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The Economic Impact of Michigan's Food and Agriculture System

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EXECUTIVE SUMMARY

Major Findings

Michigan's food and agriculture system remains a major contributor to income and employment in the state's economy. The agri-food system encompasses everything from inputs such as fertilizers purchased by farmers to the food consumers buy at supermarkets and restaurants as well as the ethanol and fiber produced in the state. The system accounts for an estimated **\$104.7 billion** in direct, indirect and induced economic activity annually. This sector also accounts for approximately **805,000** jobs. These figures are estimates based on the best available sources of information with measurements generally consistent with the calendar years 2014-2016. However, most processing estimates are for 2012. The Census Bureau, which collects this information, generally updates this every five years. Data for 2017 is currently being collected but will not be released until 2020 or 2021.

Some activities such as direct farm sales to consumers are not captured, and given the delay in publishing data, particularly for food processing and wholesaling, the actual figures may be higher especially for the economic impact numbers. The economic impact includes, not only the direct impact of the industries themselves, but the impact on related industries (indirect impacts) and impacts on household spending (induced impacts).

Economic Impact

Exhibit A provides the summary analysis. Michigan's food and agriculture system which includes agriculture, food processing and manufacturing, leather processing, food wholesaling, retailing and food service, as well the floriculture/ornamentals/turfgrass and ethanol industries, accounts for a total of approximately \$104.7 billion in total economic activity – including direct, indirect and induced activity. This is an increase of 14.5 percent from the 2012 study (mostly based on 2010 data) and represents a compound annual growth rate of 2.3 percent. (See Table 12 in the body of the report for 2010-2016 comparisons). During the same time period, inflation increased by a compound annual growth rate of about 1.5 percent based on the GDP deflator.

These figures must be interpreted carefully. The direct impact of the entire system is \$62.4 billion; an increase of 19.0 percent or a compound annual growth rate of 2.9 percent from the 2012 study. The direct impact of the agribusiness and farm sector is \$8.4 billion or about 13.4 percent of the total. Most of the value-added activity in the sector is related to food processing, wholesaling and retailing (grocery, restaurant and food service). In 2016, the state's gross product was \$487.2 billion; the agri-food system directly accounts for 12.8 percent of this total. When the total economic impact is considered, the agri-food system accounts for 21.5 percent of the state's gross product.

Impact on Jobs

Michigan's food and agriculture system is a major source of employment for the state's workforce. Total employment in this sector – including direct, indirect and induced effects is approximately 805,000 of which more than 549,000 are directly employed within the sector. The level of employment declined between 2010 and 2015

by around 119,000. Most sectors of the agri-food system saw a decline in employment. Increased automation and labor shortages are the likely primary reasons for this decline

The food and agriculture system remains an important source of employment. The total employment impact accounts for approximately 17.2 percent of the total employment in the state. Given these figures, Michigan's food and agriculture system remains of substantial importance to the state's economy.

Full-time direct employment in the farm sector including farm labor is estimated to be in excess of 88,000 or approximately 16.1 percent of the total direct employment in the sector. Most sector employment is accounted for in food processing, wholesaling and retailing.

Exhibit A: Total Direct Indirect and Induced Economic Activity in Michigan's Agri-Food System (2016)

| | Economic Output (millions \$) | | | Employment | | |
|---|-------------------------------|----------------------|----------------|----------------|----------------------|----------------|
| | Direct | Indirect and Induced | Total | Direct | Indirect and Induced | Total |
| Agricultural Production and Processing | | | | | | |
| Farming | 8,357 | 4,333 | 12,690 | 88,274 | 37,162 | 125,436 |
| Food Processing and Manufacturing | 18,618 | 11,963 | 30,581 | 32,729 | 62,423 | 95,152 |
| Leather Processing | 218 | 124 | 342 | 470 | 739 | 1,209 |
| Adjustment of Double Counting | (1,238) | (667) | (1,905) | | | |
| Net Total | 25,955 | 15,753 | 41,708 | 121,473 | 100,324 | 221,797 |
| Food Wholesale and Retail | 33,217 | 25,159 | 58,376 | 414,365 | 151,550 | 565,915 |
| Floricultural/Ornamental/Turfgrass Services and Retail | 3,048 | 1,249 | 4,297 | 13,269 | 3,394 | 16,663 |
| Net Impact of Ethanol Production | 197 | 74 | 271 | 175 | 503 | 678 |
| Grand Total for the Food and Agricultural System | 62,417 | 42,235 | 104,652 | 549,282 | 255,771 | 805,053 |

The Economic Impact of Michigan's Food and Agriculture System

Introduction

Michigan's food and agriculture system is a major contributor to income and employment in the state's economy. The food and agriculture system accounts for approximately \$104.7 billion in direct, indirect and induced economic activity. This sector also accounts for approximately 805,000 jobs both directly, indirectly and through induced activity.

The food and agriculture system is fairly complex. The supply chain for products produced generated by this sector goes through several steps. Inputs are used at the farm level to grow the crops, livestock and milk, and fruits and vegetables. Farm products in turn are collected, graded, sorted, etc. After this step, the commodities are sent to food processors to create manufactured food products, or in the case of fresh fruits and vegetables, sent to wholesalers and brokers to be sold to retailers such as supermarkets or the food service industry. These food products are then wholesaled and retailed or consumed in restaurants.

Agricultural products used for energy such as ethanol, which uses corn as a feedstock, follows a somewhat different path. In the case of ethanol, corn is collected and the ethanol is extracted from the corn. The primary residual product, Dried Distillers Grains (DDGs), is used as an animal feed.

As the above outline shows, the food and agricultural system is complex and interconnected. The food and agriculture system is much more than farming. As such, in order to obtain a complete picture of the economic contribution of the sector, allied economic activity and employment also need to be considered as well as the income and employment generated throughout the system. The primary method used to generate figures on the total economic activity engendered by the food and agriculture system is an input-output model with multipliers generated by IMPLAN, a company that specializes in economic impact analysis software. More information about IMPLAN and the underlying assumptions the program uses can be found in the appendix.

This paper will analyze the economic **impact** of the farm, food processor and wholesale and retail levels of the agri-food supply chain on the Michigan economy. The input supply sector will also be considered, as will first level handlers of agricultural commodities such as grain elevators. For the purposes of this report, the nursery and landscape industries will also be considered part of the agri-food sector. Michigan is an important producer of many nursery and landscape products. The size and impact of the ethanol sector will also be discussed. Currently, the state has five ethanol plants in operation.

It should be noted the research methodology in this paper is based on that in Professor John N. Ferris' Staff Paper 00-11, *An Analysis of the Importance of Agriculture and the Food Sector to the Michigan Economy*, which was written in May of 2000. In most respects, this paper is an update of Professor Ferris' previous study. This allows for comparisons between the periods.

Economic Impact of the System

Farm Input Supply Firms

Farm products are produced through converting inputs such as fertilizer, fuel, agricultural credit services, equipment, land, chemicals, seed, and other factors of production into milk, beef, grains, fruits, vegetables and other farm products. The farm input supply industry is a critical link in the food and agriculture supply chain. For example, in 2016, Michigan farmers purchased \$573.2 million in fertilizer and lime, \$328.0 million in pesticides, and \$285.8 million in petroleum fuels and oil (Michigan Agricultural Statistics Service, p.4).

The total economic impact of the input supply sector is included in the multiplier effects of the farm sector. The income and economic activity generated at the farm level includes the farm input supply industry.

The Farm Sector

Livestock and Dairy

In dollar terms, livestock and dairy comprise the largest sector of the farm economy in Michigan in terms of sales and economic impact. Table 1 shows the economic impact of the livestock and dairy sector. These figures are a three year average from 2014 through 2016. As table 1 indicates, the total direct impact of the livestock and dairy sector was \$3.59 billion. Of this amount, dairy accounted for almost \$1.88 billion or slightly more 50 percent of the total. Dairy farming is the largest single livestock industry in the state. Other major livestock activities included cattle, hogs, eggs and turkeys. Dairy and eggs show an upward trend in production and value. The current difficulties facing the dairy sector may put downward pressure on dairy sales and output, although the increase in milk production has led to a range of possible new dairy processing facilities. A major pork processing facility that has recently begun operation will likely spur increased hog production.

The economic impact figures are derived from IMPLAN, and are adjusted to take double counting into account. The value of the livestock products include the value of feed, which is also included in the value of grain and hay production. In order to obtain a more accurate figure, the value of feed was subtracted out (see Table 5 on page 8).

The total economic impact of the livestock and dairy sector is approximately \$5.13 billion. This includes both direct and backward linked indirect economic activity resulting from livestock and dairy farming. Backward linked industries in the farm sector are input supply industries that were previously discussed.

Table 1: Economic Impact of the Livestock Products (Average 2014-2016)

| Commodity | Direct Impact (\$1,000s) | Total Impact (\$1,000s) |
|----------------------|-------------------------------------|------------------------------------|
| Milk | 1,881,472 | 2,775,035 |
| Cattle | 610,993 | 829,149 |
| Hogs | 353,022 | 499,732 |
| Honey | 13,009 | 18,416 |
| Eggs | 327,896 | 449,230 |
| Trout | 1,109 | 1,570 |
| Wool | 300 | 425 |
| Sheep and Lambs | 37,532 | 53,130 |
| Turkeys and Broilers | 184,533 | 252,817 |
| Mink | 2,423 | 3,430 |
| Horses* | 150,000 | 212,340 |
| Other | 23,400 | 33,125 |
| Total | 3,585,689 | 5,128,399 |

Sources: *2006 DNR Figure, Michigan Agricultural Statistics Service: Michigan Agricultural Statistics 2016-2017

Field Crops

Field crops are the second largest sector of the Michigan farm economy and are an important input in livestock production. Table 2 shows the economic **impact** of the major field crops grown in the state. The three largest field crops in dollar terms are corn, soybeans, and hay. Corn is the largest single farm sector crop with sales in excess of \$1.3 billion. Wheat, sugar beets, potatoes and dry beans also account for more than \$140 million each a year in direct economic activity per year. Michigan ranks second in the U.S. in the production of dry beans.

The total direct economic activity generated by the field crops is \$3.22 billion. Total economic activity including backward linked activity, such as farm input supplies, is \$5.12 billion.

Table 2: The Economic Impact of Field Crops (Average 2014-2016)

| Crop | Direct Impact (\$1,000s) | Total Impact (\$1,000s) |
|----------------|-------------------------------------|--|
| Corn for Grain | 1,206,986 | 2,072,468 |
| Dry Beans | 146,617 | 251,756 |
| Hay | 367,290 | 593,144 |
| Maple Syrup | 5,384 | 8,695 |
| Oats | 6,430 | 11,041 |
| Potatoes | 181,738 | 293,489 |
| Soybeans | 910,586 | 1,215,582 |
| Sugarbeets | 189,349 | 308,490 |
| Wheat | 208,671 | 358,309 |
| Other | 1,396 | 2,254 |
| Total | 3,224,447 | 5,115,228 |

Source: Michigan Agricultural Statistics Service: Michigan Agricultural Statistics 2016-2017

Vegetables

Michigan is known for the wide variety of vegetables grown in the state. Table 3 lists the major vegetables grown and the economic value generated by these products. In dollar terms, cucumbers and tomatoes are the largest category of vegetables produced in the state. However, there are many vegetables which by themselves are small in terms of sales; however when aggregated, their impact is quite large.

The state is an important producer of many specific categories of vegetables. In 2016, Michigan was the number one producer of cucumbers, squash, and asparagus, and ranked second in celery production. The state is the third largest producer of snap beans, and fourth in carrot production (Michigan Agricultural Statistics, p.1).

The direct value of the vegetable sector is \$278.32 million with a total economic impact of approximately \$428.20 million. It should be noted that IMPLAN multipliers do not vary with the type of vegetable produced.

Table 3: The Economic Impact of Vegetable Production (Average 2014-2016)

| Crop | Direct Impact (\$1,000s) | Total Impact (\$1,000s) |
|---------------------------|-------------------------------------|------------------------------------|
| Cucumbers for Processing | 40,027 | 61,581 |
| Snap Beans for Processing | 17,283 | 26,590 |
| Tomatoes for Processing | 13,229 | 20,353 |
| Snap Beans | 11,592 | 17,834 |
| Cabbage | 13,567 | 20,873 |
| Carrots | 7,419 | 11,414 |
| Sweet Corn | 22,127 | 34,042 |
| Cucumbers | 13,951 | 21,464 |
| Onions | 10,400 | 16,000 |
| Tomatoes | 31,137 | 47,904 |
| Asparagus | 20,142 | 30,988 |
| Celery | 18,782 | 28,896 |
| Bell Peppers | 13,944 | 21,453 |
| Pumpkins | 11,085 | 17,054 |
| Squash | 20,489 | 31,522 |
| Other | 13,148 | 20,228 |
| Total | 278,322 | 428,198 |

Source: Michigan Agricultural Statistics Service, Michigan Agricultural Statistics 2016-2017

Fruit

As is the case with vegetables, Michigan is a major producer of fruits. Table 4 shows the economic **impact** of fruit production in the state.

Table 4: The Economic Impact of Fruit Production (2014-2016)

| Crop | Direct Impact (\$1,000s) | Total Impact (\$1,000s) |
|----------------|-------------------------------------|------------------------------------|
| Apples | 249,284 | 386,684 |
| Blueberries | 117,705 | 182,584 |
| Tart Cherries | 58,705 | 91,063 |
| Sweet Cherries | 19,821 | 30,746 |
| Grapes | 25,305 | 39,253 |
| Peaches | 7,625 | 11,828 |
| Plums | 753 | 1,168 |
| Strawberries | 6,243 | 9,684 |
| Total | 485,441 | 753,010 |

Source: Michigan Agricultural Statistics Service, Michigan Agricultural Statistics 2016-2017

The largest fruit categories in dollar terms are apples, blueberries, and tart cherries. Michigan leads the nation in the production of tart cherries. The state was the third largest producer of apples and blueberries in 2016. Grape production includes both juice and wine grapes. Given the growth in the wine industry, this figure might be understated.

The direct economic **impact** of fruit production in the state is \$485.44 million. The total economic activity including backward linked industries related to fruit production is \$753.01 million. As is the case with vegetable farming, IMPLAN uses the same multiplier for all types of fruit and for the fresh and processed markets.

Nursery/Landscape

Michigan is a major producer of nursery and landscape products. It is a major producer of Geraniums, Impatiens, and Petunias. The state is a major producer of Christmas trees as well. The economic impact of this industry is often overlooked.

The direct **impact** of nursery and landscape production is estimated to be \$783.40 million. The total impact of nursery and landscape production, including backward linked industries, is \$1.26 billion.

The Size of Michigan Farming

The total economic impact of Michigan farming is summarized in table 5. Table 5 overstates the total impact of the farm sector due to double counting. For example, breeding livestock can be both a cost of production and a source of revenue. Table 5 does show the importance of the farm sector on the Michigan economy. Even after adjusting \$1.90 billion in seed and feed and other farm produced inputs, the sector accounts for about \$10.78 billion in total economic activity and more than \$7.11 billion in direct economic activity.

Table 5: Summary of the Economic Impact of Farming

| Type of Product Produced | Direct Impact (\$1,000s) | Indirect and Induced Impacts (\$1,000s) | Total Impact (\$1,000s) |
|--------------------------------|--------------------------|---|-------------------------|
| Livestock/Dairy | 3,585,689 | 1,542,710 | 5,128,399 |
| Field Crops | 3,224,447 | 1,890,781 | 5,115,228 |
| Vegetables | 278,322 | 149,876 | 428,198 |
| Fruit | 485,441 | 267,569 | 753,010 |
| Adjustment for Double Counting | (1,238,000) | (667,000) | (1,905,000) |
| Floriculture/Nursery/Turfgrass | 783,404 | 481,490 | 1,264,894 |
| Total Farm Impact | 7,119,303 | 3,665,426 | 10,784,729 |

Food Processing and Manufacturing

The next step along the supply chain from the farm level is food processing and manufacturing. Intermediate steps such as collection, transportation, grading, sorting, etc. are backward linked to food processing and manufacturing. Just as there is a multiplier effect for farming, there is also a multiplier effect for food processing and manufacturing. Table 6 shows the **impact** of food processing and manufacturing in Michigan. For the most part, these figures come from the 2012 economic census. While the 2012 census figures are the most recent and accurate figures available, they likely underestimate the current value of food processing and manufacturing. The effects of inflation have likely increased food processing sales and related economic impact.

Table 6 shows the wide range of activities carried out by the food processors and manufacturers in the state. The legacy of the prepared cereal entrepreneurs can be seen in the size of the breakfast cereal industry in the state which accounts for about \$2 billion in total economic activity. The size of the Michigan dairy industry is reflected in the size of the fluid milk industry, and the production of other dairy products, especially dry milk powder. The great diversity of agricultural commodities grown in Michigan is reflected in the size of the processed fruit and vegetable products industries. The pending expansion of hog processing will increase the size of the animal slaughtering and processing figures, which in terms of economic **impact**, is already the largest processing activity in the state.

The total size of the food processing and manufacturing industries is \$18.62 billion in direct economic activity and approximately \$30.58 billion in total economic activity. Indirect and induced economic activity resulting from food processing and manufacturing is about \$11.96 billion.

Table 6: The Economic Impact of Food Processing 2012

| Industry | Direct Impact (\$1,000s) | Indirect and Induced Impacts (\$1,000s) | Total Impact (\$1,000s) |
|---|-------------------------------------|--|--|
| Dog and Cat Food Manufacturing | 38,000 | 13,912 | 51,912 |
| Other Animal Food Manufacturing | 306,000 | 143,943 | 449,943 |
| Flour Milling/Oilseed/ Fats and Oils Processing | 831,111 | 578,730 | 1,409,841 |
| Breakfast Cereal Manufacturing | 1,361,889 | 598,778 | 1,960,667 |
| Sugar Manufacturing | 541,468 | 367,282 | 908,750 |
| Candy and Chocolate Manufacturing | 716,532 | 495,697 | 1,212,229 |
| Frozen food Manufacturing | 699,000 | 486,282 | 1,185,282 |
| Fruit and Vegetable/Canning/Pickling/Drying | 1,124,000 | 511,764 | 1,635,764 |
| Fluid Milk Processing | 1,342,000 | 787,369 | 2,129,369 |
| Dry Condensed and Evaporated Milk | 2,823,000 | 1,513,954 | 4,336,954 |
| Other Dairy Product Processing | 549,000 | 384,300 | 933,300 |
| Animal Slaughtering and Processing | 2,844,000 | 2,799,000 | 5,643,000 |
| Bread and Bakery Products | 1,256,000 | 829,509 | 2,085,509 |
| Other Baked Products/Tortillas | 185,000 | 130,535 | 315,535 |
| All Other Food Manufacturing | 1,589,000 | 1,134,073 | 2,723,073 |
| Soft Drinks/Water/Ice/Distilleries | 2,167,958 | 1,050,389 | 3,218,347 |
| Breweries | 197,500 | 106,004 | 303,504 |
| Wineries | 47,042 | 31,357 | 78,399 |
| Total | 18,618,500 | 11,962,878 | 30,581,378 |

Source: U.S. Census Bureau

Food Wholesaling and Retailing

Retailing and wholesaling are an important component of the agri-food system. The figures for these activities were estimated using the U.S. Department of Agriculture figures for spending on food in 2014, and adjusting for Michigan's share of the U.S. population. The multiplier used is a weighted average of wholesaling, retail and food service multipliers. It is estimated that direct **impacts** of the wholesaling, retailing and food service sectors of the agri-food system is approximately \$33.22 billion with a total economic impact of approximately \$58.38 billion.

Total Value of the Food and Agriculture System

The last two components of the Food and Agriculture System not accounted for in previous sections are leather processing and ethanol. Their respective economic impacts are included in the summary Table 7. The ethanol figures have been adjusted to exclude the value of corn used in the production of ethanol and to include the value of dried distillers grains produced as a result of the ethanol production process.

Table 7 presents the total value of the Michigan Food and Agriculture System. Direct economic activity is estimated to be \$64.42 billion, an increase of 19.0 percent from 2010 to 2016. The total economic impact of these industries is equal to \$104.65 billion, an increase of 14.5 percent from 2010 to 2016. The activities accounted for

are not entirely complete. For example, farm market sales are not included, nor are some agri-tourism activities. The figures should be considered estimates and not the definitive picture of Michigan food and agriculture. They are the best estimates given the level of information available and the assumptions made. The Appendix provides a more complete discussion of the methodology used.

Table 7: Aggregate Estimates of Direct and Total Economic Impact of Output in Michigan's Food and Agriculture System (2016)

| | Economic Output (millions \$) | | |
|---|-------------------------------|----------------------|----------------|
| | Direct | Indirect and Induced | Total |
| Agricultural Production and Processing | | | |
| Farming | 8,357 | 4,333 | 12,690 |
| Food Processing and Manufacturing | 18,618 | 11,963 | 30,581 |
| Leather Processing | 218 | 124 | 342 |
| Adjustment of Double Counting | (1,238) | (667) | (1,905) |
| Net Total | 25,955 | 15,753 | 41,708 |
| | | | |
| Food Wholesale and Retail | 33,217 | 25,159 | 58,376 |
| | | | |
| Floricultural/Ornamental/Turfgrass Services and Retail | 3,048 | 1,249 | 4,297 |
| | | | |
| Net Impact of Ethanol Producton | 197 | 74 | 271 |
| | | | |
| Grand Total for the Food and Agricultural System | 62,417 | 42,235 | 104,652 |

The Impact of the Food and Agriculture System on Employment

Introduction

The techniques used to determine the level of employment attributed to the food and agriculture system is similar to determining the economic impact of this sector. One thing that makes the analysis easier is the fact that double counting is less of an issue; a job is only counted once. Jobs are not inputs in other jobs. One thing making the analysis more difficult however is that employment estimates are on a jobs basis and do not discern full and part-time employment. Basing employment in terms of full-time equivalents (FTEs) would make comparisons easier. Adjusting for FTEs is done at the farm level, but is not done in the other industries.

As a result, the employment figures listed in this section may overstate the full effects of employment resulting from the food and agriculture system. As noted, the farm sector is adjusted to include employment on an FTE basis. Most other industries such as wholesaling and many food manufacturing operations also employ people on a full time basis. Other industries such as the food service industry employ many people on a part-time basis.

The employment numbers have multiple sources across several different years. An attempt was made to use the latest data available. Data sources include the 2012 U.S. Economic Census, County Business Patterns, and Bureau of Labor Statistics (BLS) for the state of Michigan, and the 2012 Census of Agriculture for farm level employment. Retail employment estimates were generated using output per employee and total sector revenues. (See the Appendix for additional detail.)

As is the case with the economic impact figures, the employment figures will be split by farm sector, food processing/manufacturing, wholesaling, and retailing. As is the case with the economic impact analysis, employment in the nursery/landscape/turf grass and ethanol industries will also be considered.

Farm Input Supply Firms

As is the case with the economic impact figures, employment figures in the input supply industries are linked backward into agricultural production. The input supply industry is an important aspect of the food and agriculture system. Employees in this industry serve a vital role in providing goods and services to farmers.

As farming becomes more complex, the need for the services offered by input supply firms is likely to increase. The utilization of custom harvesting, custom spraying, crop scouting, and other services will likely increase in the future, especially given the increasing emphasis on food safety, minimizing environmental impacts and the need for increased record keeping, placing more emphasis on the input supply industry.

Farming

The U.S. Census of Agriculture breaks both farmers and farm labor down according to the number of hours worked. This allows an estimate of the number of FTEs employed in farming. In 2012, the state had 78,948 farmers including partners and other farm owners, not all of them full-time producers. There were also 83,451 hired farm workers in 2012. Table 8 gives a breakdown of the number of farmers and hired farm workers in 2012.

Table 8: Employment on Michigan Farms 2012

| Type of Employment | Total Number | Full-Time Equivalents |
|----------------------|----------------|-----------------------|
| Owner Operators | | |
| Days Worked Off Farm | | |
| None | 32,025 | 32,025 |
| Less than 200 | 16,326 | 10,158 |
| More than 200 | 30,597 | 3,060 |
| Total | 78,948 | 45,243 |
| Hired Labor | | |
| Days Worked on Farm | | |
| 150 or More | 25,710 | 25,710 |
| Less than 150 | 57,741 | 17,321 |
| Total | 83,451 | 43,031 |
| Grand Total | 162,399 | 88,274 |

Sources: USDA Census of Agriculture

Table 8 shows the dichotomy of Michigan farms. Most farmers are either full-time farmers or part-time farmers many who derive little income from their on-farm activities. It is estimated there are 45,243 farmer FTEs. Farming is also an important employer; especially for part-time or seasonal work. The number of hired labor FTEs is estimated to be 43,031. In 2012, there were 162,399 people employed at the farm level with a total number of FTEs in the industry estimated to be 88,274. Using an employment multiplier of 1.421 yields a total number of those employed in farming and backward linked industries of 104,764. Indirect and induced employment is equal to 125,436. Compared with the 2012 study, the level of employment in farming is steady or increasing slightly, with the number of farm operators increasing slightly and the number of employees declining somewhat.

Food Processing and Manufacturing

Due to the diversity of Michigan agriculture, the state has a wide range of food processing and manufacturing facilities. The employment resulting from food processing and manufacturing is outlined in table 9. This figure should be considered an estimate. Many industries have one or a few firms. Some employment numbers are suppressed or are somewhat dated in order to protect the identity and employment levels of specific firms. Employment figures for food processing were generally provided by the U.S. Census Bureau, County Business Patterns, an annual publication generated by the U.S. Census Bureau and are generally for either 2014 or 2015.

Table 9: Food Processing Employment in Michigan

| Industry | Direct Employment | Indirect and Induced Employment | Total |
|--|--------------------------|--|---------------|
| Pet Food Manufacturing | 38 | 124 | 162 |
| Other Animal Food Manufacturing | 263 | 1,010 | 1,273 |
| Flour Milling | 496 | 3,180 | 3,676 |
| Starch and Vegetable Oil Manufacturing | 149 | 1,862 | 2,011 |
| Breakfast Cereal Manufacturing | 1,499 | 3,437 | 4,936 |
| Sugar Manufacturing | 1,136 | 3,203 | 4,339 |
| Chocolate and Confectionary Manufacturing | 595 | 1,147 | 1,742 |
| Nonchocolate Confectionary Manufacturing | 376 | 429 | 805 |
| Frozen Food Manufacturing | 1,921 | 3,398 | 5,319 |
| Fruit and Vegetable Canning/Pickling/Drying | 2,950 | 3,857 | 6,807 |
| Fluid Milk and Butter Manufacturing | 1,736 | 5,033 | 6,769 |
| Dry and Condensed Milk Manufacturing | 1,717 | 9,142 | 10,859 |
| Cheese Manufacturing | 632 | 2,060 | 2,692 |
| Ice Cream and Frozen Dessert Manufacturing | 192 | 219 | 411 |
| Animal (Except Poultry) Processing | 1,820 | 2,132 | 3,952 |
| Poultry Processing | 2,045 | 1,641 | 3,686 |
| Meat Processed from Carcasses | 1,058 | 1,081 | 2,139 |
| Seafood Processing | 26 | 27 | 53 |
| Bread and Bakery Product Manufacturing | 5,013 | 2,456 | 7,469 |
| Cookie, Cracker and Pasta Manufacturing | 425 | 474 | 899 |
| Tortilla Manufacturing | 137 | 101 | 238 |
| Snack Food Manufacturing | 814 | 1,555 | 2,369 |
| Coffee and Tea Manufacturing | 201 | 449 | 650 |
| Flavoring, Syrup and Concentrate Manufacturing | 68 | 300 | 368 |
| Seasoning and Dressing Manufacturing | 954 | 1,292 | 2,246 |
| All Other Food Manufacturing | 925 | 1,069 | 1,994 |
| Soft drink and Ice Manufacturing | 3,163 | 7,148 | 10,311 |
| Breweries | 1,601 | 3,689 | 5,290 |
| Wineries | 634 | 619 | 1,253 |
| Distilleries | 145 | 289 | 434 |
| Total | 32,729 | 62,423 | 95,152 |

Source: U.S. Census Bureau

The number of employees in food processing and manufacturing industries is estimated to be 32,729. There were an additional 470 workers employed in the leather tanning and finishing industry. The total level of employment directly in these industries is 33,199 with a total level of employment resulting from food processing, including indirect and induced jobs of 95,152. The level of employment in food processing and manufacturing appears to be declining.

Food Wholesaling and Retailing

Most of the employment in the agri-food system occurs at the wholesale and retail level. Employment in wholesaling is outlined in table 10. In total, the wholesaling sector accounted for 27,123 jobs in direct employment and a total of 59,193 in direct, indirect and induced employment. Employment in food wholesaling appears to be declining slightly.

Table 10: Wholesaling Employment

| Industry | Direct Employment | Indirect and Induced Employment | Total Employment |
|--|-------------------|---------------------------------|------------------|
| General Line Merchant Wholesalers | 4,343 | 5,136 | 9,479 |
| Packaged Frozen Food Wholesalers | 1,686 | 1,993 | 3,679 |
| Fish and Seafood Wholesalers | 61 | 72 | 133 |
| Meat and Meat Product Wholesalers | 1,588 | 1,877 | 3,465 |
| Fruit and Vegetable Wholesalers | 2,081 | 2,460 | 4,541 |
| Dairy Product Wholesalers | 1,905 | 2,252 | 4,157 |
| Poultry Product Wholesalers | 19 | 22 | 41 |
| Confectionary Wholesalers | 1,617 | 1,912 | 3,529 |
| Other Grocery Product Merchant Wholesalers | 8,099 | 9,577 | 17,676 |
| Nursery and Florist Merchant Wholesalers | 1,211 | 1,432 | 2,643 |
| Alcoholic Beverage Wholesalers | 4,513 | 5,337 | 9,850 |
| Total | 27,123 | 32,070 | 59,193 |

Source: U.S. Census Bureau

Employment in retailing is extremely difficult to estimate. Food products are sold virtually everywhere: gas stations, club stores, bookstores, golf courses, and bowling alleys to name a few. Furthermore, much of the employment at the retail level is part-time. This is especially true for those employed in the food service industry. Conversely, not all purchases at grocery stores or other traditional food outlets are spent on food products.

One way to estimate employment at the retail level is to divide the expenditures on food purchases by retail sales per employee. This was used to derive a figure for food store employment. Figures for food service are from the U.S. Census Bureau

Total employment in the wholesale, retail and food service sectors of the food and agriculture system is estimated to be 387,242. The total **impact** of these sectors on employment is 506,672. It appears that employment in these sectors is declining, especially in the retail and food service industries. Consumers are moving away from traditional supermarkets toward more efficient mass merchandisers such as Meijer and Wal-Mart. Also, as is the case with industries, automation and labor shortages is putting downward pressure on employment in the food retailing and food service.

Ethanol

One ethanol plant normally employs 35 people. It is estimated the five plants in operation in Michigan employ 175 people directly. Using a multiplier of 3.875 yields a total direct and indirect employment for these plants of 678 persons.

Given the increased interest in alternative energy and technological advances in methane digesters and other forms of bio-energy, employment and output in agri-energy may increase in the future. However, increases from corn ethanol are unlikely.

Employment Summary

Table 11 gives the breakdown of employment in Michigan's Food and Agriculture sector by industry. Two sectors not commented on separately but shown in Table 11, are leather processing and floriculture/ornamental/turfgrass services and retail. Floriculture/ornamental/turfgrass adds an additional 13,269 direct jobs with a total impact on employment of 16,663.

It is estimated the Food and Agriculture System accounted for 549,282 jobs in direct activity and 255,771 jobs in indirect and induced activity for a total of 805,053 jobs in the state.

It appears the level of employment in the food and agriculture system has declined since the 2012 study. Overall employment has declined by approximately 119,000 or 12.9 percent. Declines appear to be in the food retail and food service sectors, as well as in the ornamental horticulture retail and services industries. This decline may be due to increased automation in the affected industries, increased concentration in the food retail sector and technological change such as the growth of self-serve food checkout lanes. Nonetheless, the size of the sector would likely increase if labor shortages could be addressed.

According to the Bureau of Labor Statistics (BLS), there were approximately 4.67 million people employed in Michigan in March 2018 not adjusted for FTEs. Including indirect and induced effects, the Food and Agriculture System accounted for approximately 17 percent of all the jobs in the state. This sector is an important source of jobs and income to the state's residents.

Table 11: Total Employment in Michigan’s Food and Agriculture System

| | Direct | Indirect and Induced | Total |
|---|----------------|-----------------------------|----------------|
| Agricultural Production and Processing | | | |
| Farming | 88,274 | 37,162 | 125,436 |
| Food Processing and Manufacturing | 32,729 | 62,423 | 95,152 |
| Leather Processing | 470 | 739 | 1,209 |
| Total Agricultural Production and Processing | 121,473 | 100,324 | 221,797 |
| | | | |
| Wholesale and Retail | | | |
| Wholesale | 27,123 | 32,070 | 59,193 |
| Retail and Food Service | 387,242 | 119,480 | 506,722 |
| Total Wholesale, Retail and Food Service | 414,365 | 151,550 | 565,915 |
| | | | |
| Floricultural/Ornamental/Turfgrass Services and Retail | | | |
| | 13,269 | 3,394 | 16,663 |
| | | | |
| Ethanol | | | |
| | 175 | 503 | 678 |
| | | | |
| Total | 549,282 | 255,771 | 805,053 |

Comparisons of 2010 and 2016 Economic Impacts and Employment

This report represents a complete update and restatement of a similar report published by the Product Center in 2012. That report was largely based on 2010 data while this report is largely based on 2012 through 2016 data. Table 12 presents comparisons across the six year period.

The total economic impact of the Michigan Food and Agricultural System increased 14.5 percent in total for a compound annual growth rate of 2.3 percent somewhat higher than the rate of inflation measured by the GDP deflator. As a result of declining farm prices, the economic impact of farming declined by 3.1 percent from the 2012 study. The economic impact of landscape services also declined; this may be due to labor shortages in that industry.

There was a decline in employment. Overall system employment was down by approximately 13.0 percent. There were losses in food processing, wholesale and retail and landscape services. Despite these declines, the food and agriculture system is a major source of economic activity and adds a level of stability to a state that is dependent on industries that are susceptible to business cycle fluctuations.

Table 12 summarizes the changes between the findings in the 2012 study and the 2018 study.

Table 12: 2010-2016 Comparison of the Total Economic Impact and Employment in Michigan's Food and Agriculture System

| Category | Economic Impact (\$ Millions) | | | Employment | | |
|--|-------------------------------|----------------|-------------|----------------|----------------|---------------|
| | 2010 | 2016 | % Change | 2010 | 2016 | % Change |
| Food & Agricultural Production & Processing | | | | | | |
| Farming | 13,091 | 12,690 | -3.1 | 104,764 | 125,436 | 19.7 |
| Food Processing and Manufacturing | 24,563 | 30,581 | 24.5 | 129,186 | 95,152 | -26.3 |
| Leather Processing | 84 | 342 | 407.1 | 380 | 1,209 | 94.5 |
| Adjustment for Double Counting | (2,140) | (1,905) | (11.0) | | | |
| Net Total | 35,598 | 41,708 | 17.2 | 234,330 | 221,797 | (5.5) |
| | | | | | | |
| Food Wholesale and Retail | 51,046 | 58,376 | 14.4 | 655,099 | 565,915 | (13.6) |
| | | | | | | |
| Floricultural/Ornamental/Turfgrass services and retail | 4,515 | 4,297 | (4.8) | 33,393 | 16,663 | (50.1) |
| | | | | | | |
| Net Impact of Ethanol Production | 223 | 271 | 21.5 | 678 | 678 | 0.0 |
| | | | | | | |
| Total Food and Agriculture | 91,382 | 104,652 | 14.5 | 923,500 | 805,053 | (12.9) |

Michigan's food and agriculture system accounts for a total of approximately \$104.7 billion in economic activity and approximately 805,000 jobs. The system generates more than \$62.4 billion in direct activity (farming, food processing and manufacturing, wholesaling, retailing, and food service), and almost 550,000 jobs in the same activities.

Given these figures, the importance of the food and agriculture system on the economy becomes evident. To a great extent, the health of the Michigan economy is dependent on this sector. The food and agriculture system also adds to the stability of the state's economy. Much of Michigan's economy is based on industries that have strong adverse reactions to economic downturns. Due to the fact that food is a necessity, the food and agriculture system is more resistant to the negative impacts of a recession.

Appendix: Research Methodology

Overview

The research methodology in this paper is based on that in Professor John N. Ferris' Staff Paper 00-11, *An Analysis of the Importance of Agriculture and the Food Sector to the Michigan Economy*, which was written in May of 2000. In most respects, this paper is the update of Professor Ferris' previous study.

One shortcoming to this study is that different years were used for the analysis. To the greatest extent possible the complete and recent data available information was used to generate the estimates. However, for processing and manufacturing, the most recent available data tended to be from the U.S. Economic Census and are based on 2012 figures. Farm employment is based on the 2012 Agriculture Census and is also somewhat dated. The farm output figures are from the U.S. Department of Agriculture. Most of the rest of the data was retrieved from the Census Bureau's Industry Statistics Portal. The reasons for using multiple years is to generate the most up to date estimate possible and to be consistent with previous economic impact studies. Despite these shortcomings, this analysis does give a good general perspective on the size and scope of the food and agriculture system.

The Farm Sector and Food Manufacturing

The output on farms is a three year average from 2014 through 2016. Due to climate and other factors, farm output can vary widely from year to year; a three year average eliminates some of this variability. The multipliers used to determine the total economic impact of farming are derived from IMPLAN; related industries were subtracted out in order to reduce the potential for double counting.

On farm employment is derived from the U.S. Census of Agriculture data for Michigan. The same adjustments used by Professor Ferris were made for part-time labor and part-time farmers to generate a figure for FTEs.

Food manufacturing output figures primarily come from the 2012 U.S. Economic Census, the employment figures were provided primarily from the County Business Patterns. This information was gathered from the Census Bureau's Industry Statistics Portal.

Wholesaling and Retailing

Output for wholesaling and retailing were generated from the USDA Economic Research Service's Food CPI, Prices and Expenditures; Food and Alcoholic Beverages: Total Expenditures historical data series for 2014. These figures for food consumed at home, consumed away from home and alcoholic beverages were multiplied by Michigan's share of the U.S. population to get Michigan's share of total consumption.

Sales per employee was used to estimate the number of employees in food retail. The Economic Census and County Business Patterns were used for retailing in the ornamental horticulture, retail, and food services industries.

Agri-Energy

The estimates for employment related to ethanol production were derived from Dale Swenson's *Model Economic Analyses: An Economic Impact Assessment of an Ethanol Production Facility in Iowa*. The economic impact

estimate was based on the value of ethanol produced and the value of DDGS minus the value of the corn that was used to produce the ethanol.

IMPLAN

IMPLAN is a standard economic impact software package. From direct effects, in the case of this study, sales in the various industries, the total impact on the economy can be estimated. This includes the direct effects, the indirect effects, which are changes in the inter-industry purchases as they respond to the directly affected industry and induced effects, which reflect changes in households as a result of the activity; in this case agri-food industry activity (IMPLAN, p102). It should be noted the indirect and induced effects can vary over time. Some multipliers declined in this study compared to the 2012 study; likely because Michigan's overall economy has grown faster than the agri-food system between 2012 and now.

In order to minimize double counting an IMPLAN run was done for every agriculture commodity, food processing activity, food wholesaling, retailing and food service. The impacts on related industries in the system were then subtracted out.

IMPLAN uses the following assumptions to derive its results: constant returns to scale; no supply constraints; fixed commodity input structure; homogenous sector output, and it assumes the technology used is constant (IMPLAN, p.103).

Constant returns to scale means if output increases the amounts of the inputs used increase by the same proportion. No supply constraints means that inputs are unlimited and that output is limited only by the demand for its products. This assumption is not an issue in this study; this is actual output not potential output. Fixed commodity input structure means firms will not substitute one input for another if input prices change. Homogenous sector output means the proportions of all the commodities produced by that industry remain the same as output increases or decreases. As a result of these assumptions, the results of the economic impact and impact on employment should be considered estimates.

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