per day without consideration of any additional results from feeding the better quality alfalfa hay, which would increase dry matter intake. The higher quality alfalfa hay would also be about 4 percent higher in crude protein. The additional 0.4 pounds of protein could replace about 0.8 pounds of soybean meal in the ration at a cost savings of $0.18 per cow per day.

Feeding moldy silage from the top 6 inches to 12 inches of an uncovered bunker or pit silo has been shown to reduce the digestibility of good silage in dairy cow rations. In addition, feeding moldy silage has the potential to introduce mycotoxins and molds. Mycotoxins can create cow health problems and milk rejection resulting in significant financial losses.

Action Steps to Fix the Problem:
Understand the value of producing or purchasing higher quality forage for dairy production rations. Specifically:

- Plant more alfalfa.
- Harvest alfalfa as haylage or baleage in order to avoid the problems associated with drying alfalfa for hay. Harvest alfalfa when the first blooms appear.
- Prioritize corn silage harvest at optimal time, and properly pack and seal bunkers.
- Sample all forages prior to feeding so that rations can be balanced.

Tactic 4: Improve Milk Quality.

Value available in milk through quality is primarily associated with bacteria and somatic cell count (SCC) levels. Bacteria and SCC levels significantly less than the legal maximum are demanded by dairy buyers because they are associated with a high-quality product that has an extended shelf life. Low SCC milk is also associated with higher solids and a greater cheese yield. Improved taste and desired texture of the manufactured product also add value to the milk.

Improvement Possible:
Current 2014 DHIA SCC levels = 338,000 for Missouri versus 263,000 for the U.S.

Action Steps to Fix the Problem:

- Provide a clean dry resting environment for lactating cows. The tactics and/or investments needed for a specific operation depend on current milk quality status and the desired dairy production system.
- Maintain, service, and test milking machines.
- Maintain clean outdoor environments, especially high traffic areas, to promote cleanliness of the cows, particularly during wet conditions.
- Perform good milking hygiene; present clean cows for milking; follow consistent standard procedures, effective milking technique, and effective teat disinfection.

Tactic 5: Strive for Better Cow Comfort in Housing.

For confinement dairies in Missouri, many use freestalls of older design with inadequate dimensions and less than ideal ventilation and bedding.

Improvement Possible:
Increased cow comfort removes the facilities' constraint on expressing the cow's genetic potential.

Action Steps to Fix the Problem:

- Open ridge caps to improve ventilation during all seasons.
- Raise natural ventilation capability in warm and hot weather by opening up all sides of barns.
- Remodel/refurbish freestalls to allow for adequate lying and lunge space by replacing loops with modern, cow friendly designs and/or removing center dividers between rows of stalls.
- Lengthen/adjust stall to fit current cows by removing/relocating brisket board and neck rail.
- Move to deep sand bedding, comfort mattresses or compost bedded pack barns.
- Groom (brush or rake) stalls with bedding.

Tactic 6: Improve Dry Matter Intake.

Cows are often fed feedstuffs that are "on-hand." Feed is rated as good by many producers if the cows eat it, and feed that cows don't eat is rated bad. Consider these feed management mistakes:

- Feed bunks may be rarely checked or cleaned out, and old feed is allowed to accumulate and spoil. Spoiled feed in the bunk lowers feed intake.
- Dry matter intakes may rarely be calculated, so many producers do not really know how much feed cows are consuming.
- Many feed bunks are not covered, which exposes the feed to weather elements and allows feed to deteriorate faster in the summer. Feed exposed to the elements will quickly lower in quality and palatability, so cows reduce feed intake.
- Cows fed in open areas exposed to the weather will eat less because cow comfort is lacking.

Improvement Possible
Dry matter intake drives milk production. One additional pound of dry matter intake will result in an increase of 2 pounds to 2.5 pounds of milk produced. One pound of feed dry matter costs about $0.10, and milk price is about $0.19 per pound. Consuming one additional pound of dry matter per day would return about $0.19 to $0.25 per day of added income above feed cost per cow. On a 1,000-cow dairy, reducing shrink by 3 percent could amount to $65,700 a year, based on today's feed prices (Quaife 2011).

Action Steps to Fix the Problem
The following are strategies to increase dry matter intake:

- Provide covered feeding areas.
- Check feed bunks and clean feed not eaten from the feed bunks daily.
- Do not feed moldy feed because it reduces feed consumption and feed digestibility.
- Provide cow comfort facilities and equipment in the feeding area to encourage cows to increase feed intake.

Tactic 7: Focus on Better Reproductive Management.

The estimated average calving interval for Missouri dairy herds exceeds 15.1 months. However, the U.S. national DHIA average is 14.3 months, and many Missouri herds achieve 13.5-month calving intervals. Reproductive management requires basic knowledge about reproduction, heat detection skills, breeding expertise and a plan to ensure that techniques are implemented in a timely manner. Many Missouri dairy production units fail to consistently implement a sound reproductive plan.

Improvement Possible
A direct relationship exists between the calving interval length and the average number of days in milk for dairy herds. Average number of days in milk directly influences the milk volume produced. A 30-day increase in the calving interval results in a 5-pound decrease in the herd tank average or the daily milk production per cow per day. Extended calving intervals also reduce the number of calves produced each year.

Action Steps to Fix the Problem
The goal is to maintain the average number of days in milk for the herd at 180 days. This requires good reproductive management. To achieve this goal, the herd manager and/or herdsman must be skilled in heat detection and breeding and consistently implement his or her chosen reproductive protocol. Sound nutritional management, installation and proper operation of environmental systems that maintain cow comfort and heat stress reduction implementation are essential.

Tactic 8: Develop Economies of Scale.

There are substantial benefits to operational scale. Increasing scale is a major driver to lower costs and increase profitability in the U.S. dairy industry. Dairy operators that learn to manage cattle, technology, labor and risks effectively attract capital and grow.

Financial indicators like "return on assets" and "net farm income per cow" clearly support scale as a method to add profitability to the dairy production industry. Of course, smaller operations efficiently managed with appropriate debt loads and realistic family living expectations can be profitable as well. These smaller operations have traditionally been the mainstay of Missouri's dairy industry and can remain so well into the future.

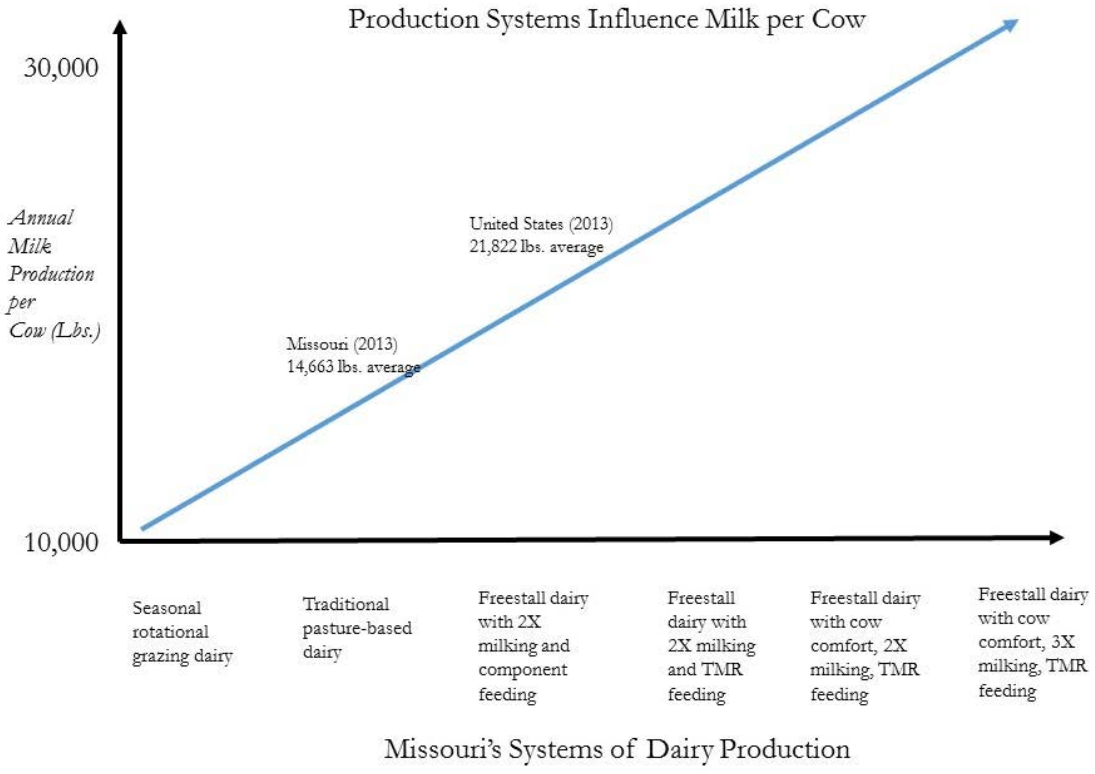
2. Benchmarking Missouri's Dairy Industry

Missouri's dairy industry is an amalgamation of several distinct types of dairy farming. Traditionally, the Ozark region of southwest and south central Missouri, where most of the state's dairies were located, was home to pasture-based dairies. In northern Missouri and counties that bordered the Missouri and Mississippi rivers, confinement or partial confinement dairies evolved. Soil types and cropping potential influenced the systems that dairy producers chose as they developed their operations over decades. In the past two decades, larger confinement farms have begun to appear throughout Missouri, and larger intensive rotational grazing dairies have also developed, mostly in the southern half of Missouri.

2.1 Missouri Production Systems

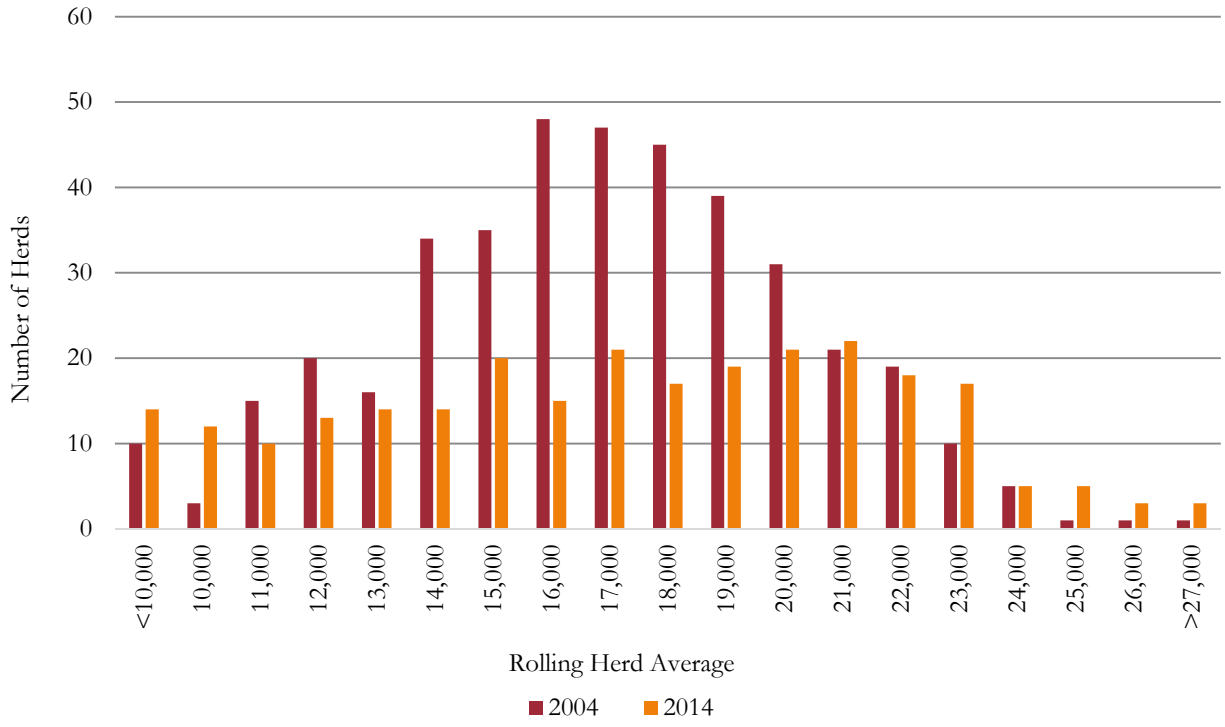
Production system choices impose different limits on milk production per cow. This diversity of systems makes benchmarking Missouri's dairy industry more challenging than simply comparing milk production per cow. However, a careful examination of different benchmarks may be used to reveal Missouri's relative strengths and weaknesses. Exhibit 2.1.1 depicts the annual milk production per cow commonly seen in Missouri and the system of production associated with it, as well as the average production in Missouri and the U.S.

Exhibit 2.1.1 – Common Production Systems in Missouri and Relative Milk Production



Comparing the 2004 and 2014 rolling averages of herds enrolled in DHIA in Exhibit 2.1.2 serves as a proxy indicator of production system changes in Missouri during the past decade. Expressed by an industry observer, one possible explanation of the Exhibit 2.1.2 trend is that Missouri has experienced an industry dividing into two dairy models. During the past decade, the number of rotational grazing dairy producers with rolling herd averages below 14,000 pounds grew. Meanwhile, the number of the state's higher producing confinement herds progressed beyond 20,000-pound rolling herd averages. Between those two production levels, as many as half of the DHIA herds disappeared.

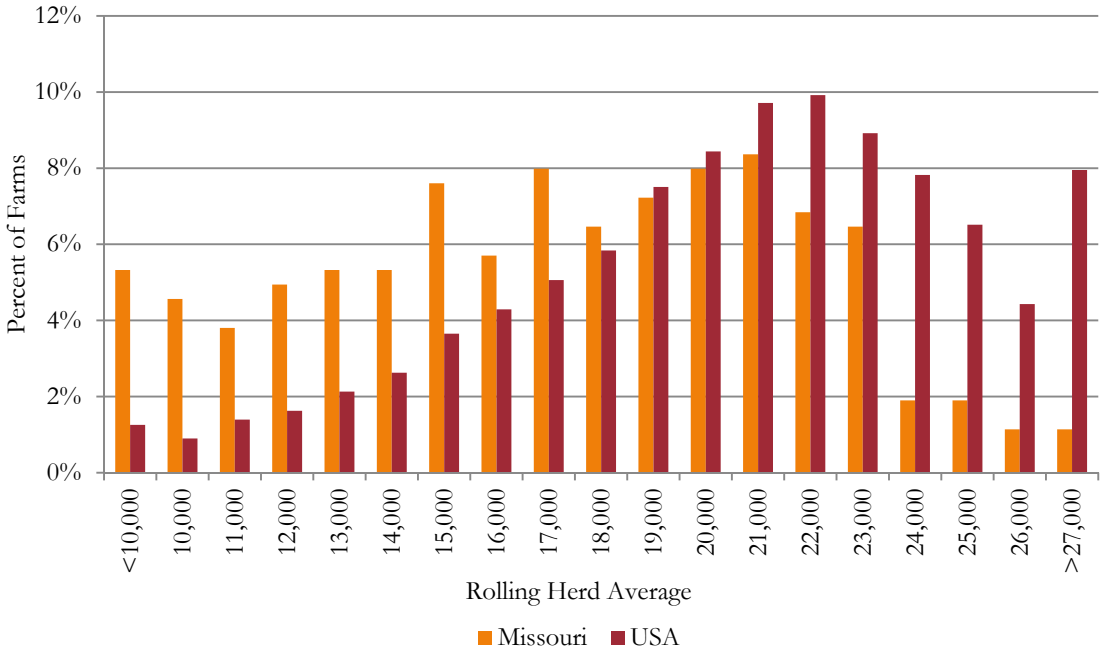
Exhibit 2.1.2 – Missouri DHIA Rolling Herd Averages, 2004 and October 2014



Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

Exhibit 2.1.3 compares the percentage of Missouri DHIA-enrolled and U.S. DHIA-enrolled dairy farms using October 2014 rolling herd averages. Missouri had a different distribution of production levels than the U.S.

Exhibit 2.1.3 – Missouri and U.S. DHIA Rolling Herd Averages, October 2014



Source: Dairy Herd Information Association (DHIA), Dairy Records Management Systems (DRMS)

Further explanations and an analysis of strengths, weaknesses, opportunities and threats (SWOT) of each production system can be found in the following exhibits.

Exhibit 2.1.4 – Seasonal Rotational Grazing Dairy, SWOT Analysis

Operation Description: Lowest milk production per cow typically is seen by the low-input style rotational grazing dairies with at least 50 percent of the cows' annual dry matter intake provided by grazing. These systems depend on labor-efficient parlors milking large numbers of relatively low-producing but fertile cows that calve seasonally with the arrival of the grazing season to achieve profitability.	
Strengths: The focus on micro-managing high-quality pastures results in lower input costs. Emphasis on minimal facilities results in lower investment costs per cow and allows profitability even with lower production levels. Majority of investment is in reproducing cows and appreciating land leads to growth in wealth over time if only minimal profitability is maintained.	**Opportunities:** Missouri has emerged as a national leader in this style of dairying. This clustering effect has attracted new dairy producers from other states and countries. Innovations in forages, crossbreeding, irrigation, and system refinements are widely shared. Opportunity exists to potentially develop value-added markets for "grass-based milk."
Weaknesses: Weather risk, especially drought, can greatly impact the profitability of these dairies. Lack of cow housing limits milk production per cow potential.	**Threats:** U.S. dairy industry continues to evolve toward a higher production per cow model. Rotational grazing dairies do not buy as many inputs and, thus, have less industry interest and vendor technical support. As rotational grazing dairies add inputs to overcome weather risks, they creep toward the cost structures of traditional dairying but with limited upside production potential.

Exhibit 2.1.5 – Traditional Pasture-Based Dairy, SWOT Analysis

Operation Description: This style of dairying predominates in much of southern Missouri in some form. Production per cow is capped by heat stress in the summer, forage quality on set-stocked pastures, component feeding with concentrate in the barn and lack of cow comfort during severe weather conditions.	
Strengths: Traditionally, this has been the most widely used and understood system in Missouri. Existing sunk investments in facilities mean producers continue dairying as long as an operating margin exists. This system has one of the lowest barriers to entry due to existing dairies available to buy or lease.	**Opportunities:** Move toward either rotational grazing systems to lower input costs or toward new generation of confinement facilities to raise production and lower costs per unit.
Weaknesses: With milk production per cow capped by physical limitations, margins have narrowed over time and reduce the capacity to replace capital and make next-generation investments.	**Threats:** Dairies tend to be final-generation businesses in that the smartest business decision for existing middle-aged producers is to not reinvest but instead run the facility until the end of its useful life and then retire and sell farm or switch to beef production.

Exhibit 2.1.6 – Freestall Dairy with 2X Milking and Component Feeding, SWOT Analysis

Operation Description: This style of dairying exists mostly outside of the Ozarks on dairies with less than 100 cows. Production per cow is limited by a lack of cow comfort in older style freestall barns and the use of component feeding.	
Strengths: Widely used and understood system in Missouri outside of the Ozarks. Existing sunk investments in facilities mean producers continue dairying as long as an operating margin exists. Established confinement dairy skill sets allow easier move to higher production systems.	**Opportunities:** Many facilities allow incremental investments into existing facilities and equipment that improve labor efficiency and cow comfort.
Weaknesses: Herd size limits affordability of TMR feeding system and parlor investments necessary to achieve higher milk per cow and labor efficiency.	**Threats:** Existing facilities may be locked into an area that cannot grow herd size due to urban encroachment, rising land prices or county and local restrictions. Producers may prefer to stay with smaller herds so they don't have to hire employees, and this limits the capacity to pay for new investments.

Exhibit 2.1.7 – Freestall Dairy with Cow Comfort, 2X Milking, TMR Feeding, SWOT Analysis

Operation Description: This style of dairying is represented by producers who have reinvested in newer freestalls, fan and sprinkler cooling with adequate ventilation during all weather conditions. Freestalls are large enough for cows to comfortably use (adequate width, length and lunge space) and have bases (beds) that provide adequate cow comfort. Milk production per cow is often limited simply by udder stress caused by only milking two times per day.	
Strengths: All the pieces are in place for high milk production per cow.	**Opportunities:** Move to three times per day milking when labor pool allows.
Weaknesses: Milk production per cow may be limited by udder stress caused by only milking two times per day.	**Threats:** Managing a high-producing herd requires constant attention to detail.

Exhibit 2.1.8 – Freestall Dairy with Cow Comfort, 3X Milking, TMR Feeding, SWOT Analysis

Operation Description: These dairies typically achieve the highest milk production per cow because all efforts are made to maximize cow comfort during all weather conditions.	
Strengths: All the pieces are in place for high milk production per cow.	**Opportunities:** Micromanaging cows with attention to detail and adoption of the latest technologies can unlock the herd's genetic potential.
Weaknesses: Milking three times per day requires another shift of workers for milking to be managed or robotic milking systems can be installed and managed.	**Threats:** Managing a very high-producing herd requires attention to detail, skill sets to solve problems quickly and a continual commitment to learning as new innovations appear.

2.2 Key Production Benchmarks of Missouri Dairy Farms

Rolling herd average, SCC and pregnancy rate are benchmarks that can be used to analyze production productivity. An analysis of these Missouri benchmarks, gaps and tactics that can improve each respective production measure are identified in Exhibit 2.2.1.

Exhibit 2.2.1 – Gap Analysis on Missouri Production Benchmarks

Measure	Source	Benchmark			Tactics to Improve
		MO	U.S.	Gap	
Rolling herd average *(lbs./cow)*	DHIA DRMS 2014 USDA-NASS 2013	17,105 14,663	21,116 21,822	4,011 7,159	• Improve dry matter intake and forage quality • Heat stress abatement • Cow comfort in stalls • Lower number of days in milk via better reproduction • Systems that lead to proper attention to detail • Genetic improvement
Somatic cell count (SCC) *(thousands)*	DHIA DRMS 2014	338.4	262.9	75.5	• Clean resting and high traffic areas • Use correct milking procedures, and maintain equipment • Systems that lead to proper attention to detail
Pregnancy rate as indicated by calving interval *(months)*	DHIA DRMS 2014	15.1	14.3	0.8	• Improved heat detection/breeding • Heat stress reduction • Estrus synchronization protocols • Cow comfort systems • Improved nutrition

2.3 Key Financial Benchmarks of Missouri Dairy Farms

An analysis of Missouri dairy producer financial benchmarks, gaps and tactics that can improve each respective financial measure are identified in Exhibit 2.3.1. Benchmarks are derived from USDA-reported data for Missouri and the U.S.

Exhibit 2.3.1 – Missouri Financial Benchmarks Gap Analysis and Tactics

Measure	Source	Benchmark			Tactics to Improve
		MO	U.S.	Gap	
Milk price *(per cwt.)*	USDA-NASS (2009-2013 avg.)	$17.92	$17.64	$0.28	• Need to maintain slight price edge by at least maintaining farm performance to U.S. average • Quality, volume and component premiums • Niche or collective processing • Organic production
Feed cost *(per cwt.)*	USDA-ERS Cost of Production Survey 2013	$16.46	$15.91	$0.55	• Raise milk production per cow • Improve forage quality and yields • Graze to remove harvest and storage costs • Reduce waste in storage and feeding • Volume buying of feedstuffs individually or in purchasing groups • Use of nutrition consultants or dairy nutrition training programs to optimize rations • Improve reproduction to decrease herd's number of days in milk
Hired/unpaid labor cost *(per cwt.)*	USDA-ERS Cost of Production Survey 2013	$10.33	$3.80	$6.53	• Increase herd size to achieve economies of scale • Build contractor network to outsource feed production, manure handling, heifers raising • Improve productivity through labor training programs • Design and implement labor-efficient holding areas and parlors
Machinery and equipment cost *(per cwt.)*	USDA-ERS Cost of Production Survey 2013	$5.63	$3.57	$2.06	• Custom hire operators or collective ownership groups for forage harvesting • Increase herd size to achieve economies of scale
Net cash farm income *(avg. per farm)* *(avg. per cow)*	USDA-NASS Census of Agriculture 2012	$48,569 $602	$201,930 $1,004	$153,361 $402	• Increase herd size to achieve economies of scale • Decrease variable and fixed costs by spreading over other enterprises • Move to value-added production
Return on assets *(percent)*	USDA-ERS ARMS Survey 2012	-2.1	4	6.1	• Decrease asset allocation • Improve net farm income • Build contractor network to outsource feed production, manure handling, heifers raising to lower capital investment per cwt. and mimic scale in smaller herds • Increase gross farm income with other enterprises

Exhibit 2.3.2 details the USDA cost of production estimates by herd size for the U.S. and an average herd in Missouri. Most of the operating costs data for Missouri is very similar to what has been estimated by different herd sizes in the U.S. However, allocated overhead is the category where Missouri is noticeably higher than the U.S., as shown in the capital recovery of machinery, and equipment and opportunity cost of labor categories. Most of this can be attributed to Missouri's smaller herd sizes that result in unpaid family labor and machinery/equipment split across smaller milk production levels.

Exhibit 2.3.2 – USDA Cost of Production U.S. Estimates by Herd Size versus Missouri, 2013

Item	Estimated Cost by Herd Size in the United States					Missouri
	50-99 Cows	100-199 Cows	200-499 Cows	500-999 Cows	>1,000 Cows	Average Herd
	$/Cwt	*$/Cwt*	*$/Cwt*	*$/Cwt*	*$/cwt*	*$/Cwt*
Gross value of production:						
Milk sold	21.15	20.76	20.64	20.02	18.86	19.78
Cattle	1.97	1.70	1.49	1.55	1.45	2.04
Other income	1.08	0.95	0.94	0.87	0.82	1.34
Total, gross value of production	24.20	23.41	23.07	22.44	21.13	23.16
Operating costs:						
Feed--						
Purchased feed	7.85	8.22	9.65	10.00	10.12	10.27
Homegrown harvested feed	11.25	9.84	7.96	5.56	3.26	5.51
Grazed feed	0.25	0.15	0.12	0.02	0.02	0.68
Total, feed costs	19.35	18.21	17.73	15.58	13.40	16.46
Other--						
Veterinary and medicine	0.92	0.82	0.96	0.94	0.67	0.70
Bedding and litter	0.39	0.34	0.32	0.30	0.12	0.11
Marketing	0.22	0.23	0.24	0.29	0.22	0.15
Custom services	0.62	0.65	0.71	0.70	0.41	0.55
Fuel, lube, and electricity	1.22	1.01	0.99	0.74	0.58	1.29
Repairs	1.02	0.72	0.71	0.42	0.43	0.83
Other operating costs	0.01	0.00	0.00	0.00	0.00	0.00
Interest on operating capital	0.01	0.01	0.01	0.01	0.01	0.01
Total, operating cost	23.76	21.99	21.67	18.98	15.84	20.10
Allocated overhead:						
Hired labor	0.93	1.35	2.02	2.02	1.60	0.93
Opportunity cost of unpaid labor	7.38	3.66	1.55	0.54	0.17	9.40
Capital recovery of machinery and equip.	6.88	4.87	3.88	2.69	2.12	5.63
Opportunity cost of land (rental rate)	0.06	0.04	0.02	0.01	0.00	0.22
Taxes and insurance	0.33	0.26	0.24	0.17	0.10	0.46
General farm overhead	0.97	0.78	0.73	0.46	0.44	0.63
Total, allocated overhead	16.55	10.96	8.44	5.89	4.43	17.27
Total costs listed	40.31	32.95	30.11	24.87	20.27	37.37
Value of production less total costs listed	-16.11	-9.54	-7.04	-2.43	0.86	-14.21
Value of production less operating costs	0.44	1.42	1.40	3.46	5.29	3.06

Source: USDA-Economic Research Service

2.4 Regulatory Environment for Water Quality

The purpose of this section on water quality requirements is to compare regulatory requirements in selected states versus Missouri. States included in the review are Missouri, Iowa, Kansas, South Dakota and Wisconsin. Information in this section should be confirmed with local state regulatory agencies before using information for planning or managing an existing facility. This review did not consider air quality standards. A brief review of each state's approach follows. States are listed in order of decreasing regulation complexity:

Iowa:
The rules applying to working dairies will be for confined feedlot operations (CFOs). Iowa has a unique approach to CFOs, and it requires a construction permit but does not issue operating permits. Because there is no operation permit (but nutrient management plan is required), a CFO cannot discharge for any reason. Iowa CFO regulations are complex to understand and highly detailed. They have many exceptions and nuances dealing with everything from storage design to implementation of facility and manure application setbacks. Iowa has extensive additional requirements that are not apparent in the tables beyond any other state. Iowa requires all CFO information, including the required annual updates to the nutrient management plan, to be submitted to the local county board of supervisors. Iowa uniquely does not allow liquid manure application to soybean fields by permitted operations. It also has many additional fees including an annual nutrient management plan submission fee, indemnity fund fee and construction permit fee. Finally, Iowa has another set of rules for open feedlots that allow discharges under certain situations. These rules are rarely applied to milking cows, but dairy operators may fall under them if they raise young stock or maintain dry cows on open feedlots. It was impossible to fully understand Iowa rules without calling a state resource.

Wisconsin:
Wisconsin has three separate permits covering all dairy sizes. It is the one state that explicitly states that all operations are expected to follow appropriate rules and standards. This statement is particularly relevant for nutrient management plan requirements. Wisconsin has detailed rules mostly by incorporating many technical standards from organizations like the Natural Resource Conservation Service (NRCS), American Society of Civil Engineers (ASCE) and American Society of Agricultural Engineers (ASAE) for storage design and nutrient management criteria. In addition to incorporating the NRCS 590 Nutrient Management Standard by reference, Wisconsin rules also have detailed, complex requirements about setbacks, winter manure applications (governed by manure type; method of application; and within irrigated systems, nozzle pressure) and edge-of-field manure stacking. Wisconsin has the longest storage period requirements consistent for its long winters. It was impossible to fully understand Wisconsin rules without calling a state contact.

Kansas:
Kansas is unique in that all dairies require a permit, and it has no exception for size. Smaller operations can use the state permit, but large operations must use the more stringent site specific permit. The state permit is similar to Missouri's state permit in that it eliminates much of the public comment and reporting needed for larger operations. Kansas only extends those benefits to operations with less than 700 cows because its site-specific permits allow discharges under certain conditions. More operations are covered by regulations in Kansas. However, the rules largely follow federal requirements and are fairly easy to find and follow.

Missouri:
Missouri rules are more complex than rules in Kansas, but Kansas rules affect all operations directly, which makes them more complicated to implement. Missouri is unique in providing farmers the choice of degree of regulation except for the largest operations. The options include either a state permit or a National Pollutant Discharge Elimination System (NPDES) permit. Having two parallel permit options is more complex, but that complexity offers flexibility for producers. An operation that agrees to never discharge eliminates permit requirements for public notice and submission of records. Missouri has worked to consolidate key information for regulating operations.

South Dakota:
South Dakota contains all of its requirements within the one general permit that covers all CAFOs in the state. The permit was approved in 2003 and expired in 2008, but it is still the effective basis of regulation of CAFOs in the state. The state website implies the permit will be updated soon. The rules in South Dakota are closely related to federal requirements, and there are few specific requirements for design criteria common in the other states.

Exhibits 2.4.1 through 2.4.11 compare key regulatory attributes for Missouri, Iowa, Kansas, South Dakota and Wisconsin. The exhibits define the dairies that are regulated in each state and characteristics of the rules that they are expected to follow. Note that in all states, unregulated operations are expected to protect water quality. In some cases, they are expected to implement water quality rules even when not getting a permit. For example, the Wisconsin Department of Natural Resources states that "Compliance with Wisconsin's agricultural standards and prohibitions is required of all cropland and livestock operations in the state regardless of size." In other states, the requirements to specifically follow water quality rules are less clearly stated, but if a spill occurs during land application, having followed the rules may mitigate/eliminate a regulatory penalty.

Exhibit 2.4.1 – Regulatory Summary: Missouri, Iowa, Kansas, South Dakota and Wisconsin

Category	Comparison Summary
Permit types	MO has the most flexibility in permit types. It is the only state offering producers the choice between a permit requiring never to discharge and a higher degree of regulatory requirements for a permit that allows emergency discharges under specific conditions.
Permit types and costs	Missouri's largest operations (Class IA) have the highest permit fee among the selected states. Costs of other permits are similar to those in other states except Kansas, which has the lowest costs.
Who is covered	Missouri is like Kansas and Wisconsin in permitting operations and explicitly requiring nutrient management plans of operations starting at 700 mature cows. Iowa and Kansas requirements apply at lower animal numbers.
Facility setbacks	Iowa has the most extensive requirements. Wisconsin has the lowest. Missouri requirements are similar to those in Kansas and South Dakota.
Storage design period	States farther north had longer storage design periods consistent with their longer over-winter periods, which are unsuitable for manure application.
Manure application setbacks	Wisconsin and Iowa have complex and extensive setback requirements. Kansas requirements are the most limited. Missouri requirements are intermediate in range and complexity. Some of the complexity in Missouri requirements leads to lower setback requirements.
Nutrient management	Wisconsin and Iowa have the most detailed nutrient management requirements requiring the plan be submitted annually. South Dakota requires annual plans, but those plans are maintained on-site (not required to submit to agency).

Exhibit 2.4.2 – Key Permits: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit Designation	Permit Type	Discharges Ever Allowed?	Authority	Public Notice	Cost
MO	State	General	No	Missouri Department of Natural Resources	No	$150-$300/year
MO	1B/C-NPDES	General	Yes	Missouri Department of Natural Resources	Yes	$350-$450/year
MO	IA-NPDES	Site-specific	Yes	Missouri Department of Natural Resources	Yes	$5,000/year
IA	CFO	Construction only	No	Iowa Department of Natural Resources	Yes	$350
IA	Small CFO	Construction only	No	Iowa Department of Natural Resources	No	$350
KS	State	Site-specific	Yes	Kansas Department of Health and Environment	Yes	$25 + $25/year
KS	Large CAFO	Site-specific	Yes	Kansas Department of Health and Environment	Yes	$100-$400/year
SD	CAFO	General	Yes	Department of Environment and Natural Resources	Yes	$175-$250
WI	Large Dairy	General	Yes	Wisconsin Department of Natural Resources	Yes	Not available
WI	Large CAFO	Site-specific	Yes	Wisconsin Department of Natural Resources	Yes	Not available
WI	Small CAFO	General	No	Wisconsin Department of Natural Resources	Yes	Not available

Exhibit 2.4.3 – Key Permit Size Thresholds: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit	Regulatory Threshold	Notes
MO	State	≥700 and ≤4,900 mature cows	Regulatory threshold based on single animal type inventory.
MO	1B/C-NPDES	Required ≥700 and ≤4,900 mature cows if you propose to discharge	Regulatory threshold based on single animal type inventory.
MO	IA-NPDES	Required, >4,900 mature cows	Regulatory threshold based on single animal type inventory.
IA	CFO	≥700 mature cows	Sum animals confined under cover and open lots separately.
IA	Small CFO	200-700 mature cows	Sum animals confined under cover and open lots separately. Most rules and fees related to Small CFOs only apply to those required to have a manure management plan (≥500 animal units (350 mature cows)).
KS	State	All dairies <700 mature cows	All dairies will need to have a permit independent of size in KS.
KS	Large CAFO	≥700 mature cows	Regulatory threshold based on sum of all animal types.
SD	CAFO	Required ≥ 700 mature cows	Regulatory threshold based on sum of all animal types.
WI	Large Dairy	Required ≥ 715 and ≤4086 mature cows	Regulatory threshold based on sum of all animal types. Must have at least 80% animal units as dairy.
WI	Large CAFO	Required >4085 mature cows	Regulatory threshold based on sum of all animal types. All large CAFOs except dairy must always use this permit.
WI	Small CAFO	<715 mature cows	Only operations designated as needing a permit.

Exhibit 2.4.4 – Key Facility Setback Requirements and Site Restrictions: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit Designation	Feature	Setback Criteria	Restriction	Setback
MO	All	Occupied residence, non-owned	700 to 2,099 mature cows	Facility setback	1,000 ft.
MO	All	Occupied residence, non-owned	2,100 to 4,899 mature cows	Facility setback	2,000 ft.
MO	All	Occupied residence, non-owned	≥4,900 mature cows	Facility setback	3,000 ft.
MO	All	100-year Flood plain	≥4,900 mature cows	Manure storage	Restricted
MO	All	Listed watersheds	≥4,900 mature cows	Facility	Prohibited
IA	All	Public use areas and buildings	< 350 mature cows	Manure storage	0-1,875 ft.
IA	All	Public use areas and buildings	350-699 mature cows	Manure storage	1,275-1,875 ft.
IA	All	Public use areas and buildings	700-2,099 mature cows	Manure storage	1,875-2,500 ft.
IA	All	Public use areas and buildings	≥2100 mature cows	Manure storage	2,375-3,000 ft.
IA	All	Other CAFO	<700 mature cows	Facility	1,250 ft.
IA	All	Other CAFO	≥700 mature cows	Facility	2,500 ft.
IA	All	Drinking water well	All CFOs	Facility	100-1,000 ft.
IA	CFO	100-year flood plain	All CFOs	Facility	Restricted
IA	CFO	Designated wetland	All CFOs	Facility	2,500 ft.
IA	CFO	Wellhead, sinkhole, water source	All CFOs	Facility	200-1,000 ft.
IA	CFO	Right-of-way of a thoroughfare	All CFOs	Facility	100 ft.
KS	All	Occupied residence, non-owned	<200 mature cows	Facility	None
KS	All	Occupied residence, non-owned	200-699 mature cows	Facility	1,320 ft.
KS	All	Occupied residence, non-owned	≥ 700 mature cows	Facility	4,000 ft.
KS	All	Groundwater	All permitted operations	Facility	>10 ft. depth
SD	CAFO	100-year flood plain	≥ 700 mature cows	Facility	Restricted
SD	CAFO	Public drinking water well or source	≥ 700 mature cows	Facility	1,000 ft.
SD	CAFO	Private well or source	≥ 700 mature cows	Facility	250 ft.
SD	CAFO	On-site well	≥ 700 mature cows	Facility	150 ft.
SD	CAFO	Shallow aquifer	≥ 700 mature cows	Facility	Restricted
WI	All	Wells	Barnyards, feedlots and reviewable facilities	Facility	250-1,000 ft.

Note: Most setback restrictions for residential buildings only apply when the building is not owned by the dairy.

Exhibit 2.4.5 – Key Storage Design Requirements: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit Designation	Storage Type	Minimum Storage Period	Notes
MO	All	All but anaerobic lagoon.	180 days	
MO	All	Anaerobic lagoon	365	Design plans for all earthen basins to be submitted with permit application
IA	CFO	All	None	Must be able to meet over-winter non-application period requirements for liquid manure in new rules. Must locate and decommission any tile lines within 50 feet of the storage.
IA	Small CFO	All	None	
KS	All	All	120 days	Dairies typically designed for 180-day storage.
SD	CAFO	For lots under cover	270 days	
SD	CAFO	For open lots	365 days	
WI	Large Dairy	Liquid storages	180 days	
WI	Large CAFO	Liquid storages	180 days	
WI	Small CAFO	Liquid storages	180 days	

Exhibit 2.4.6 – Key Manure Land Application Setback Requirements Ranges for Dairy: Missouri, Iowa, Kansas, South Dakota and Wisconsin, Feet

State	Permit Designation	Drinking Water Well	Intermittent Stream	Perennial Stream/River /Canal	Lakes and Impoundments	Occupied Residence, non-owned	Property Boundary
MO	All	300	0-100	0-100	0-100	0-150	50
IA	CFO	0-800	0-800	0-800	0-800	0-750	0-100
IA	Small CFO	0-800	0-800	0-800	0-800	N/A	0-100
KS	All	N/A	0-100	0-100	0-100	N/A	N/A
SD	CAFO	150-1000	35-100	35-100	35-100	N/A	N/A
WI	All	100-1000	21-600	21-600	21-600	0-500	N/A

Exhibit 2.4.7 – Key Factors Affecting Manure Land Application Setback Distances: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit Type	Vegetation in Setback	Vegetation in Field	Application Down-Slope	Method of Application	Type of Animal	Form of Manure	Type of Storage	Soil Test Phosphorus	Sensitive Water Resource
MO	All	Yes	No	Yes	Yes	No	Yes	No	No	No
IA	CFO	Yes	No	No	Yes	No	Yes	No	No	Yes
IA	Small CFO	Yes	No	No	Yes	No	No	No	No	Yes
KS	All	Yes	No	Yes	No	Yes	No	No	No	No
SD	CAFO	Yes	No	No	No	No	No	No	Yes	No
WI	All	Yes	Yes	No	Yes	No	Yes	No	No	Yes

Exhibit 2.4.8 – Other Manure Land Application Restrictions: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit Designation	Applications, frozen and/or snow-covered ground	Slope prohibition
MO	All	Surface application prohibited.	Prohibited, slope >20%.
IA	CFO Small CFO	No application of liquid manure 12/21-4/1 for snow-covered ground and 2/1-4/1 for frozen ground. Only applies to operations required to have a manure management plan.	Limited on ground with >10% slope. Injection preferred on these slopes. Only applies to operations required to have a manure management plan.
KS	All	Liquid applications prohibited.	None, must meet P Index.
SD	CAFO	Application of liquid manure prohibited; application of solid manure to be avoided, setback must be 100 feet.	Irrigation prohibited, slope $\geq$6%. Winter application, prohibited slope $\geq$4%.
WI	Large Dairy and Large CAFO	<12% solids, surface application prohibited. $\geq$12% solids, surface applications prohibited in 2/1 to 3/31. Extensive rules in this area.	Slope >9%, solid manure.
WI	Small CAFO	<12% solids, surface application prohibited. $\geq$12% solids, surface applications prohibited in 2/1 to 3/31.	

Note: These restrictions are often bypassed under "emergency" conditions defined in the rules.

Exhibit 2.4.9 – Selected Nutrient Management Plan Requirements: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit Type		New Plan		Modifications		Record Keeping
		Plan Duration	Submission Requirements	Public Notice	Submission Requirements	Public Notice	
MO	General	Five years	Maintain on-site	No	Maintain on-site	No	Maintain on-site
MO	All NPDES	Five years	Submit for approval	Yes	Submit for approval	Yes	Submit annually
IA	CFO[1]	Annually	Submit for approval	Yes	Submit for approval	No	Maintain on-site
IA	Small CFO[1]	Annually	Submit for approval	Yes	Submit for approval	No	Maintain on-site
KS	State	Five years or by permit cycle if less	Maintain on-site	No	Maintain on-site	No	Maintain on-site
KS	Large CAFO	Five years or by permit cycle if less	Submit for approval	Yes	Submit for approval	Yes	Annually
SD	CAFO	Annual	Submit for approval	No	Maintain on site, submit changes in land base for approval	No	Submit annually
WI	Large Dairy	Annual	Submit for approval	Yes	Submit for approval	Typically No	Submit annually
WI	Large CAFO	Annual	Submit for approval	Yes	Submit for approval	Yes	Submit annually
WI	Small CAFO	Annual	Submit for approval	No	Not stated	No	Submit annually

[1] Plans for these operation are called Manure Management Plans and are only required for CFOs with $\geq$350 mature cattle.

Exhibit 2.4.10 – Nutrient Management Plan Testing and Training Requirements: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Permit Type	Soil Test P Limit?	Soil Testing	Manure Sampling	Specialized Training
MO	General	No	Every five years.	Annually	No
MO	1B/C-NPDES	No	Every five years.	Annually	No
MO	IA-NPDES	No	Every five years.	Annually	Yes
IA	CFO, Small CFO		Every four years on operations with ≥350 mature cows.	Not required	For applicators
KS	State	Yes	Required before applications if sensitive ground water area and manure has been applied within five years; otherwise, every three years or annually if manure is applied two or more consecutive years; includes residual soil nitrate.	Annually	No
KS	Large CAFO	Yes	Every three years or annually if manure is applied two or more consecutive years; includes residual soil nitrate.	Annually	No
SD	CAFO	Yes	Annually, including residual soil nitrate.	Annually	Yes
WI	All	Yes	Every four years.	Solids quarterly, liquid twice per month; only when applying manure	Yes

Exhibit 2.4.11 – Nutrient Management Plan Testing and Training Requirements: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Core Website	Web Address
MO	Missouri DNR Water Protection Program Concentrated Animal Feeding Operation website	http://www.dnr.mo.gov/env/wpp/cafo/
IA	Iowa DNR Animal Feeding Operations website	http://www.iowadnr.gov/Environment/LandStewardship/AnimalFeedingOperations.aspx
KS	Kansas DHE Livestock Waste Management Section website	http://www.kdheks.gov/feedlots/index.html
SD	South Dakota DENR Feedlot Permit Program website	http://denr.sd.gov/des/fp/fphome.aspx
WI	Wisconsin DNR CAFOs, water permits and NR 243 website	http://dnr.wi.gov/topic/AgBusiness/CAFO/WPDESNR243.html

2.5 Local Restrictions on Animal Feeding Operations

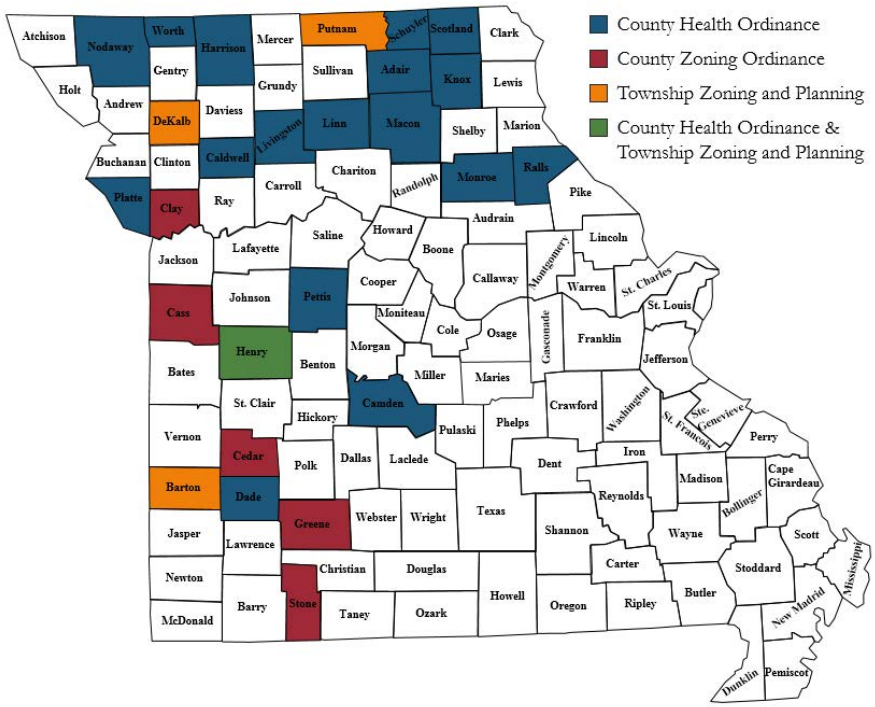
Missouri and other states have allowed local powers to create restrictions that impact livestock agriculture. Often, these restrictions have limited the ability of existing operations to expand and deterred new operations from relocating. Exhibit 2.5.1 shows a comparison between Missouri, Iowa and Indiana concerning local restrictions in their respective states. All three states have local control mechanisms that can impact dairy operations, but they vary in the degree of impact.

Exhibit 2.5.1 – Local Restrictions on Animal Feeding Operations, Select States

State	State law(s) specifically limiting county AFO rules?	Significant local limits on AFOs that exceed state standards?	Local control mechanism
Missouri	No	Yes	• County health ordinance • County or township zoning
Iowa	Yes	Yes	• Master matrix system
Indiana	No	Yes	• County zoning

Local governments in Missouri have imposed additional requirements and fees on animal feeding operations beyond what is required in regulations by the Missouri Department of Natural Resources. Two strategies have been used by these local governments to add requirements: county health ordinances and zoning ordinances (county and township). Exhibit 2.5.2 shows a map for Missouri that identifies all known local restrictions that impact animal feeding operations.

Exhibit 2.5.2 – Missouri Counties Known to Have Local Restrictions on Animal Feeding Operations



Source: University of Missouri

The scope of the ordinances and zoning restrictions can be quite broad. Exhibit 2.5.3 summarizes counties where health ordinances impose local requirements or fees that exceed state requirements. Typically, there is a lot of similarity among many of the county health ordinances. For example, the health ordinances in Harrison and Livingston counties have identical wording.

Exhibit 2.5.3 – Summary of County Health Ordinances, Selected Missouri Counties

County	Classification of CAFO	Air Quality Restrictions	Facility Setbacks	Lagoon or Feedlot Setbacks	County Fees	Financial Security
Caldwell	≥ 300 AU	Yes	¼ - 1 mile from another CAFO	2,000 feet from an existing residence	$1,000-10,000	$30,000-$70,000 cash or surety bond; Extra $20,000 per 500 AU over 2000
Camden	≥ 250 AU	Yes	½ - 2 miles from another CAFO	1-5 miles from dwellings, public areas, water supply sources	$1 per AU original and annual renewal for a permit	$100 per AU, cash or surety bond
Harrison	≥ 300 AU	Yes	¼ - 1 mile from another CAFO	1,000-3,000 feet from public building or dwelling	$1000-10,000	$15,000-$100,000 cash or surety bond
Henry	≥ 1000 AU	Yes	None	3,000 feet from occupied dwelling	Original or renewal fee is $0.71 per AU; Permit fees range from $6,000 to $12,500	None
Linn	≥ 300 AU	Yes	¼ - 1 mile from another CAFO	None	$1,000-10,000	$30,000-$70,000 cash or surety bond; Extra $20,000 per 500 AU over 2000
Livingston	≥ 300 AU	Yes	¼ - 1 mile from another CAFO	1,000-3,000 feet for public building or dwelling	$1,000-10,000	$15,000-$100,000 cash or surety bond
Pettis	≥ 300 AU	No	¼ - 1 mile from another CAFO	None	$5 for permit	None
Platte	≥ 300 AU	Yes	¼ - 1 ½ mile from another CAFO, increase ¼ mile each 500 over 7,000 AU	None	$1,000-10,000; $1 per AU over 10,000 AU; Renewal is $100-500	$1,000-$150,000 surety bonds or insurance; $20,000 extra each 500 AU over 7,000 AU

Note: Copies of the ordinances can be downloaded at http://nmplanner.missouri.edu/regulations/mocountyrules/.
Source: University of Missouri

Other states have varied in how they have treated county legislation concerning livestock. Iowa state law includes two measures that limit county-level legislation affecting animal feeding operations.

Iowa Code 331.304A, passed in 1998, limits county powers to regulate livestock operations when it is more restrictive than the state laws and regulations, which provides in part: "A county shall not adopt or enforce county legislation regulating a condition or activity occurring on land used for the production, care, feeding or housing of animals unless the regulation of the production, care, feeding or housing of animals is expressly authorized by state law."

Iowa Code 459.403, passed in 2002, prevents counties from charging fees for construction permits, manure management plans or other areas related to animal agriculture. "A county shall not assess or collect a fee under this chapter for the regulation of animal agriculture, including but not limited to any fee related to the filing, consideration, or evaluation of an application for a construction permit pursuant to section 459.303 or the filing of a manure management plan pursuant to section 459.312."

Additionally, Iowa developed a master matrix program in 2004 that counties can adopt for use. This criterion is used during the evaluation of a construction permit for permitted confinement feeding operations, including dairy operations. The matrix has three subcategories for air, water and community impacts. Producers in counties that have opted into this matrix have higher standards than other permitted operations in counties that have not adopted this program. As of 2014, only 11 counties in Iowa have not passed the use of the master matrix program in their counties.

Indiana allows counties to create local zoning ordinances that could affect a confined feeding operation. Indiana Code 36-7 Planning and Development provides the broad authority to plan and adopt zoning ordinances. Zoning ordinance restrictions usually include residential and public building setbacks. The Indiana Department of Agriculture (2012) developed a guide that recommended three models or approaches to local regulation and that gives local officials some guidance in what could be adopt in a respective county if the given county wishes to have a local zoning ordinance.

2.6 Water Availability

Missouri is a riparian water law state, so landowners have a right to reasonably use water sources that are touching or underneath their land. Under riparian law, a landowner can withdraw as much water as needed as long as the withdrawals do not adversely impact the water use of other individual water users. Exhibit 2.6.1 details water right laws, groundwater permits and usage reporting for Missouri, Kansas, Iowa, South Dakota and Wisconsin. Many western U.S. states, such as Kansas and South Dakota, use prior appropriation water law that are determined by priority of beneficial use. This means that the first person to use water or divert water for a beneficial use can acquire individual rights to the water and the rights can be sold or transferred.

Exhibit 2.6.1 – Groundwater Laws and Permits: Missouri, Iowa, Kansas, South Dakota and Wisconsin

State	Doctrine of Appropriation	Groundwater Permit Required	Groundwater Use Reported
Missouri	Riparian	No	>100,000 gpd
Kansas	Prior appropriation	Yes	
Iowa	Riparian (modified)	Yes, >25,000 gpd	>25,000 gpd
South Dakota	Prior appropriation	Yes	
Wisconsin	Riparian	Yes, >100,000 gpd	Yes

Source: National Conference of State Legislatures (2013)

Missouri water users who withdraw or divert 100,000 gallons per day (gpd), equivalent to 70 gallons per minute all day, from streams, rivers, lakes, wells, springs or other water sources are considered major water users. Missouri Water Law (Section 256.400–430 of the Revised Statutes of Missouri) requires that major water users register their water use annually with the Missouri Department of Natural Resources (DNR). Users may be designated as major even if they only withdraw or divert the 100,000-gallon threshold on one day in a year.

For Missouri, a majority of the water currently used for irrigation comes from groundwater sources. The Missouri DNR Division of Geology and Land Survey/Wellhead Protection Section is the regulatory agency in charge of irrigation wells in Missouri. It is the clearinghouse for all well construction rules. It also maintains a Missouri database of licensed private well drillers and pump installers that should be used when drilling or repairing a well. Groundwater use data for Missouri, Iowa, Kansas, South Dakota and Wisconsin are detailed in Exhibit 2.6.2. Primary groundwater use in Missouri is for irrigation, amounting to 77 percent of the total groundwater.

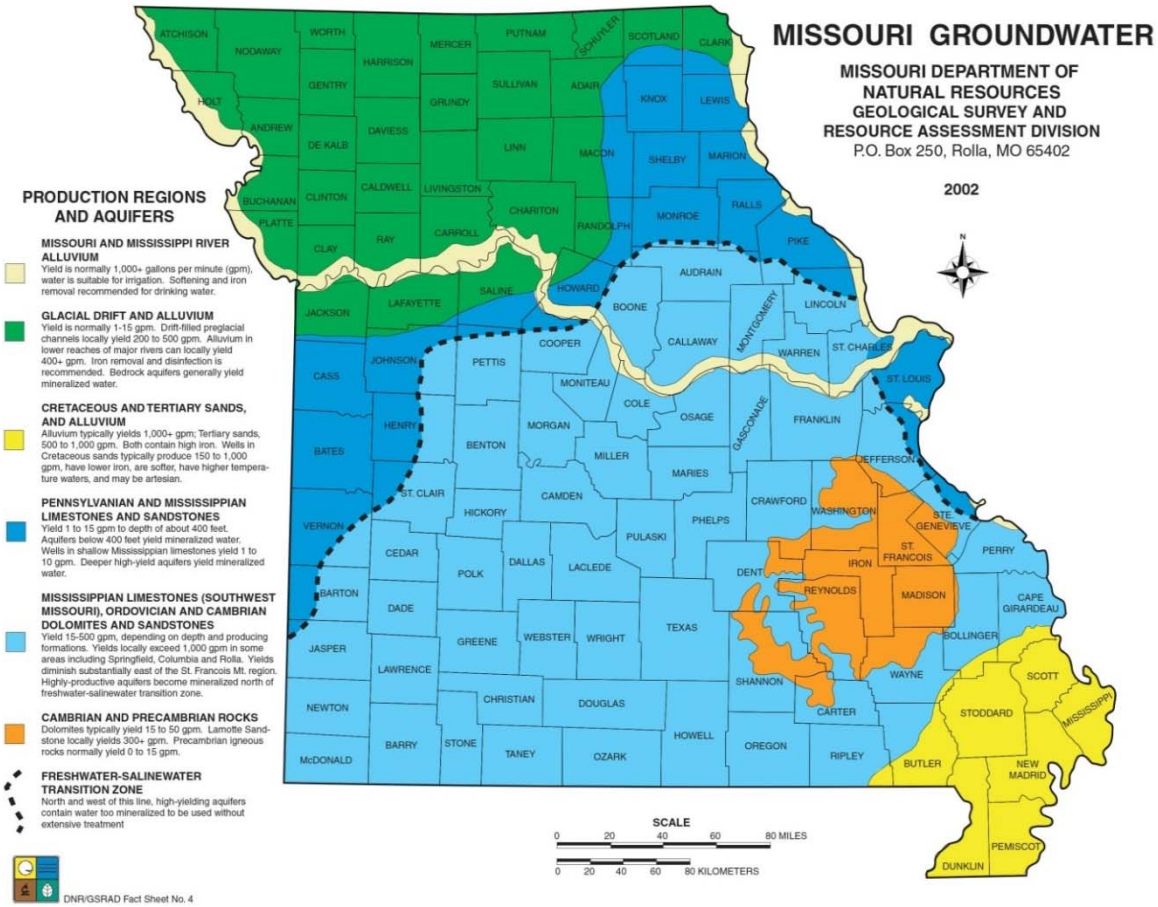
Exhibit 2.6.2 – Groundwater Use: Missouri, Iowa, Kansas, South Dakota and Wisconsin, 2005

	Total Groundwater		Livestock/Aquaculture		Irrigation	
State	Fresh, no saline (mgd)	% of total state water supply	Groundwater (mgd)	% of total groundwater used	Groundwater (mgd)	% of total groundwater used
Missouri	1,750	20%	27	2%	1,340	77%
Kansas	2,950	78%	86	3%	2,620	89%
Iowa	683	20%	99	14%	32	5%
South Dakota	271	54%	38	14%	149	55%
Wisconsin	975	11%	104	11%	104	11%

Source: National Groundwater Association (2012)

It is important to understand the geology of Missouri to have an idea of how much groundwater is typically available in various areas, as shown in Exhibit 2.6.3. Special areas in Missouri may require that dairy producers either case or grout deeper, depending on the area and geologic conditions. Requirements for well construction are based on yield, use of well and the region where the well is located.

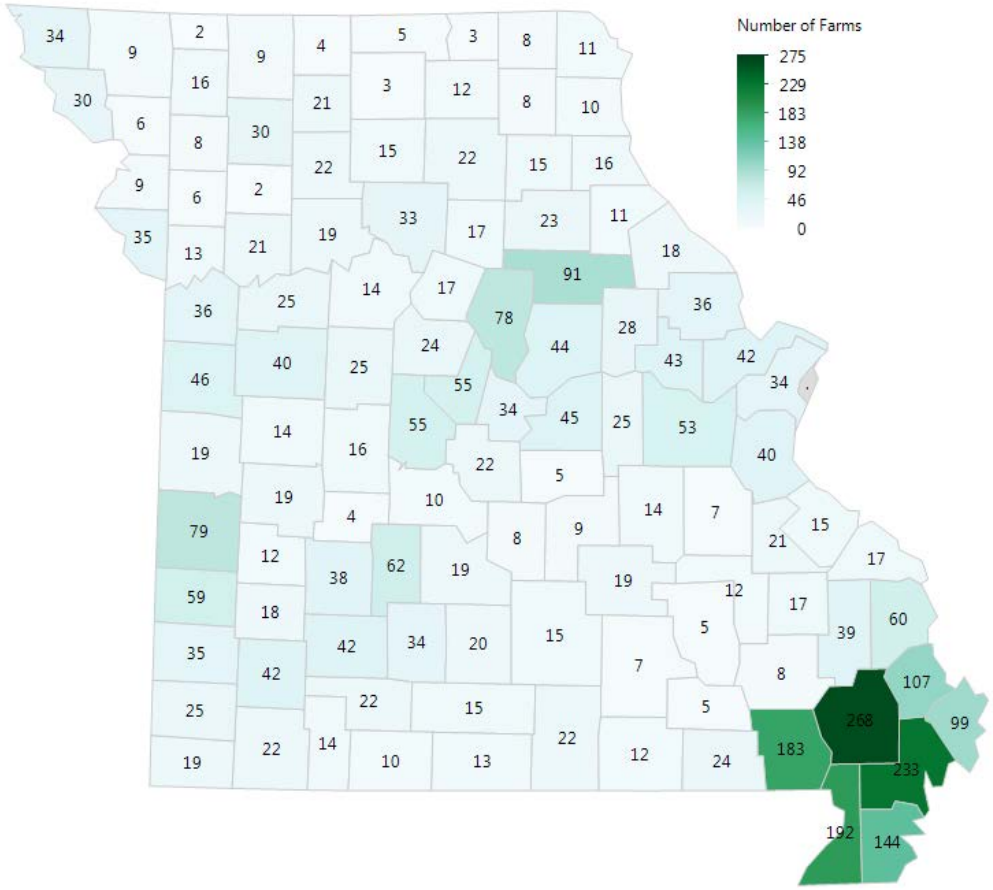
Exhibit 2.6.3 – Missouri Groundwater Production Regions and Aquifers



Source: Missouri Department of Natural Resources

Exhibit 2.6.4 provides a county-level analysis of where irrigation occurs in Missouri. Missouri had 3,727 farms, or 3.8 percent of total farms in the state, that irrigated in 2012. Of the approximately 1.2 million acres that were irrigated, irrigation occurred predominately on cropland. The southeast corner of Missouri has the strongest concentration of irrigation.

Exhibit 2.6.4 – Missouri Farms with Irrigation, 2012



Source: National Agricultural Statistics Service, Census of Agriculture

2.7 Business Climate

Tax rates, utility costs, infrastructure and population demographics are all key indicators of a state's business climate. Exhibit 2.7.1 outlines these key indicators for Missouri, Illinois, Iowa, Kansas, Minnesota, South Dakota and Wisconsin. Missouri has the highest number of interstate miles and persons below poverty level, while the median household income was the lowest among the selected states.

Exhibit 2.7.1 – Business Climate in Missouri and Other States

Category	Unit	MO	IL	IA	KS	MN	SD	WI
Tax Rates								
Corporate	%	6.25%	9.50%	6%-12%	4%-7%	9.80%	None	7.90%
Individual Income Tax Collection	$ per capita	$853	$1,206	$987	$1,005	$1,489	$0	$1,183
State and Local Sales Tax	%	7.58%	8.16%	6.78%	8.15%	7.19%	5.83%	5.43%
Gasoline Tax	¢/gal.	17.0	19.0	21.0	24.0	28.5	22.0	30.9
Diesel Tax	¢/gal.	17.0	21.5	22.5	26.0	28.5	22.0	30.9
Utility Costs								
Avg. Commercial Electric	$/kWh	$0.090	$0.089	$0.092	$0.102	$0.099	$0.089	$0.113
Avg. Residential Electric	$/kWh	$0.110	$0.115	$0.123	$0.124	$0.128	$0.115	$0.146
Avg. Residential Natural Gas	$/1,000 cu ft.	$24.72	N/A	$15.96	$20.05	$12.71	$13.47	$12.41
Infrastructure								
Freight Railroad	miles	3,958	7,027	3,855	4,855	4,449	1,754	3,385
Interstate	miles	1,379	1,239	782	874	914	679	743
Public Road	miles	131,978	144,337	114,438	140,614	138,833	82,536	115,094
Airports	number	359	468	194	330	324	138	421
Income and Population								
Median Household Income	dollars	$47,380	$56,797	$51,843	$51,332	$59,836	$49,495	$52,413
Per Capita Income	dollars	$25,649	$29,666	$27,027	$26,929	$30,913	$25,740	$28,155
Population	number	6,044,171	12,882,135	3,090,416	2,893,957	5,420,380	844,877	5,742,713
Persons below Poverty Level	percent	15.5%	14.1%	12.4%	13.7%	11.5%	14.1%	13.0%
Cost of Living	ranking	16	22	14	13	28	29	24

Source: Missouri Economic Research and Information Center, Tax Foundation, U.S. Department of Transportation, U.S. Energy Information Administration and U.S. Census Bureau.

For selected states, Exhibit 2.7.2 provides a state business tax climate analysis conducted by the Tax Foundation. Missouri is ranked 17th of all U.S. states. The five best states in this year's index were Wyoming, South Dakota, Nevada, Alaska and Florida. Many of these top states have no corporate or individual income tax. Rankings are also displayed by various tax categories such as corporate tax, individual income tax, sales tax, unemployment insurance tax and property tax. Missouri ranked in the top 10 states in corporate tax and property tax.

Exhibit 2.7.2 – 2015 State Business Tax Climate Ranks and Component Tax Ranks

State	Overall Rank	Corporate Tax Rank	Individual Income Tax Rank	Sales Tax Rank	Unemployment Insurance Tax Rank	Property Tax Rank
Missouri	17	4	29	29	12	7
Illinois	31	47	11	34	38	44
Iowa	41	49	32	23	33	38
Kansas	22	38	18	30	9	28
Kentucky	26	29	30	11	45	17
Minnesota	47	44	46	37	29	34
South Dakota	2	1	1	35	41	18
Texas	10	39	6	36	15	36
Wisconsin	43	33	43	14	27	31

Note: 1 is best, and 50 is worst. Rankings do not average to total. States without a tax rank equally as 1 for that component. D.C. score and rank do not affect other states. Report shows tax systems as of July 1, 2014 (the beginning of fiscal year 2015).
Source: Drenkard and Henchman (2014)

3. Dairy Revitalization Efforts and Public Incentives

Several U.S. states have implemented initiatives to strengthen their dairy industries. At the production level, several factors motivate dairy relocation. According to Normand St-Pierre from The Ohio State University, important factors that lead to dairy operations selecting a given area or location include cash flow potential, capital expenditures required and the area's tax structure and incentives (Latzke 2013). From a tax perspective, property taxes tend to be a greater concern than income taxes. Economic incentives have moderate importance. Within different subcategories of relocation factors, several other items are important. Regarding regulation, important factors include CAFO-friendly legislation, the judicial system's position toward agriculture and clear regulatory processes. When selecting a specific site, producers look for fresh water access, land to handle animal waste, average milk price, fresh water quality and waste handling and odor regulations (Latzke 2013).

Public incentives are one approach that states have taken to strengthen their dairy industries. Exhibit 3.1 details a comparison of selected policies and incentive programs that have been developed in other states. The following subsections (3.1 through 3.9) describe a few state-by-state efforts that have sought to address dairy producers' needs, position their states as dairy-friendly and revitalize the dairy industry.

Exhibit 3.1 – Dairy State Policy Comparison, 2014

State	Title	Background	Funding Source
AR	Arkansas Milk Stabilization Act of 2009	The Secretary after each month shall calculate the monthly average blend price of milk received by Arkansas producers and obtain from USDA's ERS the monthly average cost of production in Missouri and Tennessee. The Secretary shall compare the monthly Arkansas average blend price of milk with 70% of the estimated monthly cost of production in Missouri and Tennessee. If the Secretary determines the Arkansas average blend price of milk is lower than the 70% of the estimated cost of production in Missouri and Tennessee, producers will be eligible for a monthly grant, provided funds are available. The Secretary shall consult with the Arkansas Milk Stabilization Board. The monthly grant cannot exceed $5 per cwt. per month, and the annual average grant cannot exceed $2 per cwt. The Secretary will provide quality incentive grants to producers if funds are available, accordingly: (1) 50 cents per cwt. of milk for each cwt. of milk produced above the producer's average annual production during the preceding two years; (2) 50 cents per cwt. for the milk produced during a given year above the average annual production of the preceding two years if the somatic cell count is below 400,000 for milk produced during the given year; (3) Annual incentives to milk producers for milk production and quality shall be limited to not exceed $50,000 per producer.	The program is subject to state appropriations and was funded at $9.1 million for the 2009 and 2010 calendar years. Since that time, the program has not been funded.
KY	Market Incentive Leadership of KY (MILK) Program	Producers participating in the MILK program receive an incentive payment to increase production and improve quality. Producers can qualify for incentive if they increase production by 5% (50 cents/cwt.) or 10% (75 cents/cwt.) in 2015 above the 2013/2014 average base (Calculated Monthly). Additional premiums are rewarded for milk quality improvements (SCC $\leq$ 300,000 average of all pickups for month and PIC $\leq$ 20,000 pre-incubation count – producer's marketing agency requirement). The maximum amount per year for an eligible farm is $15,000. The program does not replace or affect existing incentives paid by marketing agencies in Kentucky. A total of 213 producers across the state participate currently.	MILK was funded through the 2013 and 2014 calendar years with $1.8 million. Kentucky's Master Tobacco Settlement Agreement allocates 50% of the program. The program is managed by the Kentucky Dairy Development Council.
KY	Udderly Kentucky Milk	"Udderly Kentucky" milk is trademarked by the Kentucky Department of Agriculture and processed by Prairie Farms Dairy in Somerset, Kentucky. This facility processes milk from 105 Kentucky producers in the region. Prairie Farms offers "Udderly Kentucky" milk in whole, 2%, 1%, and skim varieties in gallon sizes. In addition, producers participating in the program receive a 7 cent per-gallon premium. The milk is sold in Wal-Mart stores in the state.	Is funded through the Kentucky Proud program, which is administered by the Kentucky Agricultural Development Board and funded at $2.8 million through 2013 and 2014.
NC	NC Dairy Advantage	The program offers several consulting services that help producers to improve milk quality, feeding rations and operational profitability. Some of these services are provided at no cost to the producer. Similar to the Wisconsin program, producers can utilize a farm assessment and on-farm profit program. These programs are offered through NC State University Extension. The program also uses resources through the NC Department of Agriculture and NC Dairy Producers Association.	The program is set up as a 501(c)3 program. It utilizes resources from several areas including the university system, extension services and several state organizations like the NC Ag Foundation, NC Dairy Foundation, NC Dairy Producers Association, Golden Leaf Foundation, and the Agricultural Development and Farmland Preservation Trust Fund.

State	Title	Background	Funding Source
NY	Dairy Acceleration Program	Dairy Acceleration Program funding provides 80% of project cost while farm covers 20% on eligible projects, such as $5,000 to write a business plan and develop a business growth model; $6,000 for a comprehensive nutrient management plan for farms under 300 cows; up to $4,500 to update existing CNMP for farms under 300 cows; and up to $3,600 for an initial evaluation of financial and environmental needs for farms under 300 cows.	The program is being funded at $1 million through the state appropriations process.
VT	Best Management Practice Program	BMP provides state financial assistance to Vermont farmers. Funding through the BMP program is available for the voluntary construction of on-farm improvements designed to abate non-point source agricultural waste discharges into the waters of the state. Such construction must meet standards that are consistent with goals of the federal Water Pollution Control Act and with state water quality standards. BMP funds can be combined with federal cost share to provide a maximum of 85% of an approved project. State cost share is limited to a maximum of 35% when combined with federal cost share and up to 80% without federal cost share. A minimum of 15% of the costs will be covered by the farmer.	The program is funded through the state and works in partnership with USDA funds. In 2013, the Vermont budget included approximately $300,000 for all grant programs including BMP.
WI	Grow Wisconsin Dairy Producer Grant	The program provides grants up to $5,000 to be applied toward business development and expansion needs. These funds can be used toward different business development areas such as business planning, financial analysis, transition planning and farm transfers. Business planning grants assist producers in the early stages of planning dairy start-up or major changes in business structure. Funds are also applicable for dairy farm modernization and expansion efforts to provide assistance with professional services costs related to siting, engineering, design, layout of new barns, parlors or other farm structures. Assistance (up to $5,000) for related professional services and consultant. The producer is required to cover 20% of the grant amount.	Both Wisconsin Dairy Producer Grant and Profit Teams are funded through annual appropriation of $200,000.
WI	Dairy Profit Teams	The program provides up to $5,000 grant for on-farm management team to assist dairy producers in improving management of existing operational systems and identify opportunities to improve profit. The Profit Teams are a successful model in which groups of specialists and advisors work with farmers to evaluate opportunities for their farm, based on the specific needs of their operation. Services include a series of three to four meetings in which the farmer and team members identify issues and opportunities, develop strategies for near and long-term planning. Topics include new or appropriate technology implementation, farm growth, financial success, long-term sustainability and other production-enhancing measures through focuses on herd health, nutrition, milk production, software for operational efficiencies and training, managed grazing planning or transition to organic production. Assistance (up to $5,000) to cover meeting expenses including facilitator's expenses, consultant fees, applicable testing and associated costs. The producer is required to cover 20% of the grant amount.	Both Wisconsin Dairy Producer Grant and Profit Teams are funded through annual appropriation of $200,000.
WI	Dairy and Livestock Farm Investment Tax Credit	The Wisconsin Dairy and Livestock Farm Investment Credit is a nonrefundable credit equal to 10% of the amount a producer spends on dairy and livestock farm modernization or expansion. The maximum credit is $75,000. This credit applies to building or facility construction, improvement or acquisition, or it applies to acquiring equipment for housing, confinement, feeding, milk production or waste management. It relates exclusively to dairy or livestock animals.	This credit is available for taxable years beginning on or after January 1, 2006 and before January 1, 2014.

3.1 Missouri

The Missouri Dairy Growth Council (MDGC) has been one revitalization effort in Missouri. MDGC's mission is to grow a stronger and more viable dairy industry. Formed in January 2003, the council meets regularly to explore opportunities in communication, legislation, education and capital sources for producers. This group consists of dairy producers, allied industry representatives, state government staff and university faculty. The council has participated in trade shows such as the World Dairy Expo in Madison, Wis., and World Ag Expo in Tulare, Calif. Promoting Missouri as a dairy state to producers seeking to relocate or expand existing operations has been the primary goal.

Other programs in Missouri that have benefited dairy producers originate from the Missouri Agricultural and Small Business Development Authority (MASBDA). Housed at the Missouri Department of Agriculture, MASBDA implements financial assistance programs for Missouri livestock and crop producers as one of its roles. These programs include numerous loan programs, loan guarantees, tax credits and grants available to producers. The following is a list of financial assistance programs available to Missouri producers, including dairy, from MASBDA.

Beginning Farmer Loan Program
Beginning farmers can receive loans from commercial lenders on an average of 20 percent to 30 percent below conventional rates through this program. The reduced rates are made possible by tax-exempt bonds issued by MASBDA and sold to commercial lenders. Lenders, in turn, pass the savings derived from the tax-exempt bonds to beginning farmers in the form of lower interest rates. Bonds issued by the authority, including those used to fund beginning farmer loans, do not constitute a debt, liability or obligation of the state or of any political subdivision but are payable solely from the authority's revenues or assets. A qualified beginning farmer can borrow up to $509,600 to buy agricultural land, farm buildings, farm equipment and breeding livestock. For fiscal years 2010 to 2014, 49 beginning farmer loans were approved by MASBDA, and they totaled $9,767,663.

Animal Waste Treatment System Loan Program
Livestock producers are able to secure direct loans from MASBDA for animal waste treatment systems. Loans can be made for up to 10 years at fixed interest rates that are below conventional interest rates (currently at 4.3 percent). Loan proceeds may generally be used for financing waste facilities and equipment as approved by the Department of Natural Resources. For fiscal years 2010 to 2014, eight loans were approved by MASBDA, and they totaled $1,129,565.

Single-Purpose Animal Facilities Loan Guarantee Program
The Single-Purpose Animal Facilities Loan Guarantee Program is designed to provide banks and other lenders with a 50 percent first-loss guarantee on loans of up to $250,000 for up to 10 years. Independent livestock producers may use the loans to finance the acquisition, construction, improvement, rehabilitation or operation of land, buildings, facilities, equipment, machinery and animal waste facilities used to produce poultry, hogs, beef or dairy cattle or other animals in a single-purpose animal facility. Borrowers who qualify for the guaranteed livestock loan may also qualify for a reduced interest loan through the Missouri Linked Deposit Program administered by the state treasurer's office. For fiscal years 2010 to 2014, six guarantees were issued by MASBDA, and they totaled $892,500.

Family Farm Breeding Livestock Loan Program
The program provides Missouri tax credits to lenders in lieu of the first-year interest being paid on breeding livestock loans made to "small farmers" who are Missouri residents and who have less than $250,000 in gross agricultural product sales per year. Maximum eligible loans cannot exceed 90 percent of the cost of purchasing breeding livestock. Each small farmer shall be eligible for only one family farm livestock loan per immediate household family and only one type of livestock. For fiscal years 2010 to 2014, 122 producers took advantage of the program, and the program issued $204,658 in tax credits.

Dairy Business Planning Grant
This program provides Missouri dairies an opportunity to expand by providing business planning grants to aid them in determining the feasibility of the planned expansion. The grants provide up to 90 percent of the cost of the business plan, and the maximum grant is $5,000. This program was funded in fiscal year 2005 through general revenue funding. Eleven grants were funded, and they totaled $29,500. In fiscal year 2009, the program received no general revenue funding, but through contributions to MASBDA from the Missouri Dairy Growth Council and the Missouri Soybean Association, three grants were funded, and they totaled $15,000. In fiscal year 2011, the program received no general revenue funding, but again, through contributions to MASBDA from the Missouri Dairy Growth Council and the Missouri Soybean Association, four grants were funded, and they totaled $12,950.

Dairy Cow Loan Program
The goal of the Dairy Cow Loan Program is to facilitate the expansion of Missouri dairy operations by paying the first year's interest on any Missouri linked deposit loans made for the purchase of dairy cows or other replacement dairy females. This program has not been funded.

Livestock Feed and Crop Input Loan Guarantee Program
This program provides a 50 percent first-loss guarantee on loans made for livestock feed or crop inputs used to produce livestock feed. Thus, it encourages lenders to continue to make loans to farmers for livestock feed and feed crops on competitive terms. This program was authorized by legislation beginning in fiscal year 2012, but it has never been utilized.

3.2 Wisconsin

Beginning in the 1980s, Wisconsin milk production showed potential for decline. From 1988 to 2004, the state's annual milk production dropped from about 25 billion pounds to about 22 billion pounds. However, with intervention, the industry not only reversed this trend, but it also found opportunities to grow. Milk output totaled nearly 28 billion pounds in 2013. Over time, larger dairies have contributed more production by growing and modernizing their operations, and smaller dairies have pursued options like grazing and organic production to improve their viability (Natzke 2014).

Reversing the industry's decline involved several efforts. For producers and processors, the state introduced tax breaks, use-value tax assessments and investment-related tax deductions. The Professional Dairy Producers of Wisconsin (PDPW) and Dairy Business Association formed as groups that supported dairy producers and the dairy industry. The University of Wisconsin-Madison also implemented programs focused on modernizing the state's dairy industry (Natzke 2014).

PDPW is a dairy industry professional organization. In 2013, its membership totaled 1,600 farms in 18 states. The organization hosts several events and programs for its members. For example, PDPW organizes meetings and event focused on topics such as business transition, feed and nutrition, animal health, technology and financial management. It also hosts mentorship and internship programs for students interested in the dairy industry and develops other youth-centered programming. On its website, PDPW provides a virtual trade show that allows for identifying product and service providers. It also supports various initiatives including those that connect dairy producers with community leaders, veterinarians and agriculture service providers (PDPW 2014). The Dairy Business Association's purpose is to benefit the Wisconsin dairy industry by "fostering a positive business and political environment." Memberships include farmers, processors and other industry groups and businesses. Regulatory issues addressed by the group have included those related to water, the environment and waste management (Dairy Business Association 2014).

As the Wisconsin dairy industry positions itself for the future, it considers its specialty cheese business as an opportunity. Its cheese expertise gives the state credibility and the added value (Natzke 2014). Because Wisconsin has a dairy history, young producers have opportunities to assume leadership of their family farms. This is one reason Wisconsin hasn't implemented an aggressive attempt to attract farmers from other states. However, the state's many processors, dairy support services, animal genetics and health care, technologies and dairy education opportunities make it a good choice for dairy operations. These benefits may have contributed to relocation inquiries from producers from places including California, Pennsylvania, Maryland, Pakistan, Turkey, England and Japan during 2011 (Barrett 2012). Despite the opportunities available to Wisconsin's dairy industry, water quality and quantity remain challenges for the industry (Natzke 2014).

Currently, the Wisconsin Department of Agriculture, Trade and Consumer Protection administers the Dairy 30x20 program to support the Wisconsin dairy industry's future. The name stems from the initiative's goal to increase Wisconsin milk production to 30 billion pounds by 2020. The state has a need for more milk production because Wisconsin dairies supply only about 90 percent of the milk that state processors require. The initiative has several objectives. Those include helping producers to boost profitability, address management and operational needs, form business and legal frameworks, foster herd health, optimize milk production and support beginning farmers. Since 2012, the initiative has provided grant funding to Wisconsin dairy farms that need assistance related to business development, modernization, expansion or consulting. Funding may be used for planning purposes or improving profitability. Each farm legal entity that applies may request as much as $5,000, and they must supply at least 20 percent match. Possible eligible expenditures include professional services, equipment rental and supply purchases that are depreciated within a one-year period (Wisconsin Department of Agriculture, Trade and Consumer Protection 2014).

Processors also have grant resources available through the Dairy 30x20 program. They may request as much as $50,000 for eligible expenses such as operating costs, employee training expenses, equipment rental and equipment purchases that may be depreciated within a one-year period. The processor grant program also has at least a 20 percent match requirement. The processor grants are another tool used to improve the Wisconsin dairy industry's long-term sustainability (Wisconsin Department of Agriculture, Trade and Consumer Protection 2014).

3.3 New York

The milk production and dairy processing story in New York illustrates opportunities available when a state can attract manufacturers producing a popular dairy product. In New York, yogurt – and Greek yogurt in particular – has been that popular product. Chobani and Fage both process Greek yogurt in New York. When Fage first selected New York as a processing location, it wanted to be near the large Greek-heritage population in New York City (Neuman 2012). Upstate New York's proximity to numerous markets within a day's drive was another motivation for other companies like Alpina and Muller Quaker to build yogurt facilities in the area (Sommerstein 2013). Dairy farmers have benefited from the Greek yogurt production boom because Greek yogurt requires about three pounds of milk to produce one pound of the yogurt. When making traditional yogurt, a pound of milk yields a pound of yogurt. Greek yogurt production's need for extra milk generates good demand for New York-produced milk. The state economy has experienced positive results because Greek yogurt supports job creation and an economic multiplier effect (Neuman 2012).

State support for New York's dairy industry includes the PRO-DAIRY program. The program has a mission to "increase the competitiveness and sustainability of New York's dairy businesses through industry-applied research and educational programs that enhance farm profitability while advancing dairy professionals' knowledge, skills and enthusiasm." Formed in 1988, PRO-DAIRY has several focus areas: dairy farm business management, field crops and nutrient management, dairy environmental systems and renewable energy, dairy profit discussion groups, dairy management education, dairy youth programs and dairy industry communications and outreach. According to the program's 2013 annual report, PRO-DAIRY has received support from the New York State Department of Agriculture and Markets, New York state government, New York Department of Environmental Conservation, Cornell University College of Agriculture and Life Sciences and New York Farm Viability Institute (PRO-DAIRY 2013).

Several other efforts have targeted strengthening the New York dairy industry. For example, the state has made grants available for modernized milking equipment, business plans and anaerobic digesters (Sommerstein 2013). New York annually hosts a Yogurt and Dairy Summit. At the most recent summit, held during October 2014, the governor's office shared that several items were discussed. Those included a "Made in NY" program that encourages state institutions to purchase more dairy products made in New York. A renewable energy task force would form to identify energy needs of the dairy industry. Producers have access to newly approved funding that would support energy efficiency efforts. To expose students to dairy processing and train processing technicians and managers, the state has allocated as much as $1 million to a dairy processing facility at SUNY Cobleskill. At the summit, the governor also announced that yogurt would be the official snack of New York (Booker 2014).

Advocating for his state, Senator Chuck Schumer suggested a Farm Bill amendment in 2013 that would create a dairy block grant pilot program similar to the program already available for specialty crop producers. The amendment suggested a $5 million pilot program that would fund technical assistance to improve dairy productivity, profitability and environmental stewardship. Funding would have allowed dairies to access experts on topics such as animal nutrition, housing, breeding and nutrient management. Assisting small-scale dairy operations would have been the program's focus. In New York, dairy producers benefiting would have been better equipped to supply milk to buyers such

as Greek yogurt manufacturers. However, in other states, the pilot program would have given latitude in addressing specific needs state by state (Senator Charles E. Schumer 2013).

3.4 South Dakota

South Dakota sought to raise its profile as a dairy state when its dairy numbers began to constrict. During the 1960s, the state was home to about 250,000 cows, but over time, inventories eventually dropped to 79,000 cows in 2004, which was its lowest level. Since then, the industry has slowly rebounded. In 2014, dairy cattle inventory totaled 97,000 cows (Walker 2014b). Much growth has been attributed to increasing dairy size; however, the Midwest Dairy Association assures that operations of all sizes have opportunities (Harriman 2014). In 2012, the state planned to double its dairy herd size during the next five years (Barrett 2012).

Several factors contributed to dairy's growth in South Dakota. Since 2012, state government officials have attempted to encourage dairy farmers in other states, such as those on the West Coast, to move their operations to their state. Even the governor has played a role in these recruitment efforts (Harriman 2014). For example, he made an appearance at the 2014 World Ag Expo hosted in California. Specifically, his visit meant to target California dairy farmers and outline the benefits of operating in South Dakota to them. South Dakota's inexpensive land and feed, processors willing to source milk and less stringent regulatory environment may interest some California producers. Weather, especially the winters and changing seasons, may still be a limitation for California producers migrating to South Dakota (Visalia Times-Delta 2014). Other domestic recruitment efforts have included attending events hosted in Wisconsin and South Dakota (Swenson 2014).

South Dakota hasn't limited its recruitment efforts to the U.S. Officials have traveled to England, Ireland, Northern Ireland, the Netherlands and Canada to share about South Dakota's dairy industry and build interest in possible relocation (Swenson 2014). To attract foreign interest, the state implemented an EB-5 investment program, which provided a loan financing option for foreign dairies, such as those in Europe, relocating to South Dakota (Harriman 2014). By investing $500,000 in an approved rural project that generated at least 10 jobs, foreign investors could access U.S. visas (Walker 2014a). At least 17 dairies took advantage of the EB-5 program (The Associated Press 2014). However, the integrity of the program has been questioned (Walker 2014a).

Despite efforts to attract dairies interested in relocating, expanding South Dakota dairies are thought to lead to "the most sustainable growth in milk production." As dairies grow or move to South Dakota, state and local governments have a goal to ensure that milk cows don't concentrate too much in a given area (Swenson 2014).

South Dakota is accommodating from a tax perspective because it doesn't levy personal income tax, corporate tax, inventory tax or business tax. The state also has good access to cropland that can produce feed for dairy animals, and because the state tends to be more remote than some others, dairy producers don't need to worry as much as urban encroachment and its associated problems (Barrett 2012). Additionally, South Dakota has the water supplies needed for dairy farms (Harker 2014). Moving forward, a key element necessary for growth is ensuring that dairy cow waste is properly handled. As producers seek to grow, they'll also need more equity to qualify for capital that's necessary for expansion (Harriman 2014).

Other stakeholders have participated in promoting the state's dairy industry. For example, two processors located in South Dakota promoted the state's dairy industry using billboards strategically placed in Tulare County, Calif. Before the billboards, an advertising campaign promoted that South Dakota is better for milk production because it lacks milk production quotas (Barrett 2012).

Dairy farms have opportunity in South Dakota because processors are present in the state. For example, Davisco Food International operates a cheese processing facility in the state, but it has had to source milk from Idaho to meet its demand and supply its buyers, including Kraft Foods and importers in foreign countries (Barrett 2012). If it could source adequate milk supplies, then Davisco may be interested in expanding (Swenson 2014). In 2014, Bel Brands USA opened a cheese processing plant in Brookings, S.D. The plant will produce Mini Babybel cheese, which has benefited from increasing sales since 2009. The company picked the Brookings area because it provided milk at good prices; opportunity for further dairy growth; a good business climate; and well-educated students from South Dakota State University, which offers dairy production and processing degrees (Walker 2014b). California Polytechnic State University in San Luis Obispo is one other U.S. university that offers comprehensive programs in both dairy production and dairy manufacturing (Swenson 2014). South Dakota State University has been involved with processors updating their facilities or building new ones (Harker 2014). Cheese production may present an opportunity for the state because as states like Washington and Oregon export cheese, those states may lack access to enough cheese and represent potential markets for South Dakota-produced cheese (Harriman 2014).

In addition to serving South Dakota processors, some South Dakota dairy producers may supply milk to processors in other states. For example, South Dakota producers could ship milk to an Agropur cheese facility in Iowa. The Agropur facility would like to double its production, which could further expand opportunities for nearby South Dakota dairy producers (Swenson 2014).

3.5 North Dakota

Motivated by South Dakota's dairy industry improvement, North Dakota itself has committed to revitalization efforts (Knutson 2014). The North Dakota Dairy Coalition leads an effort to strengthen the dairy industry. The coalition, formed in 2004, promotes several North Dakota features that make it conducive to dairy production. Those include reasonable land prices, good communities, simple permitting process, feed ingredient availability, inexpensive feed byproducts nearby, economic development loan access from the state-owned bank and its affiliates, sales tax exemptions on many agricultural products, access to five milk markets and many in neighboring Minnesota and South Dakota, area to raise heifers, economical labor rates, low electric rates and vast space availability. The website maintained by the coalition further explains these features, and it also provides listings for dairy farms available by purchase or lease, hay available from local producers and other resources that would be helpful when evaluating whether to proceed with dairying in North Dakota (North Dakota Dairy Coalition). The state has also had an interest buy-down program as an incentive program, and it doesn't levy personal property taxes (Archwamety 2008).

In the past, North Dakota has attracted dairy families from California, New York, Wisconsin, South Dakota, Pennsylvania and Canada. Although the coalition retains out-of-state recruitment as an element of its approach, it has also had a priority to assist North Dakota dairies that already operate

and would like to expand. To fund the coalition's work, it has received support from state government, agriculture-focused groups, rural electric entities and grants (Archwamety 2008).

Although the coalition formed years ago, efforts haven't sparked the desired turnaround. Challenges affecting the industry have included few milk truck drivers available, distance between farms and processors, need for high labor rates and aging producers. In 2014, the state's dairy farm count fell below 100, and it had just three processing facilities. Coinciding with this drop in dairy farms, the coalition in 2014 was planning a resource network to help improve dairy farmer success (Holdman 2014). These efforts involve groups including dairy producers, the state agriculture department, crop group leaders and other dairy industry representatives (Knutson 2014). To share its message, the coalition has had a presence at farm shows and expos (Holdman 2014). One initiative included in the coalition's plan involves supporting crop producers who would like to diversify their operations and produce milk. Instead of exporting so much feed, the coalition has a goal to retain some of that feed to raise North Dakota cattle (Knutson 2014). Currently, North Dakota supplies feed such as hay and dried distillers grains to farms in other states. With respect to attracting producers considering relocation, dairies in Washington, Oregon, California, Holland and Ireland may like the opportunities and environment available in North Dakota (Holdman 2014).

3.6 Kansas

To attract dairies, neighboring Kansas has its own dairy recruitment program – Dairy in Kansas – that brands the state as "The Premier Dairy Frontier." The effort is a collaboration between the Kansas Department of Agriculture and the western Kansas Rural Economic Development Alliance (Dairy in Kansas 2014). The state's Department of Commerce has also contributed to Kansas state dairy promotion (Greve 2012). The Dairy in Kansas campaign's promotional message emphasizes Kansas' feed availability, including corn products, distiller's grains and alfalfa; desirable climate; water access; spacious rural area; heifer accessibility; and good communities (Dairy in Kansas 2014). The state's cattle feeding industry provides good background infrastructure for dairy expansion. Factors such as water use, environmental impact, labor, and consumer perceptions are still challenges for the state's dairy industry (Latzke 2014). Kansas also has a goal to interest dairies in states such as California and encourage them to relocate to Kansas (The Associated Press 2013).

Kansas has had dairy-related opportunities because it's near four states that haven't produced enough milk to satisfy their demand: Texas, Oklahoma, Missouri and Arkansas. So far, western Kansas has become a growth spot for Kansas dairies (Latzke 2013). In 2012, the western third of the state produced 70 percent of the state's total milk output (Greve 2012). Southwest Kansas has been called the state's "dairy case" (Latzke 2014).

Kansas offers several incentive and tax exemption programs that encourage dairies to operate in the state. Regarding incentives, the state itself has implemented two programs, and local communities may offer additional incentives. The Promoting Employment Across Kansas (PEAK) program allows companies bringing new jobs to Kansas or expanding within Kansas to keep 95 percent of payroll withholding tax for a 10-year period for the eligible jobs that they create. The Rural Opportunity Zone program, available in 73 counties throughout Kansas, provides state income tax exemptions for as long as five years and $3,000 in student loan forgiveness for individuals who meet certain conditions (Dairy in Kansas 2014).

Four tax exemptions may be an option for qualifying dairies. A business income tax exemption is available to partnerships, limited liability corporations, limited liability partnerships, sole proprietorships and subchapter-S corporations. An agricultural projects sales tax program exempts sales tax for capital investment-type projects that total at least $50,000. Kansas will exempt commercial and industrial machinery and equipment property tax if the machinery is meant to build or expand a facility. Several other sales tax exemptions exist for purchasing animals for agriculture and producing food, animal or dairy products or animal offspring (Dairy in Kansas 2014).

To ensure that dairies contemplating a move to Kansas understand the state's benefits, regulations and incentives, the Dairy in Kansas initiative has an easy-to-understand website – dairyinkansas.com – devoted to educating people about those items and providing the necessary contact information if interested parties have questions that they'd like to discuss. For more information about the incentives and benefits included in this section, go to the website. Additionally, the Dairy in Kansas initiative has had representation at events such as the World Dairy Expo, Elite Producer Business Conference and World Ag Expo (Dairy in Kansas 2014).

The state's characteristics and efforts to strengthen its dairy industry have resulted in some successes. Since the mid-1990s, both dairy cattle inventories and milk production measures have improved. Not only would the state like to increase the number of dairy farms and dairy cows, but it would also like to pursue more processing and serve the artisan dairy product market (Latzke 2013).

After several dairies concentrated in western Kansas, processors began to show interest in the area (Greve 2012). For example, since 2013, Kansas Dairy Ingredients in Hugoton, Kan., has removed water from milk that it processes and shipped the concentrated product to Springfield, Mo., where Kraft makes products like Kraft Singles and Velveeta cheese (Latzke 2014). Concentrated milk not only ships more efficiently, but its availability also somewhat simplifies cheese production (The Associated Press 2013). Instead of joining a cooperative, MasCow, a dairy in Moscow, Kan., has liked having the opportunity to directly sell to Kansas Dairy Ingredients and manage its price risk, which can contribute to better financial forecasting (Latzke 2014). In 2013, Kansas Dairy Ingredients received 75,000 gallons of milk each day, and it noted that it may later expand into dry milk and cheese production (The Associated Press 2013).

McCarty Dairies, located in Rexford, Kan., also partnered with a buyer. The arrangement with Dannon allows the dairy to exclusively provide milk to the Dannon facility in Fort Worth, Texas (Greve 2012). The McCarty-Dannon partnership started in 2011, and it drew interest because it was the first such partnership to form in North America. Dannon uses the milk from McCarty Dairies to produce Dannon Cream low-fat yogurt, which is sold in Sam's Club stores (Bowman 2014).

In November 2014, Dairy Farmers of America announced a partnership with China-based Inner Mongolia Yili Industrial Group that would bring a $100 million milk powder plant to Kansas. Although no location details have yet been confirmed, western Kansas is the likely planned area for that facility (Everly 2014).

3.7 Vermont

Based a 2013 report about Vermont's dairy industry, for the past 50 years, annual Vermont milk production has totaled more than 2 billion pounds. Of all Vermont agricultural product sales recorded during 2007, the milk and other dairy products commodity group represented nearly three-quarters of the total. Dairy processing also has a presence in the state as more than 60 processing plants operate, including many farmstead or artisan cheese facilities and a few large-scale processors such as Ben & Jerry's and Cabot Creamery (Sawyer et al. 2013).

Several dairy revitalization ideas were shared in the Vermont food system's 10-year strategic plan issued in 2013. Representatives from Vermont Sustainable Jobs Fund, Everything Agricultural and the Vermont Agency of Agriculture Food and Markets authored the plan's dairy section. In it, the authors categorized industry sustainability strategies into groups: research strategies; natural resource, physical infrastructure and technology strategies; sales and distribution strategies; marketing and public outreach strategies; technical assistance and business planning strategies; financing strategies; network development strategies; education strategies; and regulation and public policy strategies. Within these categories, the dairy sustainability ideas shared include developing best practice case studies about topics such as manure management, animal housing, on-farm energy production and diversification; analyzing the state's artisan cheese sector; encouraging Vermont goat milk production to double; promoting Vermont dairy products to institutional buyers; supporting industry marketing through public relations, farmers markets, community-supported agriculture programs and an annual Dairy Summit; reaching more farmers with technical and business planning assistance; pursuing financing alternatives such as consolidating dairy farm loans into one monthly payment, allowing cooperatives to seek non-producer member equity investments and purchasing equipment to share; addressing education programs that teach future dairy industry professionals; and revising the process for hiring migrant farm workers (Sawyer et al. 2013).

Dairy management teams were a network development strategy mentioned in the plan. The teams include five to eight advisers who collectively address topics such as enhancing profitability; decreasing production costs; promoting diversified operations; addressing nutrient management; and coordinating transitions like farm transfers, organic certification and farm preservation. The advisers may include stakeholders such as family, veterinarians, bankers and feed dealers. Personnel from University of Vermont Extension, the Farm Viability Program, the Vermont Small Business Development Center and the Vermont Agency of Agriculture Food and Markets may assist producers in identifying facilitators to lead the dairy management teams. By arranging for all of a dairy's team members to meet at the same time to discuss farm challenges, the group may collectively brainstorm options to address issues and opportunities (Sawyer et al. 2013).

The Vermont food system strategic plan also highlighted several entities and efforts in the state that provide support to the Vermont dairy industry. For example, the Vermont Pasture Network and Vermont Grass Farmers' Association share resources for producers using grass as a livestock feed. To help dairy farmers to adopt energy-efficient technologies, Efficiency Vermont has historically provided a rebate program for some agricultural equipment. At the University of Vermont, the Vermont Institute for Artisan Cheese conducts research and offers artisan cheese training. As another support mechanism offered by the University of Vermont, the Dairy Center of Excellence encourages producers to participate as research partners. From an advocacy perspective, Rural Vermont helped

an effort that involved the state approving raw milk-supportive policies. Keep Local Farms is a New England effort that requests consumer donations to assist local dairies (Sawyer et al. 2013).

The VT Food Venture Center is another effort that supports innovation in Vermont's dairy industry. The center acts as a shared-used incubator for entrepreneurs. Jasper Hill Creamery is the center's main tenant. At the center, Jasper Hill produces two cheeses (Jasper Hill Farm).

The Vermont Farm & Forest Viability Program provides business, technical and management assistance to Vermont's farm, food and forestry businesses. The program administers a "Dairy Improvement Grants" program for producers who are involved in the St. Albans Co-op (Vermont Farm and Forest Viability Program 2014). The dairy cooperative is Vermont's largest. It processes some member-produced milk into products like cream, skim milk, condensed milk and powdered milk. It also sells product to processors. For example, it provides all domestic milk for Ben & Jerry's (Sawyer et al. 2013). The grants, which may provide as much as $40,000 per applicant, fund infrastructure-related expenses that seek to improve milk production and farm viability. Several groups support the grant program: Commonwealth Dairy, St. Albans Cooperative Creamery, Dairy Farmers of America, Housing Vermont and the Massachusetts Housing Investment Corporation (Vermont Farm and Forest Viability Program 2014). The Massachusetts group may be involved because the St. Albans Co-op supplies milk to some Massachusetts processors (Sawyer et al. 2013).

Commonwealth Dairy, which provides funds for the Dairy Improvement Grants program, received many assistance offers when it began considering a location in Vermont during the late 2000s (Vermont Farm and Forest Viability Program 2014 and Agency of Commerce & Community Development 2014). Commonwealth Dairy wanted to produce private label yogurt, and state and local officials developed several incentives to encourage Commonwealth Dairy to locate its facility within Vermont. Of those, a few include a federal grant facilitated by the Brattleboro Development Credit Corporation to use for a $1.15 million public-private partnership water line, more than $1.2 million in incentives from the Vermont Economic Progress Council and more than $101,000 from the Vermont Training Program to fund on-job training (Agency of Commerce & Community Development 2014).

To educate college-age students about the dairy industry, the University of Vermont offers its CREAM program, Cooperative for Real Education in Agricultural Management. Each year, 13 to 16 students participate in the program, which allows them to earn eight credits combined in their spring and fall semesters and gain first-hand experience in managing a dairy farm and being responsible for the related farm chores. Any student at the university, not necessarily those who have a dairy or livestock background, may apply to participate in CREAM (University of Vermont 2014).

3.8 North Carolina

Like other states evaluated in this section, North Carolina has also experienced a slumping dairy industry. A 2012 presentation shared that the state only produced enough milk to satisfy about half of its fluid milk needs (Davidson 2012). Several processors – seven Grade A milk processing facilities, one large commercial cheese processing facility and more than 40 farmstead processors – operated in the state based on the 2012 presentation. To improve the industry's viability, a state initiative organized an extensive resource network to include the North Carolina Association for Dairy Stabilization & Growth Inc.; NC Dairy Advantage program; and other entities such as processors, input suppliers,

state government agencies, cooperatives, the North Carolina Dairy Producers Association, nonprofits, bankers, real estate agents and retailers (Davidson 2012).

Since 2007, the NC Dairy Advantage program, an effort of the North Carolina Association for Dairy Stabilization & Growth, Inc., has focused on improving the dairy industry's viability (The North Carolina Association for Dairy Stabilization & Growth, Inc. 2013). Several groups have contributed to NC Dairy Advantage: the NC Department of Agriculture and Consumer Services, NC State University Cooperative Extension, NC Farm Bureau and the NC Dairy Producers Association (Lathrop 2012).

NC Dairy Advantage has had four priorities. Those goals have been to create more value for milk and dairy products, improve quality of life for dairy farm families, accelerate milk production output and "support the total number of dairy farms." The effort has seemed to assist in improving the state's dairy industry. Compared with 2011 data, the state has grown its milk cow inventory and milk production (The North Carolina Association for Dairy Stabilization & Growth, Inc. 2013).

On its website, NC Dairy Advantage promotes several North Carolina features that make the state conducive to dairy production. Those include agriculture-focused communities, available infrastructure, adequate water and feed availability, support accessible from professionals and other producers and higher farm milk prices than those in other areas (The North Carolina Association for Dairy Stabilization & Growth, Inc. 2013).

To offer assistance to the state's dairy industry, NC Dairy Advantage includes several programs. The first, Advantage 1-on-1, is a free service that connects dairy producers with a team that can quickly help producers when they have a question, problem or information need. The second is the Farm Assessment initiative. Through this program, dairy producers may work with the NC Dairy Advantage team to develop a SWOT analysis and long-term goals. Before reaching these final deliverables, however, the team assesses a dairy from multiple perspectives, including herd health, nutrition, milk quality, reproduction and management. As the third program, Farm Profit Teams encourage dairy producers to create a stakeholder group that meets to discuss the business and share ideas about improving the dairy business' viability. Stakeholders on these teams may include a veterinarian, nutritionist, accountant and other professionals. The Dairy 20/40 program convenes meetings for younger producers, especially those 20 to 40, who seek assistance. The NC Dairy Advantage group also offers relocation assistance, and it assists dairy farms in start-up business planning (The North Carolina Association for Dairy Stabilization & Growth, Inc. 2013).

At the 2012 Southern Dairy Conference, a presentation from a North Carolina State University extension associate further highlighted efforts to sustain the North Carolina dairy industry. North Carolina personnel engage real estate agents and consultants to identify farms and other production resources; host workshops and programs dedicated to timely, relevant topics; consider value-added and diversification opportunities including grazing, organic production and dairy product production; and attend the World Dairy Expo to learn and promote North Carolina as a good location for dairy production (Davidson 2012).

Also during 2012, NC Dairy Advantage offered as many as 12 scholarships to cheesemakers from state-inspected cheese production facilities who were interested in attending the American Cheese Society annual conference, which was scheduled to convene in state. Recipients could use the $250 to

$375 award to reduce their conference attendance costs. USDA Rural Development and N.C. Market Ready provided the grant funding for scholarships (Lathrop 2012).

3.9 Kentucky

Since 2005, the Kentucky Dairy Development Council has pursued improving Kentucky's state milk production and quality and making the state's dairy producers more competitive. The organization describes that it has several purposes, including improving the state dairy industry's profitability, encouraging dairy industry growth and development and participating in dairy legislation and regulation efforts (Kentucky Dairy Development Council).

The Market Incentive Leadership of Kentucky Program, otherwise known as the MILK Program, pays incentives to dairy producers who increase production output and produce high-quality milk. Relative to the 2013/2014 average base, calculated monthly, a 5 percent production increase would lead to a $0.50 per cwt. incentive in 2015, and a 10 percent production increase would lead to a $0.75 per cwt. incentive. Specified SCCs and pre-incubation counts are quality considerations that the milk must satisfy. To participate, producers must have at least six qualifying DHIA tests during a rolling 12-month time period. At maximum, eligible farms may earn $15,000 per year from the MILK Program incentives. Producers earn incentives monthly, and they're paid quarterly. Participating in the MILK Program doesn't change incentives that Kentucky marketing agencies pay (Kentucky Dairy Development Council).

The MILK Counts program provides technical assistance focused on improving milk quality. Although all Kentucky dairy producers are eligible to participate, those involved in the MILK Program have first priority as MILK Counts can help them to achieve the MILK Program standards and earn MILK Program incentive payments. As a collaboration between the Kentucky Dairy Development Council and the University of Kentucky Dairy Extension program, MILK Counts participation involves DHIA records review and an on-farm visit and milk quality evaluation, which assesses factors including a farm's milking methods, management, animal hygiene and dry cow treatment. Several stakeholders can be involved in the on-farm visit, including the state dairy systems extension specialist, county extension agent, Kentucky Dairy Development Council consultant and veterinarian. Following the on-farm visit, dairy farmers receive a written report that shares improvement recommendations and estimates the possible economic impact associated with milk quality improvements. On-going support like improvement plan development, monitoring and follow-up visits are optional for participating producers (Kentucky Dairy Development Council).

As a state-branded milk, Udderly Milk is trademarked by the Kentucky Department of Agriculture. Sourced from a Kentucky dairy producer, the milk undergoes processing at the Prairie Farms Dairy facility in Somerset, KY (Kentucky Department of Agriculture). Walmart stores in the state distribute Udderly Milk products. For participating as suppliers, dairy producers may earn a $0.07 premium per gallon.

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