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The Economic Impact and Potential of Michigan's Agri-Food System

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EXECUTIVE SUMMARY

MAJOR FINDINGS

Michigan's agri-food system is a major contributor to income and employment in the state's economy. The system accounts for **$60.1 billion** in direct and indirect economic activity annually. This sector also accounts for **1.05 million** jobs both directly and indirectly. Furthermore, this sector accounts for a large amount of investment activity conservatively estimated at **$8.6 billion** over the last five years.

ECONOMIC IMPACT

Exhibit A provides the summary analysis. ***Michigan's agri-food system*** which includes agriculture, leather, food, floriculture/ornamentals/turfgrass, and bio-energy industries, ***accounts for a total of $60.1 billion in total economic activity (direct and indirect) annually.*** The sector generates more than $35 billion in direct economic activity annually.

IMPACT ON JOBS

Michigan's agri-food system is a major source of employment for the state's workforce. Total employment in this sector (both direct and indirect) is **1.05 million** of which slightly over **727,000** is direct employment. The agri-food system employs nearly one quarter (24%) of all persons working in Michigan. Given these figures, Michigan's agri-food system is of substantial importance to the state's economy. The system is likely second only to the automotive industry as a primary production sector.

INVESTMENT

In addition to annual economic activity and employment, the farm sector has generated nearly $7 billion of investment over the last five years. For the same period, the Michigan Department of Agriculture was able to identify $1.6 billion in public and private investment in major agri-processing activities, for a total of **$8.6 billion** in investment. This level of investment bodes well for the future health of the system.

Exhibit A: Total Direct and Indirect Economic Activity Michigan Agri-Food and Agri-Energy Sector 2004						
Category	**Economic Output (Millons $)**			**Employment**		
Agricultural Production and Processing	**Direct**	**Indirect***	**Total**	**Direct**	**Indirect***	**Total**
Farming	4,491	2,203	6,694	72,414	30,486	102,900
Food Processing and Manufacturing	12,233	5,802	18,035	39,533	76,762	116,295
Leather Processing	509	365	874	512	782	1,294
Total	17,233		25,602	112,459		220,489
Adjustment for Double Counting	(2,645)			(12,251)		
Net Total	14,588		25,602	100,208		220,489
Michigan Share of Wholesale/Retail						
Wholesaling Margin	1,763	1,146	2,909	7,953	7,953	15,906
Retailing Margin	5,537	3,344	8,881	206,330	55,916	262,246
Total	7,300	4,490	11,790	214,283	63,869	278,152
Total of Food Production Wholesaling and Retailing Based on Michgian Agricultural Inputs	21,888		37,392	314,491		498,641
Floriculture/Ornamentals/Turfgrass Services**	1,246	765	2,011	19,091	5,174	24,265
Added Valued of Non Michigan Based Wholesale and Retail Products	12,740	7,940	20,680	393,419		524,526
Total for Agriculture, Food, and Related Industries	35,874		60,083	727,001		1,047,432
Ethanol Production	64	11	75	35	100	135
Grand Total	35,938	24,220	60,158	727,036	344,902	1,047,567

*Multipliers for the indirect impact of agricultural production and processing have been adjusted downward to eliminate the effect of double counting in the direct column.

**The total value of the floriculture/ornamentals/turfgrass industry is not shown on this line; only services are shown (no similar category exists for the other agri-food subsectors). Production, wholesaling, and retailing lines in the table also include contributes from this industry. When all four activities are taken together, the total direct impact of the floriculture/ornamentals/turfgrass industry is $2.453 billion with total economic activity (both direct and indirect) of $3.943 billion.

This report has two purposes: (1) to estimate the current economic impact of Michigan's agri-food system on the state's economy, and (2) to establish a reasonable forecast of the potential contribution of this system to future economic development in Michigan.

Throughout the report, the term "***agri-food system***" is used. ***This system represents all the economic activity associated with the supply chains for food and non-food uses for agricultural commodities.*** For either food or non-food use, the supply chain begins with input supply activities and farm production. After the farm gate, the system moves commodities into two distinct supply chains—the food supply chain (assembly, processing, manufacturing, wholesaling and retailing), and the non-food supply chain (bio-energy, floriculture/ornamentals/ turfgrass, and other non-food uses). The full extent of the economic impact of the agri-food system can not be estimated without consideration of all these various components of the related supply chains. However, this paper does not consider industrial or fiber uses of agricultural commodities.

The report is divided into two major parts aligning with the two purposes. Part I examines the current economic impact of the agri-food system, while Part II focuses on forecasting the system's potential. Part I analyzes current economic impact in three ways: (1) dollar contribution to Michigan's economy, (2) job contribution, and (3) investment contribution. All three are important indicators of the system's impact on Michigan's economy. Exhibit A reported the findings of Part I.

Part II utilizes several models of typical venture development projects that represent future economic development opportunities. From these archetypes, two scenarios are created to provide insight into the level of investment, economic activity generation, and job creation that the agri-food system could provide. Part II of the report examines the future potential for continued investment and economic activity in Michigan's agri-food system. Exhibit B summarizes the analysis. Section 1 of the exhibit shows the individual economic impacts of a sample of "model" ventures running from an ethanol plant to a small-scale agri-food business. These individual impact estimates are used to construct two scenarios for future economic development in Michigan's agri-food system:

- ***Scenario A*** (Section 2 of Exhibit B) which assumes that the current known investment patterns in Michigan's agri-food system can be continued into the future. In fact, the large projects already in process will have positive influences on the state's economy over the immediate future.
- ***Scenario B*** (Section 3 of Exhibit B) which assumes that a reasonable but more general set of venture opportunities emerges with appropriate private and public support for these ventures.

Overall, the two scenarios are based on significantly different information about the economic impact of new investment in the agri-food sector of Michigan, but they result in very comparable outcomes.

Scenario A is based on known examples and indicates the magnitude and direction of economic impact that can be expected if those currently known projects are realized in the next 3-5 years. ***The annual addition to economic output from Scenario A would be $995.4 million direct and $1,571.9 million total, and direct and total job creation would be 3,738 and 12,231 respectively.***

Scenario B is based on a more generic set of venture creation figures and shows the general patterns of total economic impact if the state pursues the establishment of 851 new ventures annually with a probable mix of small-, medium- and large-scale agri-food activities. ***The annual addition to output from Scenario B would be $964.1 million direct and $2,414.3 million total, and direct and total job creation of 7,481 and 23,020 respectively.***

Both scenarios have similar direct economic impacts on output, while the greater job creation of Scenario B reflects a greater reliance on small firms as the engine of growth. ***Either scenario shows that investing in the agri-food system would contribute significantly to Michigan's economic development.*** For the most part, Scenario A reflects projects that are fully committed. Yet the sustainability of this rate of development is not assured, particularly given the limited additional capacity for corn-based ethanol. Scenario B however shows that the rate of development could be sustained by other means and other mixes of businesses. Realizing this more sustained scenario for development requires a well-functioning agri-food policy and business development support system committed to generating the appropriate number and mix of new ventures.

The report concludes with discussions on both agri-tourism and the potential of a "bio-economy." Both of these additional areas for economic development need additional study before estimates can be made of their potential economic impact. The potential of the bio-economy may be especially large and cause the report's other estimates of future economic impact to be substantially underestimated.

From the perspective of either current total economic impact—$60.1 billion and 1.05 million jobs—or potential future impact—nearly an additional $1 billion of direct impact each year under either one of two scenarios and between 12,000 and 23,000 new jobs annually, the agri-food system in Michigan plays a substantial role in the state's economy and could play an even larger role with continued investment and policy support.

Exhibit B: Economic Impact of New Investment Michigan's Agri-Food Sector

	Output Impact (Million $)			Employment Impact (# of jobs)		
	Direct	**Indirect***	**Total**	**Direct**	**Indirect***	**Total**
1. Economic impact of a "model" agri-food business activity						
Ethanol plant	95.2	15.6	110.8	39	112	151
Biodiesel plant**	65.0	29.9	94.9	57	283	340
Large-size dairy farm	2.7	4.4	7.1	12	39	51
Small-size animal slaughtering	22.1	33.1	55.2	87	405	492
Major food processing facility	20.5	10.0	30.5	124	222	346
Large-size greenhouse & nursery	1.5	2.0	3.5	33	43	76
Small-size agri-food venture	0.2	0.5	0.7	5	9	14
2. Economic impact of Scenario A (151 businesses)[1]						
Known projects in progress (18)	669.3	201.8	871.1	1,892	3,553	5,445
Projected intiatives (133)	326.1	374.7	700.8	1,856	4,930	6,786
Total impact Scenario A	**995.4**	**576.5**	**1,571.9**	**3,748**	**8,483**	**12,231**
3. Economic impact of Scenario B (851 projected businesses)[2]						
Large-size projects (2)	41.0	20.1	61.1	248	444	692
Medium-size projects (83)	769.9	1,047.1	1,817.0	3,403	8,201	11,604
Small-size agri-food ventures (766)	153.2	383.0	536.2	3,830	6,894	10,724
Total impact Scenario B	**964.1**	**1,450.2**	**2,414.3**	**7,481**	**15,539**	**23,020**

*Included induced impact

** Vertically integrated biodiesel plant.

[1] 3-5 year projection.

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Any omissions and errors are the responsibility of the authors.

THE ECONOMIC IMPACT AND POTENTIAL OF MICHIGAN'S AGRI-FOOD SYSTEM

INTRODUCTION

This report has two purposes: (1) to estimate the current economic impact of Michigan's agri-food system on the state's economy, and (2) to establish a reasonable forecast of the potential contribution of this system to future economic development in Michigan.

Both purposes have immediate importance. As will be shown, the agri-food system has an estimated economic impact of $60.1 billion annually with employment estimated to be 1.05 million people. These numbers clearly show that the agri-food system is a substantial component of Michigan's economy—likely second only to the automotive industry as a primary production sector. The economic health of this system is thus critical to the state and its citizens. Beyond the current economic impact, however, is the need to understand what potential exists in the agri-food system to drive future economic development for the state. Michigan is facing challenging economic times. It is critical to know what contribution the agri-food system can make to meeting these challenges and accelerating growth for the state. When both the current impact and the future potential of the agri-food system are understood, decision makers (both public and private) can help maximize the economic benefits that this system does and can create.

Throughout the report, the term "***agri-food system***" is used. ***This system represents all the economic activity associated with the supply chains for food and many non-food uses for agricultural commodities.*** For either food or non-food use, the supply chain begins with input supply activities (e.g., fertilizer, crop protection products, equipment), and farm production. After the farm gate, the system moves commodities into two distinct supply chains. The food branch of the supply chain includes commodity assembly and processing (e.g., grain elevator operations, packing, storage, and shipping), food manufacturing, food wholesaling, and food retailing. The non-food branch includes diverse supply chain activities related to bio-energy, nursery/greenhouse/turf, and other emerging commercial and industrial uses of agricultural commodities. The full extent of the economic impact of the agri-food system can not be estimated without consideration of all these various components of the related supply chains.

The report is divided into two major parts aligning with the two purposes. Part I examines the current economic impact of the agri-food system, while Part II focuses on forecasting the system's potential. Part I analyzes current economic impact in three ways: (1) dollar contribution to Michigan's economy, (2) job contribution, and (3) investment contribution. All three are important indicators of the system's impact on Michigan's economy. Part II utilizes several models of typical venture development projects that represent future economic development opportunities. From these archetypes, two scenarios are created to provide insight into the level of investment, economic activity generation, and job creation that the agri-food system could provide. To improve the readability of the report, the technical discussions of how the estimates were made for each part of the report have been moved to technical appendices that follow the two main parts of the report.

PART I:
THE ECONOMIC IMPACT OF MICHIGAN'S AGRI-FOOD SYSTEM

Overview

Michigan's agri-food system is a major contributor to income and employment in the state's economy. The system accounts for approximately $60.1 billion in direct and indirect economic activity. This sector also accounts for an excess of 1.0 million jobs both directly and indirectly. Furthermore, this sector accounts for a large amount of investment activity—at the farm level alone, $7 billion over the last five years.

The agri-food system is fairly complex. The supply chain for products produced by this sector goes through numerous steps. Inputs are used at the farm level to grow the crops, livestock and milk, fruits, and vegetables. Farm products in turn are collected, graded, sorted, and otherwise initially processed. 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. The manufactured food products are also wholesaled and retailed through various channels to the end consumer.

Non-food products based on agricultural commodities also arise from the system. Floriculture/ornamentals/turfgrass products are already a substantial supply chain in their own right. Bio-energy is emerging as a new market opportunity. Agricultural products used for energy, either ethanol which uses corn or biodiesel which uses soybeans, follow yet another path. In the case of ethanol, corn is collected and the ethanol is extracted from the corn. A primary residual product, Dried Distillers Grains (DDGs), is used as an animal feed. In the case of biodiesel, the soybean oil is processed to create diesel fuel, and the soybean meal is used for animal feed.

As the above outline shows, the agri-food system is complex and interconnected. Agriculture is much more than farming. As such, in order to obtain a complete picture of the economic impact 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 generated by the agri-food system is an input-output model with multipliers generated by IMPLAN, a company that specializes in economic modeling.

Another issue of interest is the level of investment in the agri-food system. Of primary interest is investment in equipment, buildings, and related assets that expands the ability to produce, process and market farm-based commodities and products. Several sources of information were utilized to obtain an estimate. Input supply companies, farmers, processors, wholesalers and retailers generate well in excess of $2 billion a year in investment.

Readers interested in the methodology used to conduct the analysis will find it in Appendix I.

Financial Impact of the Agri-Food System

The financial impact (dollar volume of economic activity) of the agri-food system will be analyzed level by level through the supply chain—inputs, farm, manufacturing, wholesaling, and retailing. Some aspects of nursery/greenhouse/turf and bio-energy are analyzed separately. Total impact is then calculated as the final step of the analysis.

Input Supply to the Farm Sector

Farm products are produced through converting inputs such as fertilizer, fuel, credit, 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 agri-food supply chain. For example, in 2004, Michigan farmers purchased $293.2 million in fertilizer and lime, $246.6 million in pesticides, and $177.4 million in petroleum fuels and oil (Michigan Agricultural Statistics Service, p.10).

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 direct dollars, livestock and dairy ranks just slightly ahead of field crops in terms of economic activity, and slightly behind when total dollars (direct plus indirect) are considered. Table 1 shows the economic impact of the livestock and dairy sector. These figures are a three year average from 2002 through 2004. As table 1 indicates, the total direct impact of the livestock and dairy sector was $1.70 billion. Of this amount dairy accounted for almost $850 million or more than 50 percent of the total. Dairy farming is the largest single farm industry in the state. Other major livestock activities included cattle, hogs, eggs and turkeys. Dairy, eggs and turkeys show an upward trend in production and value.

The middle column represents the backward linked economic impacts of livestock and dairy production. These figures are derived from IMPLAN, and are adjusted to eliminate double counting. Specifically, the direct value column is adjusted downward by $2.6 million to take the value of feed into consideration. The value of the livestock products includes 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 the grain used for feed and hay is subtracted out.

The total economic impact of the livestock and dairy sector is $2.39 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 discussed previously.

Table 1: Total Value of Livestock Products (Average 2002-2004)			
Product	**Direct Value ($1,000s)**	**Multiplier**	**Total Value ($1,000s)**
Cull Cattle	49,508	1.540	76,242
Other Cattle	175,121	1.556	272,488
Dairy	849,777	1.364	1,159,096
Eggs	83,702	1.288	107,808
Hogs	185,178	1.522	281,841
Honey	6,545	1.415	9,261
Horses	256,000	1.415	362,240
Mink	1,866	1.415	2,640
Sheep and Lambs	3,897	1.548	6,033
Trout	721	1.427	1,029
Turkeys	67,051	1.288	86,362
Other Livestock	17,801	1.415	25,188
Total	1,697,167		2,390,229

Source: Michigan Agricultural Statistics

Field Crops

Field crops are second slightly behind livestock in terms of the direct economic impact of the Michigan farm economy. 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. Wheat, sugar beets, and potatoes also account for more than $100 million each in direct economic activity per year. The total economic activity generated by field crops including backward linked activity is $2.53 billion.

Vegetables

Michigan is known for the wide variety of vegetables grown in the state. Table 3 lists the major vegetables grown in the state and the economic value generated by these products. In dollar terms, cucumbers and tomatoes are the highest value vegetable crops produced in the state. There are many vegetables which by themselves have small dollar value of production; however, when aggregated their dollar volume is significant, which is reflected in the size of the "other" category. The state is also an important producer of many vegetables. In 2004, the state was the number one producer of cucumbers for pickles, and it ranked second in celery production and fresh market carrot production. The state is the third largest producer of asparagus and fresh market cucumbers (Michigan Agricultural Statistics, p.1).

The direct value of the vegetable sector is $280 million with a total economic impact, including backward linked industries, of approximately $435 million. It should be noted that IMPLAN treats all vegetables the same no matter what type of vegetable produced or whether the vegetable is produced for the fresh market or for the processed market.

Table 2: Total Value of Field Crops (Average 2002-2004)

Crop	Direct Value ($1,000s)	Multiplier	Total Value ($1,000s)
Barley	1,104	1.568	1,731
Corn for Grain	542,162	1.489	807,279
Dry Beans	64,830	1.554	100,746
Hay	298,644	1.478	441,395
Oats	7,741	1.478	11,441
Potatoes	101,853	1.551	157,974
Soybeans	406,950	1.554	632,400
Sugarbeets	119,743	1.506	180,333
Wheat	121,811	1.568	191,000
Other	2,585	1.515	3,917
Total	1,667,423		2,528,216

Source: Michigan Agricultural Statistics Service

Table 3: Total Value of Vegetables (Average 2002-2004)

Product	Direct Value (1,000s)	Multiplier	Total Value ($1,000s)
Asparagus	16,563	1.551	25,689
Bell Pepper	11,024	1.551	17,098
Cabbage	5,808	1.551	9,008
Carrots	19,913	1.551	30,885
Celery	16,967	1.551	26,316
Cucumbers	57,760	1.551	89,586
Onions	10,515	1.551	16,309
Pumpkins	13,489	1.551	20,921
Snap Beans	15,396	1.551	23,879
Squash	17,973	1.551	27,876
Sweet Corn	14,966	1.551	23,212
Tomatoes	28,376	1.551	44,011
Others	51,475	1.551	79,838
Totals	280,225		434,629

Source: Michigan Agricultural Statistics

Fruit

As is the case with vegetables, the state is also a major producer of fruits. Table 4 shows the economic impact of fruit production in the state. It should be noted that these figures may be somewhat understated; 2002 saw a dramatic decline in fruit production before rebounding in 2004, and the three-year average values reflect this. The largest fruits in the state in dollar terms are apples, blueberries, and tart cherries. The state leads the nation in the production of tart cherries and blueberries. The state is the third largest producer of apples. Grape production includes both juice and wine grapes. Given the growth in the wine industry, this figure is likely to be understated.

The direct economic impact of fruit production in the state is $243 million. The total economic activity including backward linked industries related to fruit production is $383 million. As is the case with vegetable farming, IMPLAN uses the same multiplier for all types of fruit and for the fresh and processed market.

Table 4: Total Value of Fruits (Average 2002-2004)

Crop	Direct Value ($1,000s)	Muliplier	Total Value ($1,000s)
Apples	86,172	1.576	135,807
Blueberries	70,852	1.576	111,663
Grapes	21,575	1.576	34,002
Peaches	7,505	1.576	11,828
Pears	872	1.576	1,374
Plums	690	1.576	1,087
Strawberries	5,184	1.576	8,170
Sweet Cherries	9,776	1.576	15,407
Tart Cherries	38,330	1.576	60,408
Others	2,307	1.576	3,636
Total	243,263		383,382

Source: Michigan Agricultural Statistics

Floriculture/Ornamentals/Turfgrass

The nursery and landscape industry has many components (farm production, wholesaling, retailing, and landscaping services), and the economic reporting on this industry is made under a rather diverse collection of headings. To best match the data sources, this analysis will report the nursery and landscape industry under the heading of floriculture/ornamentals/turfgrass.

Michigan ranks third in the nation after California and Florida in the production of floriculture/ornamentals/turfgrass products. It is first in the nation in the production of flowering hanging baskets, Geraniums, Impatiens, and Petunias. It is second in the nation in the production

of Hostas and Marigolds (Michigan Agricultural Statistics, p.1). The state is a major producer of Christmas trees as well. The economic impact of this industry is often overlooked.

The direct impact of floriculture/ornamentals/turfgrass production is estimated to be $576.51 million. The multiplier for these products is 1.592. The total impact of production including backward linked industries is $917.81 million.

Summary of Farm Production Impacts

The total economic impact of Michigan farming is summarized in table 5.

Table 5: Value of Mcihigan Farm Production (Average 2002-2004)

Type of Product Produced	Direct Value ($1,000s)	Indirect Value ($1,000s)	Total ($1,000s)
Livestock/Dairy	1,697,167	693,062	2,390,229
Field Crops	1,667,423	860,793	2,528,216
Vegetables	280,225	154,404	434,629
Fruits	243,263	140,119	383,382
Floriculture/ornamentals/turfgrass	576,514	341,295	917,809
Miscellaneous	26,298	12,886	39,184
Total	4,490,890	2,202,559	6,693,449

Source: Michigan Agricultural Statistics

In addition to the line items analyzed in the prior subsections, the miscellaneous line represents are several products produced on farms throughout the state that do not fit neatly into any of the above categories. The total direct output from these activities is estimated to be $26.30 million. Using the average farm multiplier of 1.490 gives a total economic impact of $39.18 million.

It should be noted that table 5 probably overstates the total direct impact of the farm sector due to double counting. For example, the cost of feed is included in both the value of field crops and the value of livestock production. Adjustments for double counting will be done in total after all aspects of the agri-food sector are taken together (see Table 8). Table 5 does show the importance of the farm sector on the Michigan economy. Even after adjusting for double counting, the sector accounts for well over $6 billion in total economic activity and well over $4 billion in direct economic activity.

Food Processing and Manufacturing

The next step along the supply chain from the farm level is food processing and manufacturing. Table 6 shows the impact of food processing and manufacturing in Michigan. It should be noted that these figures come from the 2002 Economic Census. While the 2002 census figures are the most recent and accurate figures available, they likely underestimate the current value of food processing and manufacturing. A good example of this is the wine industry which only accounted for $15 million in direct economic activity in 2002. The number and size of wineries continues to increase in the state. Fruit processing activities are also likely to be understated given the poor crop year in 2002.

Intermediate supply chain steps such as collection, transportation, grading, sorting, and other initial processing activities are backward linked to food processing and manufacturing. Just as there is a multiplier effect for farming, there is also a multiplier effect (shown in Table 6) for food processing and manufacturing that incorporates these intermediate activities.

Table 6: Value of Food Manufacturing 2002

Industry	Direct Value ($1,000s)	Multiplier	Total Value ($1,000s)
Animal Food Manufacturing	165,026	1.489	245,724
Flour and Malt Milling	185,205	1.531	283,549
Breakfast Cereal	1,193,953	1.740	2,077,478
Sugar Manufacturing	145,680	1.442	210,071
Candy Manufacturing	531,326	1.531	813,460
Frozen Fruit, Juice and Vegetable Manufacturing	124,162	1.574	195,431
Frozen Specialty Food Manufacturing	173,336	1.379	239,030
Canned Fruits and Vegetables	422,736	1.557	658,200
Specialty Canning	155,636	1.534	238,746
Dried and Dehydrated Food Manufacturing	70,328	1.379	96,982
Fluid Milk Manufacturing	1,046,147	1.412	1,477,160
Cheese Manufacturing	212,017	1.399	296,612
Dry, Condensed and Evaporated Milk	1,489,500	1.412	2,103,174
Ice Cream and Frozen Desserts	104,918	1.548	162,413
Animal (except poultry) Slaughtering	539,858	1.169	631,094
Meat Processed from Carcasses	868,493	1.412	1,226,312
Rendering and Meat Byproduct Processing	41,387	1.412	58,438
Poultry Processing	489,274	1.360	665,413
Bread and Bakery Product Manufacturing	877,082	1.532	1,343,690
Cookie, Cracker and Pasta Manufacturing	360,059	1.521	547,650
Snack Food Manufacturing	307,331	1.407	432,415
Soybean Oil Mills	50,000	1.447	72,350
Malt Beverages	256,000	1.369	350,464
Mayonnaise, Dressing and Prepared Sauces	224,935	1.423	320,083
Spice and Extract Manufacturing	80,552	1.423	114,625
All Other Food Manufacturing	331,340	1.492	494,359
Soft Drink Manufacturing	1,771,737	1.500	2,657,606
Wineries	15,088	1.503	22,677
Total	12,233,106		18,035,204

Source: U.S. Census Bureau

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 more than $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. The great diversity of agricultural commodities grown in the state is reflected in the size of the processed fruit and vegetable products industries.

An industry that is not included in table 6 but is part of the agri-food system is the leather tanning and finishing industry, which is dependent on the cattle slaughtered in the state. This industry accounts for $508.561 million in direct economic activity and $873.708 in total economic activity.

The total size of the food manufacturing and leather processing industries is thus $12.74 billion in direct economic activity and $18.91 billion in total economic activity. Indirect economic activity from backward linked industries is $6.17 billion. As is the case with farming, there is some double counting in food manufacturing and processing. The value of the raw commodities that are processed into consumer food products needs to be considered. As such, the figures in Table 6 somewhat overstates the total economic impact. Adjustments for double counting will be handled when the entire agri-food system is accounted for (see Table 8).

Wholesaling and Retailing

Creating an estimate for the economic value of agri-food system wholesaling and retailing requires the gathering of information on both food/beverage wholesaling and retailing, and nursery/landscape/turf wholesaling and retailing. In addition it is useful to separate the food and beverage value of wholesaling and retailing based on products whose inputs were Michigan-grown versus products with out-of-state origins. With this separation, estimates can be made of the complete supply chain value of Michigan agricultural output.

The food wholesaling and retailing information is taken from Table 7. These figures are derived from the U.S. Department of Agriculture analysis of total food and alcoholic beverage consumption. The numbers do not add up due to rounding. Farm value and processing value have already been counted and are not reconsidered here. For the purposes of this report, wholesaling includes transportation services, and these two items will thus be summed for the analysis that follows. For the purposes of determining Michigan agriculture's share of wholesaling and retailing, seafood and imported food are all assumed to originate outside the state.

Table 7: Expenditures on Food and Alcoholic Beverages in Michigan, 2004	
Food Originating on U.S. Farms	**Million Dollars**
Consumed at Home	
Farm Value	3,843
Processing	4,878
Transportation	887
Wholesaling	1,478
Retailing	3,696
Total Consumed at Home	14,782
Consumed Away From Home	
Farm Value	2,108
Processing	1,976
Transportation	396
Wholesaling	790
Retail	7,906
Total Consumed Away From Home	13,176
Seafood and Imported Food	4,103
Alcoholic Beverage Consumption	
At Home	2,087
Away from Home	2,774
Total	4,861
Grand Total	36,924

Michigan Agriculture's Share of Total Wholesaling and Retailing

In order to obtain Michigan agriculture's share of the state's food consumption, an estimate is needed for the percentage of food grown in the state that is also consumed here. Michigan imports and exports a great deal of its food products (exports are products shipped out of the state, imports are products shipped into the state). Furthermore, some products (e.g., pork) may be grown in Michigan, processed out of state, and then transported back into the state for final consumption. Ferris (p. 15) has provided an analysis that places the Michigan-grown portion of wholesaled and retailed food products at 43 percent. Based on this estimate, Michigan agriculture's share of state food wholesaling is $1.527 billion (43% of the total amount for the four lines in Table 7 that represents transportation and wholesaling). In addition, non-food wholesaling includes $82 million in activity for the nursery/landscape/turf industry, and $154 million for transportation of non-food agricultural products. Total direct economic activity of $1.763 billion for agri-food wholesaling is attributed to Michigan agriculture. The multiplier for wholesaling is 1.650 which gives a total economic impact of wholesaling (considering both direct and indirect output) of $2.909 billion.

The same technique is used to determine Michigan agriculture's share of the retail sector. In 2004, the retail sector, both at home and away from home, accounted for sales of $11.602 billion (Table 7). The Michigan agriculture's share of the retail total is $4.989 billion (43% of $11.602 billion). Adding an additional $548 million in nursery/landscape/turfgrass retail margins gives a total for the state share of the retail market of $5.537 billion. The retail multiplier is 1.604 which gives a total economic impact of retailing of $8.881 billion.

Wholesaling and Retailing Based on Out of State Farming and Processing

If 43 percent of retailing and wholesaling is based on Michigan produced farm products, it follows that 57 percent of the food consumed in the state was originally produced out of the state. However, even products produced out of state are still a source of employment and economic activity. Retailing and wholesaling activities are carried out by Michigan residents no matter the ultimate source of the original agricultural commodity, and thus these dollars of economic impact also need to be accounted for.

Given this analysis the total direct economic activity from wholesaling and retailing of non-Michigan based agri-food products, including foreign and seafood products, is $12.740 billion. The total impact including both direct and indirect economic activity is $20.680 billion.

Floriculture/ornamentals/turfgrass Services

One other agriculturally related activity is floriculture/ornamentals/turfgrass services provided by Michigan firms. According to the U.S. Economic census, landscaping services generated a total of $1.246 billion in direct economic activity. Using a multiplier of 1.615 yields a total level of economic activity, including indirect output, of $2.011 billion.

Note on the Total Value of Michigan's Floriculture/Ornamentals/Turfgrass Industry.
Because this analysis has been organized by levels in the supply chain, the true value of the nursery/ greenhouse/turf industry has been obscured by its production, wholesale, retail, and service components appearing in four separate places. Considering all four levels in the supply chain, this industry contributes direct economic activity of $2.453 billion and total economic activity (both direct and indirect) of $3.943 billion.

Bio-Energy

Due to the increase in gasoline prices and concerns about future petroleum supplies, there has been a major increase in interest in bio-energy. Bio-energy includes, ethanol produced from corn, biodiesel, wind power generated on agricultural land and methane digesters. Currently, there is only one ethanol plant in operation in the state, although there are four others currently under construction or in advanced planning.

The current ethanol plant produces 45 million gallons of ethanol per year. Its direct economic impact is estimated to be $64.5 million with a total economic impact, including indirect effects of $75 million.

Summary of Financial Impact

As noted in the introduction, the agri-food system is complex. The economic impact on the state is also quite large. Table 8 reflects the total economic impact both direct and indirect using IMPLAN multipliers. As mentioned in prior sections, the effects of double counting need to taken into consideration. This is done in two ways in the section on agricultural production and processing. First, double counting has been explicitly subtracted from the direct total. Second, the multipliers that create the indirect effects were adjusted downward to take the direct double counting into effect. As a result, the total column for agriculture production and processing does not have a separate adjustment. (Additionally, some columns in the table do not add up due to rounding.)

The value of the direct economic activity of Michigan's agri-food system is estimated to be $35.9 billion. The total economic impact equals $60.1 billion.

It should be noted that the activities accounted for in this estimate are not complete because some economic activity is not reported in a separable form or not reported in any form. For example, farm market sales are not included, nor are some agri-tourism activities. The figures used throughout this section should be considered estimates and not the definitive or complete picture of Michigan's agri-food system. They are the best estimates given the level of information available and given the assumptions of the analysis. A more complete discussion of the methodology used in the generating these figures can be found in Appendix I.

Table 8: **Aggregate Estimates of Direct and Extended Values of Output in Michigan's Agri-Food System**

	Economic Output (millions $)		
Category	**Direct**	**Indirect***	**Total**
Agricultural Production and Processing			
Farming	4,491	2,203	6,693
Food Processing and Manufacturing	12,233	5,802	18,035
Leather Processing	509	365	874
Total	17,233		
Adustment for Double Counting	(2,645)		
Net Total	14,588		25,602
Michigan Share of Wholesale Retail			
Wholesaling Margin	1,763	1,146	2,909
Retailing Margin	5,537	3,344	8,881
Total	7,300		11,790
Total of Food Production, Processing, Wholesaling, and Retailing Based on Michigan Agricultural Inputs	21,888		37,392
Floriculture/ornamentals/turfgrass Services**	1,246	765	2,011
Added Value of Non-Michigan Based Wholesale and Retail Products	12,740	7,940	20,680
Total For Agriculture, Food and Related Industries	35,874		60,083
Ethanol Production	64	11	75
Grand Total for the Agri-Food System	**35,938**		**60,158**

*Multipliers for the indirect impact of agricultural production and processing have been adjusted downward to eliminate the effect of double counting in the direct column.

**The total value of the floriculture/ornamentals/turfgrass industry is not shown on this line; only services are shown (no similar category exists for the other agri-food subsectors). Production, wholesaling, and retailing lines in the table also include contributes from this industry. When all four activities are taken together, the total direct impact of the floriculture/ornamentals/turfgrass industry is $2.453 billion with total economic activity (both direct and indirect) of $3.943 billion.

The Impact of the Agri-Food System on Employment

Introduction

The techniques used to determine the level of employment attributed to the agri-food system are similar to determining the economic impact of this sector. One thing that makes the analysis more difficult however is the fact that some jobs are only part time jobs, basing employment in terms of full-time equivalents (FTEs) would make comparisons easier. Adjusting for FTEs is done at the farm level, but it is not done in the other industries because the necessary data for making such adjustments is not available. As a result the employment figures listed in this section likely overstate the full effects of employment in the agri-food system.

The source of the employment number is the 2004 Bureau of Labor Statistics (BLS) employment numbers for the state of Michigan, and the 2002 Census of Agriculture for farm level employment. These are the most recent annual figures available. These figures are for the most part more recent than the 2002 Economic Census used in the economic impacts calculated in the prior section. Therefore, the employment figures are not directly related to the output figures outlined in tables 1 through 8.

As is the case with the economic impact figures, the employment figures are split into farm sector, food processing/manufacturing, wholesaling, and retailing. Employment in the floriculture/ornamentals/turfgrass industry and the ethanol industry is also considered.

Input Supply Firms

As is the case with the economic impact figures, employment figures in the input supply industries are linked backward from agricultural production. Therefore, the employment impact is seen in the multiplier (indirect) effects for farming. The input supply industry is an important aspect of the agri-food sector. 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, placing more emphasis on the input supply industry.

Farming

The Census of Agriculture breaks both farmers and farm labor down according to the number of hours worked. In addition to total employment, this breakdown allows an estimate of the number of full time equivalents (FTEs) employed in farming. In 2002, the state had 53,315 farmers, not all of them full time producers. There were also 86,855 hired farm workers in 2002. Table 9 gives a breakdown of the number of farmers and hired farm workers in 2002.

Table 9: Employment on Michigan Farms 2002		
Type of Employment	**Total Number**	**Full-Time Equilvalents**
Farmers		
Days Worked Off Farm		
None	23,109	23,109
1 to 49	2,751	2,476
50-99	1,598	1,119
100-199	3,510	1,295
200+	22,347	2,235
Total	53,315	30,234
Hired Labor		
Days Worked on Farm		
150 or more	23,034	23,034
Less than 150	63,821	19,146
Total	86,855	42,180
Grand Total	140,170	72,414

Source: USDA Census of Agriculture

Table 9 shows the increasing dichotomy of Michigan farmers. Most farmers are either full-time (no days worked off the farm) or substantially part-time (200+ days worked off the farm). In the part-time category, these farmers may derive little income from their on-farm activities. Taking this dichotomy into account, it is estimated that there are 30,234 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 42,180. In 2002, there were 140,170 people employed at the farm level with a total number of FTEs in the industry estimated to be 72,414. Using an employment multiplier of 1.421 yields a total number of those employed in farming and backward linked industries of 102,900. Indirect employment is equal to 30,486.

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 10. This figure should be considered an estimate. Many industries have one or a few firms. As a result, many employment numbers are suppressed in order to protect the identity and employment levels of specific firms. Table 10 presents the employment numbers for those industries where estimates are available.

Table 10: Employment in Michigan Food Processing and Manufacturing Industries 2004			
Industry	Direct Employment	Multiplier	Total Direct and Indirect Employment
Perpared Feeds	266	3.286	874
Pet Food Manufacturing	37	2.500	93
Flour Milling and Malt Manufacturing	485	4.776	2,316
Soybean Oil Mills	30	8.219	247
Shortening and Cooking Oils	64	3.208	205
Breakfast Cereal Manufacturing	3,745	5.956	22,305
Sugar and Confectionary Products	1,610	2.386	3,841
Frozen Fruit and Vegetable Manufacturing	939	2.390	2,244
Frozen Specialty Food Manufacturing	658	1.692	1,113
Fruit and Vegetable Canning	3,121	2.243	7,000
Specialty Canned and Dried Products	1,750	3.693	6,463
Fluid Milk Manufacturing	2,424	2.584	6,264
Cheese	576	3.332	1,919
Dry, Condensed and Evaporated Milk	1,091	4.808	5,246
Ice Cream and Frozen Dessert Manufacturing	332	1.970	654
Animal (Except Poultry) Slaughtering	1,437	1.968	2,828
Meat Processed from Carcasses	2,727	2.361	6,438
Poultry Processing	1,750	2.033	3,558
Rendering and Meat Byproducts	175	1.968	344
Seafood Product and Preparation	134	2.577	345
Bread and Bakery Product Manufacturing	6,840	1.907	13,044
Cookies, Cracker and Pasta Manufacturing	1,456	1.973	2,873
Tortilla Manufacturing	77	1.907	147
Potato Chips and Other Snack Foods	1,140	2.464	2,809
Coffee and Tea Manufacturing	630	2.577	1,624
Flavoring Syrup and Concentrate Manufacturing	76	2.577	196
Mayonnaise, Dressing and Sauce Manufacturing	456	2.308	1,052
Spice and Extract Manufacturing	237	2.577	611
Other Perishable Prepared Food	276	2.577	711
All Other Miscellaneous Food Manufacturing	397	2.577	1,023
Soft Drink and Ice Manufacturing	4,123	4.023	16,587
Breweries	240	3.411	819
Wineries	224	2.129	477
Distilleries	10	2.506	25
Total	39,533		116,295

Sources: BLS Quarterly Census of Employment and Wages, U.S. Census County Business Patterns

The number of employees in food processing and manufacturing industries is estimated to be 39,533. There were an additional 512 workers directly employed in the leather tanning and finishing industry, with a total employment (both direct and indirect) of 1,294. ***The total level of employment directly in agri-food processing and manufacturing is thus 40,045, with a total level of direct and indirect 117,589.***

Wholesaling and Retailing

As is the case when dealing with the financial impacts of wholesaling and retailing, employment in these industries is broken down by employment resulting from Michigan based agricultural commodities and employment based on non-Michigan agricultural commodities. Employment in wholesaling is outlined in table 11. In total, the wholesaling sector accounted for 17,634 jobs in direct employment and a total of 35,268 in both direct and indirect employment.

Table 11: Employment in Agri-Food Wholesaling Industries 2004

Industry	Direct Employment	Total Employment
General Line Grocery Merchant Wholesalers	5,878	11,756
Packaged Frozen Food Wholesalers	272	544
Fish and Seafood Wholesalers	295	590
Meat and Meat Product Wholesalers	927	1,854
Fruit and Vegetable Wholesalers	1,604	3,208
Dairy Product Wholesalers	1,426	2,852
Poultry Product Wholesalers	41	82
Confectionary Wholesalers	1,516	3,032
Other Grocery Product Merchant Wholesalers	3,991	7,982
Nursery and Florist Merchant Wholesalers	1,684	3,368
Total	17,634	35,268

Source: BLS Quarterly Census of Employment and Wages

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 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. These figures are based on the 2002 Economic Census and are adjusted by the CPI for food. Using this technique, retail employment based on food grown on U.S. farms and consumed at home equals 98,001. Retail employment based on food grown on U.S. farms and consumed away from home equals 355,987. Retail employment on food based on imports and seafood (assuming 25 percent consumed at home at 75 percent consumed away from home) is equal to 117,654. Using BLS data, employment at nursery, garden and farm supply stores is 4,111 and 4,540 at florists for a total of 8,651 in the florticulture/ornamental/turfgrass sector.

Employment in landscape services adds an additional 19,091 jobs with a multiplier of 1.271 yields a total employment figure of 24,265.

The total level of direct employment in the wholesale, retail, nursery/landscape/turfgrass services sector is 626,793 with a total direct and indirect employment figure of 826,943. Of this total 233,374 of direct employment is a result of Michigan agricultural and floriculture/ornamentals/turfgrass output and 393,419 of direct employment is a result of out of state agri-food production. Of the total direct and indirect employment, 522,906 jobs can be attributed to in state agricultural production and 524,526 jobs can be attributed to out of state agricultural production.

Bio-Energy

It is estimated that the one ethanol plant currently in operation employs 35 people. Using a multiplier of 3.875 yields a total direct and indirect employment figure for this plant of 135 persons.

It should be noted that given the increase in the number of ethanol plants under construction and the interest in biodiesel plants, methane digesters and wind energy, employment in this industry will likely increase dramatically in the near term future.

Employment Summary

Table 12 gives the breakdown of employment in Michigan's agri-food system. There is some adjustment for double counting due to the fact that some on farm employment may be counted under more than one activity (such as crop production and livestock production). Also, some processing occurs on farm which could lead to double counting of farming and processing employment.

It is estimated that the agri-food system accounted for 727,036 jobs in direct activity and 320,531 jobs in indirect activity for a total of 1.048 million jobs in the state. According to the BLS, there were 4.3 million people employed in the state in 2004 (not adjusted for FTEs). The agri-food system accounted for nearly one quarter (24%) of all the jobs in the state. This sector is thus a critically important source of jobs and income to the state's residents.

It should be noted that the figures in Table 12 are somewhat higher than those presented by the BLS on an industry by industry basis. An alternative method of calculation is presented in Appendix I. The method used in this section was selected because the BLS numbers may not adequately capture all food industry workers. For example, hotel restaurant employees would not be counted in food related employment in the BLS numbers although both are clearly food related.

Table 12: Total Employment in Michigan Agri-Food, and Agri-Energy Industries 2004			
Activity	**Employment**		
Agricultural Production and Processing	**Direct**	**Indirect**	**Total**
Farming	72,414	30,486	102,900
Food Processing and Manufacturing	39,533	76,762	116,295
Leather Processing	512	782	1,294
Total	112,459		220,489
Adjustment for Double Counting	(12,251)		
Adjusted Total	100,208		220,489
Michigan Share of Wholesale and Retail			
Wholesale	7,953	7,953	15,906
Retail	206,330	55,916	262,246
Nursery/Landscape/Turf Grass Services	19,091	5,174	24,265
Total Michigan Agri-Food	333,582		522,906
Employment from non-Michigan Based Food Wholesaling and Retailing	393,419		524,526
Total for Food and Nursery/Lanscape/Turf Grass	727,001		1,047,432
Ethanol	35	100	135
Grand Total	727,036	320,531	1,047,567

Summary of Economic and Employment Impacts

Michigan's agri-food system which includes agriculture, leather, food, and floriculture/ornamentals/turfgrass industries, ***accounts for a total of $60.1 billion in total economic activity and approximately 1.05 million jobs.*** The sector generates more than $35 billion in direct activity and just over 727,000 jobs in the same activities. These numbers are summarized in Exhibit A of the Executive Summary at the beginning of the report. ***Given these figures, Michigan's agri-food system is of substantial importance to the state's economy.***

Capital Investment in the Agri-Food System

Beyond the annual economic output and employment in the agri-food system (documented in the prior two sections), the businesses that make up this system also invest heavily in the assets and activities needed to carry out their economic endeavors. Therefore, a full examination of the system's contribution to the state is not complete without a consideration of investment levels. Investment is a long-lived activity that indicates the commitment of the system's businesses to the future.

The Farm Sector

The farm sector is a major investor in assets and real estate. This analysis will look at both term loans which are used for assets that have a typical life span of 10 years or less, and mortgages which are loans for assets of up to 30 years and are generally confined to loans for land and buildings. The analysis attempts to consider only new loans and not refinancing. It should be noted that low interest rates in the early part of this decade created an environment that encouraged lending both for new capital on an accelerated timeline and land accumulation that may have been atypical of trends under normal interest rate environments. The numbers reported may thus overstate the steady state amount of borrowing carried out by farmers.

One very important issue is the amount of capital investment that is self-financed by farmers through retained earnings. This is a very difficult figure to determine, after some discussion with farm lenders and others in the farm community, it is estimated that 20 percent of the total investment in land and short and medium term assets is self financed. However, this should be considered an estimate.

Table 13 gives the estimated total investment in the farm sector from 2001 through 2005. These figures are extrapolated from the level of lending and the market share of GreenStone Farm Credit Services, the largest farm lender in the state.

From 2001 through 2005, it is estimated that there was a total of $2.47 billion in capital investment in short and medium term assets and $4.46 billion in land and building mortgages. Dairy farmers, cash crop producers and hobby farms (who may or may not generate farm income) were the primary borrowers. In 2005, hobby farmers trailed only dairy farmers in total borrowing. Total borrowing ranged from a high of $1.72 billion in 2002 to a low of $1.15 billion in 2004.

It should be noted that only investment in new equipment, breeding livestock and buildings actually increase the productive capacity of the farm sector. Purchases of land are primarily asset transfers, and do not necessarily increase aggregate output of the farm sector. Also, the inclusion of hobby farms may overestimate the total investment in the farm economy, as does the fact that some of these loans represent refinancing at a different institution than the institution where the initial loan was written.

Table 13: Estimated Farm Sector Investment 2001-2005			
Year	Short and Medium Term Assets ($1,000s)	Land and Buildings ($1,000s)	Total ($1,000s)
2001	507,587	943,116	1,450,703
2002	840,234	876,403	1,716,637
2003	373,939	885,999	1,259,938
2004	361,756	791,247	1,153,003
2005	384,744	964,940	1,349,684
Total	2,468,260	4,461,705	6,929,965

Investment in Other Sectors

For the period 2000 through 2005, the Michigan Department of Agriculture (MDA) was able to identify $1.6 billion in public and private investment in major agri-processing activities. This translates into an average of $267 million per year in major projects. There are many activities that are not captured here. Most of the $1.6 billion identified by the MDA required some level of government or non-profit organization support. The total private sector level of investment is likely to be much higher than this figure.

The diversity of the agri-food sector is reflected in the wide range of investment projects. From 2000 to 2005 approximately 22 major fruit and vegetable projects were funded. The growing importance of agri-energy is reflected in the fact that 9 projects were funded including 3 anaerobic digesters. While currently there is only one ethanol plant in operation, the state is poised to dramatically increase its production of ethanol and other forms of alternative energy. Dairy processing was another major source of investment with a total of 8 major projects. There were 5 major nursery projects funded and an additional 5 projects funded for winery production and promotion. Judging by the number of projects that have been approved, the state is becoming more important in the poultry industry. Several loans, grants, and other sources of funding were made available for expanding facilities and stock purchases for turkey processing and egg production and processing. Among the other industries that engaged in new investment from 2000 through 2005 included aquaculture, farmers markets, beer, bakeries and many others.

PART II:
POTENTIAL ECONOMIC IMPACT OF ADDITIONAL INVESTMENT IN MICHIGAN'S AGRI-FOOD SYSTEM

Part I addressed the current impact of Michigan's agri-food system. At $60.1 billion of economic activity and 1.0 million jobs, the system is a major component of Michigan's current economy. But, what about the system's potential for growth and contribution to Michigan's future? Part II is designed to answer this question. Specifically, estimates are made of the potential economic impact (investment, output, and employment) of a range of expected new ventures in the state's agri-food system. The estimates forecast potential activity over the next three to five years. Two distinct scenarios are presented to provide reasonable alternative estimates of new venture activity. Both scenarios provide ample evidence that Michigan's agri-food system can be a substantial contributor to the state's future economic activity.

Building Baseline Data for the Analysis

Creating a forecast for future economic activity is not an easy task for any sector, let alone one that is as complex as the agri-food system. To accomplish the task, the methodology used here begins with several "archetype" examples of individual new ventures that have potential for Michigan's economy. These archetypes include the potential economic impacts estimated for (1) several model medium- and large-scale production and processing facilities, and (2) small-scale entrepreneurial ventures in selected agri-food areas. Absent actual feasibility data, a literature review using a variety of sources (e.g., state, industry, and internet sources and contacts with industry and public agency experts) was the only way to develop capital investment, output and employment baseline estimates for the model facilities and entrepreneurial activities. The Product Center's own experience to date with venture launches and business plans has also been reviewed to determine some of the estimates. Final selection of estimates has been made after scrutinizing the information closely for its fairness, relevance, and appropriateness for the analysis and, when necessary, after modifying and improving it (e.g., using an inflator to present values at current prices).

As with the Part I economic impact data, there is also an indirect (multiplier) effect from new and expanded businesses that creates additional output and employment over and above the direct effect. Since time and resource limitation did not allow conducting a detailed impact analysis, no attempt has been made to establish an input-output model to determine multipliers that emanate from a new business activity. Rather output and employment impacts have been calculated by applying the most appropriate multipliers calculated in economic impact studies for related agri-food businesses in Michigan or other states. Local and regional multipliers are expected to be different from statewide multipliers. In some cases, however, where appropriate regional or local multipliers are not available, statewide multipliers are used. This assumes the existence of no significant difference between the statewide and regional or local multipliers. In addition, multipliers could vary based upon the scale and integration levels of operations.

Based on these basic assumptions, the future economic potential of Michigan's agri-food system is constructed in two steps. First, the economic impact of the individual model ventures is established. Then two scenarios envision different investment alternatives and their effects on Michigan's economy in the next 3-5 years.

The Economic Impact of Selected Individual Model Agri-food Ventures

Exhibit 1 provides baseline information on direct and indirect economic impacts associated with several model large-scale and medium-scale production or processing facilities plus a typical small-scale agri-food entrepreneurial venture. The economic impacts are assumed to be applicable for a new venture at a generic location within Michigan. The various examples provide a preliminary analysis of how an investment in the agri-food sector affects the whole economy of a region or a county by affecting the operation of other businesses, household income and employment.

Exhibit 1: Economic impact of several individual model agri-food economic ventures

*Includes induced impacts.

	Capital Inv.	**Output Impact (Million $)**			**Employment impact (# of jobs)**		
	Million $	**Direct**	**Indirect***	**Total**	**Direct**	**Indirect***	**Total**
Agri-Energy sector							
Ethanol	77.50	95.2	15.6	110.8	39	112	151
Biodiesel**	25.7	65	29.9	94.9	57	283	340
Livestock sector							
Dairy farm	3.70	2.7	4.4	7.1	12	39	51
Animal slaughtering	3.00	22.1	33.1	55.2	87	405	492
Food processing							
Major food processing facility	20.6	20.5	10.0	30.5	124	222	346
Nursery and greenhouse							
Greenhouse & open field ornamentals	1.13	1.5	2.0	3.5	33	43	76
Small-scale agri-food venture	0.08	0.2	0.5	0.7	5	9	14

**Assumes vertically integrated biodiesel facility that includes crushing and refining.

In reality, the full effects of some of the medium- and large-scale new ventures may take several years to be realized. In most cases, wherever it is deemed appropriate and data is available, averages of at least 4-5 year performances have been considered to come up with a reliable estimate of outputs and employment numbers. In this way, the analysis compresses the total economic impact of the businesses into a single year. Details of the assumptions and methodologies in each case are described in Appendix II.

Each type of venture in Exhibit 1 is now described in more detail.

Agri-Energy sector

This sector includes a broad array of product categories. The examples considered here are ethanol and biodiesel.

It is also worthy of note that agri- or bio-energy is a subset of a larger group of emerging ventures that make up what is termed the bio-economy. Bio-economy ventures produce products that replace petroleum-based products and other non-renewable resource products. A full consideration of this broader category is beyond the scope of this report, but it is addressed briefly after the future scenarios are presented.

Ethanol production facility

Ethanol production has been broadly adopted in the state. One plant is in full operation and four more are in the process of being built. Understanding the economic impact of such plants is obviously important.

Exhibit 1 summarizes the characteristics and economic impacts of a new ethanol plant. The model uses corn for the production of ethanol. The new ethanol production facility will be a 54 million gallon plant that requires a capital investment of $77.5 million. The direct total output per year from the facility is estimated to be $95.2 million providing an investment-output ratio of 1:1.2. That means the ethanol facility will approximately generate output of $1.20 for every $1 of capital investment. This ratio is consistent with the investment-output ratios in some other ethanol plant impact analyses and feasibility studies (e.g., an economic impact analysis for an ethanol plant in Iowa shows an investment-output ratio of 1:1.1). In producing this direct output, the facility will consume about 19.3 million bushels of corn per year and create 39 jobs. Overall, adding the direct and indirect impacts together, the ethanol plant will contribute to $110.8 million in total outputs, and 151 jobs in total employment.

An integrated biodiesel plant

In Michigan, an increased interest has developed in biodiesel production in recent years. According to the Energy Information Administration, Michigan consumed 1.3 billion gallons of diesel fuel in 2003. That was 5% higher than 2002, and included sales of low and high sulfur distillate which is used as a transportation fuel, for space heating and as a fuel for other stationary (non-transportation) applications in commercial, industrial, and electricity generation sectors. If diesel fuel consumption continued to grow at the same rate between 2003 and 2006, and if diesel fuel sold in the state contained 5% biodiesel, this would create a potential demand for over 75 million gallons of biodiesel per year. A 20% biodiesel composition will create demand for over 300 million gallons of biodiesel. This assumes no growth in future diesel fuel use in the state. This provides a business opportunity for 20 biodiesel facilities each with 15 million gallons capacity. As with ethanol, biodiesel is a substantial economic development opportunity if use expands.

There are two basic options to consider for a biodiesel facility: A stand-alone biodiesel production facility or an integrated production facility. A stand-alone biodiesel production plant produces biodiesel from oils and recycled fats purchased on the open market and delivered to the facility. An integrated biodiesel facility processes soybean into oil and coproducts. The oil will

then be further processed into biodiesel and other coproducts in on-site biodiesel production plant. The stand-alone biodiesel plant has the advantage of being less capital intensive and easier to site the plant. But one significant factor in considering a stand-alone plant is the security and cost of supply.

The specific example used in this report analyzes the potential economic impact of a model biodiesel production facility at a generic Michigan location. Considered is the operation of an integrated soybean crushing and biodiesel production plant. In addition to the production of biodiesel, the facility will process soybean into soybean oil and co-products. This approach is selected for the following reasons: (1) the long-term survival of the facility is secured through an uninterrupted supply of feedstock that is available at reduced costs; (2) flexibility could be added to the facility by expanding or reducing the soybean-processing portion of the processing plant; (3) multiple oilseed processing could be possible that would allow the facility to expand its market opportunities from sales of edible and other oils; and, (4) an integrated biodiesel facility provides an additional value-added opportunity for soybean producers of Michigan.

The economic impacts of the biodiesel production facility are measured to include the direct, indirect and induced impacts. The biodiesel plant will have a capacity of 15 million gallons. This appears to be the appropriate size facility that captures most of the economies of scale (e.g., Shumaker, et al. 2005). The facility will consume about 10 million bushels of soybeans. Assuming a capital investment of $25.7 million, the integrated biodiesel plant will have a direct output impact of $65 million. The total regional economic impact is estimated at $94.9 million. Similarly, there is a strong impact to local and regional employment. About 57 new jobs are required to staff the soybean processing and the biodiesel production facility. Overall employment is projected to increase to a total of about 340 jobs.

In the scenarios presented in the next section, these biodiesel impact estimates may also serve as surrogates for other types of bio-economy projects, e.g., bio-refineries added to existing ethanol plants. If non-integrated facilities are used for biodiesel, one such plant represents no more than half the investment and employment impact of the integrated plant. As a result, it would take at least two non-integrated plants to substitute for the impact of one integrated plant.

Need for Additional Research, Including Potential Interaction on the Livestock Industry

The model ethanol and biodiesel facilities have significant direct and indirect economic impacts in terms of output and employment. They provide an extended opportunity for Michigan corn and soybean producers to add value to their products through processing. Long-term successes in the production of ethanol and biodiesel will, however, depend on the market for their coproducts, which mainly include animal feed. Currently, due to the limited number of cattle, Michigan's livestock industry does not appear to have the capacity to fully accommodate feed products from an increasing number of ethanol and biodiesel facilities. It is also worth noting that a well-developed livestock industry could be a reliable source of feedstock for biodiesel refineries. These situations suggest the need for a detailed study that addresses the long-term feasibility and economic impact of ethanol and biodiesel production facilities on the Michigan economy. Integrated corn-ethanol-livestock and soybean-biodiesel-livestock production models should be developed to determine the long-term feasibility and contribution of the agri-based energy sector of Michigan. In addition, such models should address effects and consequences of new research findings, technologies (e.g., availability of other low-cost and efficient feedstocks, and bio-refinery applications for higher value co-products) and future energy consumption trends that

affect not only future ethanol and biodiesel production but also future corn, soybean and livestock production.

Livestock sector

Two types of new business development projects are considered: A large-scale dairy farm and a small-scale animal slaughtering plant. These are obviously two of many possible ventures, and they serve as potential surrogates for other similar-sized livestock ventures. They are chosen as particularly relevant to Michigan and representative of both production facilities and processing facilities that would contribute to the sector.

Large-scale dairy farm

The dairy industry represents an important segment of the Michigan economy. With this significant impact, there are still efforts to further strengthen the economic development contribution of the industry. Recent experience of the MSU Product Center shows that an increasing number of nascent entrepreneurs have interest in starting new dairy farms or in expanding existing ones by adding value-added activities.

Considered here is a large-scale dairy farm with over 1,000 cows. Establishing the farm will require an initial capital investment of $3.7 million. The annual output from the farm, which is the direct impact of such an operation, is estimated at $2.7 million. The dairy farm purchases supplies and services (e.g., feed, machinery, maintenance and repair, veterinarian services, transportation, trade, etc.) from a broad array of other industries generating an output of $4.4 million in indirect and induced economic activities. The total economic impact from the farm is estimated to reach $7.1 million a year. The farm will create 12 jobs as a direct employment impact. It will also generate 39 jobs in indirect and induced impact, for a total employment impact of 51 jobs.

Small-scale animal slaughtering

Cattle numbers are important factors that determine the size, and number of animal slaughtering facilities. Currently, with an overall inventory of about 1 million cattle and calves, Michigan's cattle production can hardly support large-scale slaughtering facilities. Entrepreneurs who are interested in establishing such facilities should partly depend on cattle imports from other states.

Considered in this analysis is a small-scale beef slaughtering facility. This investment approach assumes that, in the short-to-medium-term, establishment of an increased number of small-scale slaughtering facilities that focus on specialty meat products would create a market opportunity for existing cattle producers. This would eventually pave the way for an increased cattle production that could in the future support large-scale slaughtering facilities in the state.

Based on the experience of the MSU Product Center working with nascent entrepreneurs who want to enter this market, it was assumed that the facility will have a slaughtering capacity of 10,000 cattle per year. Exhibit 1 presents a summary of the economic impacts of the small-scale animal slaughtering facility. The direct impact in terms of output is estimated to be $22.1 million. This direct output from the slaughtering facility will support an additional output of $33.1 million as indirect and induced impact, for a total output of $55.2 million. Much of this impact is expected to be concentrated in the agriculture sector. The new facility will create 87 jobs and support an additional 405 jobs, for a total of 492 jobs.

Major food processing facility

Because of the diverse nature of its agri-food sector, Michigan provides a wide range of advantages for processors and manufacturers of food and related products. Therefore, Michigan's agri-food processing segment is currently one of the most important manufacturing sectors. According to the U.S. Census Bureau, there were 885 food processing establishments in the state in 2002.

The food processing facility assumed in this analysis is expected to represent a wide range of food processing activities. The economic estimates themselves are based on the Product Center's experience to date and the experience with the agricultural renaissance zones around the state. In this sense then, the example presented could represent fruit and vegetable manufacturing, grain and oilseed milling, sugar and confectionery product processing, or a bakery and related food manufacturing facility.

The direct and indirect economic impacts from a large-scale food processing facility are presented in exhibit 1. The facility with a capital investment of $20.6 million will have an annual output of $20.5 million as a direct impact. The indirect and induced output impacts of the food processing facility are estimated at $10.0 million for a total impact of $30.5 million. The food processing facility will have a direct employment of 124 persons. Total indirect and induced employment impact is 222 jobs. Overall, 346 new jobs will be directly or indirectly related to the large-scale food processing facility.

Large-scale nursery and greenhouse facility

The nursery and greenhouse industry comprises a broad array of businesses involved in the production, distribution and services associated with ornamental plants (e.g., growers and wholesalers, garden centers, retailers, etc.) and landscaping services. This is one of the most significant segments of Michigan's agricultural economy as shown in Part I of this report.

In view of its importance, recent growth trends and potentials, and an increasing interest of entrepreneurs who want to enter this market, a large-scale nursery and greenhouse facility is presented in this analysis. The facility will incorporate the production and wholesaling of plants and flowers grown in greenhouses and in open fields. These are mainly container and field-grown ornamentals, and greenhouse flowering plants and foliages.
Economic impact results for the large-scale nursery and greenhouse facility are presented in exhibit 1. A capital investment of $1.13 million will generate $1.5 million as a direct impact, and $2.0 million as an indirect and induced impact. The total economic impact per year will be $ 3.5 million. The facility generates 33 jobs as a direct employment impact. The total employment impact including the indirect and induced impacts is 76 jobs.

Small-scale agri-food entrepreneurial venture

Fundamental to future success in the agri-food system will be the ability of businesses to innovate and to fully grasp contemporary consumption patterns, their driving forces and growth opportunities. In this regard, small-scale agri-food entrepreneurial ventures that can adapt their ideas, technologies and resources to the ever-changing consumer wants, needs and perceptions, will play a significant role in promoting Michigan's economy. The experience of the MSU Product Center shows that potential ventures in this area are very diverse and consist of businesses involved in a wide range of niche products and services including agri-tourism.

Based on the Product Center's experience with such ventures, the economic impact of a small-scale entrepreneurial venture results in a capital investment of $0.08 million, contributes approximately a total of $0.2 million in direct output, and creates jobs for five (5) people. The indirect and induced impacts from the venture are estimated to be $0.5 million. Overall, the small-scale entrepreneurial activity is expected to generate $0.7 million in total output and generates 9 additional jobs, for a total of 14 jobs. Although one such venture appears to have limited impact, the probability of generating a large number of these ventures around the state is very high. Hundreds of such ventures could be generated per year as will be seen in the scenarios presented in the next section.

Conclusions on Individual Ventures

The possible individual ventures presented in Exhibit 1 and then analyzed throughout this section hold significant promise to create economic development impacts. The scale of these various ventures does vary significantly. Ethanol facilities have the largest impact ($77.5 million in investment, $110.8 million in total annual output, and 151 total jobs), while small-scale ventures have the smallest ($80,000 in investment, $700,000 in total output, and 14 total jobs). As shown there are many other venture opportunities between these two extremes. The remaining analysis must now show how these various individual projects might aggregate into a portfolio of opportunities for the state.

Scenarios for Analyzing the Economic Impact of New Investment

A variety of economic impact analyses can be conducted that represent and reflect different potential business development perspectives, approaches and assumptions. This report considers two scenarios that appear to be appropriate for examining aggregated statewide economic impact of new investment in the agri-food sector of Michigan in the next 3-5 years. The two scenarios are as follows:

- ***Scenario A*** which assumes that the current known investment patterns in Michigan's agri-food system can be continued into the future. In fact, the large projects already in process will have positive influences on the state's economy over the immediate future.
- ***Scenario B*** which assumes that a reasonable but more general set of venture opportunities emerges with appropriate private and public support for these ventures.

Both scenarios are future oriented. Using the individual estimates of the prior section as surrogates for a range of possible venture opportunities, they specifically examine the effects of changes in the number, size and capital investment of new businesses on the state economy in terms of additional output and job creation. Given the uncertainties of any future forecasting, the creation of two scenarios built on differing assumptions is essential to understanding the range of possible outcomes for new venture development.

Scenario A: Future economic impact of known and expected projects

This scenario envisions (1) implementation of currently known large-scale projects that are already in the pipeline within the state, and (2) establishment of new small-to-medium-scale businesses with some additional large-scale businesses projected based on current patterns of entrepreneurial activities as experienced by the MSU Product Center and based upon industry expert judgments.

Following are most important characteristics of this scenario as shown in exhibit 2.

- Projects in part A of exhibit 2 (four ethanol plants and 14 major food processing facilities) are basically reflective of the ongoing large-scale agri-food processing facilities in ag-renaissance zones of Michigan with two additional projects based on the experience and activities of the MSU Product Center.
- Projects in part B of the exhibit are projected assuming recent performances in terms of new business start-ups at the Product Center. In the first ten months of 2005, the Product Center provided support and assistance in business development activities that led to 36 start-ups (either new businesses or new products for existing businesses). Most of these new start-ups are small-and medium-scale businesses. So most of the projections in the exhibit, except for the biodiesel, are made based upon these recent achievements. The biodiesel projection is made based on information from industry experts.
- The projects are expected to be realized in 3-5 years. This projection appears to be realistic particularly for some of the medium-scale and large-scale projects that have complex business development processes. In addition, it is assumed that the projects receive adequate support and full participation from all stakeholders, service providers and public agencies involved at all stages of the business development processes.
- Baseline investment, output and employment estimates in exhibit 1 are used to estimate the economic impacts of these projects.

The direct economic impact of 18 large-scale agri-food processing facilities is estimated to be $669.3 million. When the indirect and induced impacts are added together, the currently known projects will contribute to $871.1 million in total output. In producing this total output, the projects require a capital investment of $598.4 million. About 1,892 jobs are also required to run these facilities. They will create 3,553 additional jobs as indirect and induced impact, for a total 5,445 jobs.

Exhibit 2: Scenario A - Economic impact of new investment in currently known projects and expected agri-food initiatives (3-5 years projection)

* Includes induced impact

	No. of Businesses	Capital Inv.	Output Impact (Million $)			Employment Impact (# of jobs)		
		Million $	Direct	Indirect*	Total	Direct	Indirect*	Total
A. Known projects in process								
Ethanol	4	310.0	382.3	61.2	443.5	156	446	602
Major food processing facility	14	288.4	287.0	140.6	427.6	1736	3107	4843
Total A	18	598.4	669.3	201.8	871.1	1892	3553	5445
B. Projected initiatives								
Biodiesel	2	51.4	130.0	63.7	193.7	114	570	684
Animal slaughtering	6	18.0	132.6	198.9	331.5	522	2427	2949
Dairy farm	5	18.5	13.5	22.5	36	60	195	255
Greenhouse & open field ornamentals	20	22.6	30.0	39.6	69.6	660	838	1498
Small-scale agri-food venture	100	8.0	20.0	50	70	500	900	1400
Total B	133	118.5	326.1	374.7	700.8	1856	4930	6786
Total impact (A+B)	151	716.9	995.4	576.5	1571.9	3748	8483	12231

The cumulative direct impact of the projected small-to-medium-scale initiatives (part B in Scenario A) is estimated to be $326.1 million. Indirect and induced impacts add another $374.7 million, for a total economic impact of $700.8 million in total output. In producing this total output, the small-scale and medium-scale ventures require $118.5 million in capital investment. Noticeable in this category is the impact of small-scale agri-food ventures. A capital investment of $8 million in 100 small-scale agri-food ventures could generate a total output of $70 million as a direct, indirect and induced impact. They will also create 500 jobs as direct impact, add 900 jobs as an indirect and induced impact, for a total of 1,400 jobs.

Overall, the total direct economic impact of the 151 new ventures in Scenario A is estimated at $995.4 million. When the indirect and induced effects are considered, the impact will be nearly $1.6 billion in total output. The new businesses will also create 3,748 jobs as a direct impact. When the indirect and induced impacts are added together, they contribute to over 12,000 jobs. This full direct and indirect contribution could be realized, if the currently known agri-food processing initiatives in ag-renaissance zones and the other projected initiatives are fully realized in the next 3-5 years.

Scenario B: Potential economic impact of forming new businesses that reflect statewide establishment births

The appeal of Scenario A is its foundation assumptions drawn from known or readily projected venture activity. The scenario does have two potential drawbacks: (1) the capacity of the state to expand ethanol beyond the five anticipated plants is limited and therefore additional economic development from ethanol is not likely to be sustainable; and (2) the potential emergence of other new ventures is likely to exceed the experience of the Product Center as it is only one of many new venture support organizations in the state. A second, more general scenario is needed to address the potential shortcomings of the first. The challenge is to find an appropriate set of base assumptions to start from.

The number of new firm births is one of the most popular measures of entrepreneurship activity (Advanced Research Technologies, 2005). The U.S. Census Bureau issues annual data on establishment births[1] for major industries and services in each state. This information is a good indicator of future potential entrepreneurial activities in different sectors and regions. Therefore three-year averages of establishment births (1999/00-2001/02) in the (1) agriculture, forestry, fishing and hunting, (2) manufacturing, (3) wholesale, and (4) retail trade categories have been used to make annual projections of possible entrepreneurial activities in the agri-food sector of Michigan. ***The fundamental assumption of Scenarios B is that the agri-food sector can achieve the same rate of establishment births as the economy as a whole.*** This assumption would be achievable if the appropriate levels of investment and support are provided to the sector.

Exhibit 3 lays out the steps that create Scenario B. Step 1 shows the general rates of establishment births. Step 2 then applies these rates to the agri-food system. The agriculture, forestry, fishing, and hunting rate of Step 1 applies directly to farm births in Step 2. The manufacturing, wholesale, and retail rates of Step 1 which apply to all firms in these various

[1]According to the U.S. census Bureau, births are establishments that have zero employment in year t and positive employment in the first quarter of year t+1.

sectors are applied to the agri-food system based on the relevant ratio of agri-food firms to total firms (Step 2).

Based on these assumptions, a potential exists to establish 851 businesses per year (final outcome of Step 2) in the agri-food system of Michigan. Considering the current agri-food entrepreneurship activities of the MSU Product Center, this statewide hypothetical figure appears to be achievable. In 2005, with its limited resources, the Center could contact and provide services and assistances to nearly 400 clients interested in developing and commercializing different products and businesses. It is obvious that, for a variety of reasons (e.g., infeasible business ideas, shortage of capital, lack of technical knowledge to develop new products, limited services and assistances, etc.), not all of them are going to start new businesses. But this trend shows that, if there is an additional technical and institutional support with adequate resources, and the state aggressively pursues recruitment of entrepreneurs in the agri-food sector of Michigan, achieving these businesses is highly likely.

Exhibit 3: Scenario B basic assumptions

Step 1: 3-year (2000 -02) average "establishment births" for Michigan four agri-related areas (U.S. census Bureau)	
Births in agriculture, forestry, fishing and hunting	61
Births in manufacturing	897
Births in wholesale	985
Births in retail	3307

Step 2: Approximation of establishment births in the agri-food sector on annual basis*	
Farm births: 3-year average as presented above	61
Food manufacturing births: Ratio of food manufacturing to all manufacturing in MI (885/15893) x 897	50
Agri-food wholesale trade births: Ratio of agr-food wholesale to all wholsale in MI (1268/12876) x 985	97
Agri-food retail trade births: Ratio of agri-food retail to all retail in MI (7563/38876) x 3307	643
Approximate total # of new establishments in the agri-food sector per year	**851**

Step 3: Projection by types of businesses	
90% will be small-scale businesses	**766**
10% will be medium-scale and large-scale businesses (only two large-scale businesses per year)	85

Step 4: Baseline capital investment, output and employment estimates
Large-scale project: A major food processing facility in Ag renaissance zones (Scenario A)
Medium-scale project: Average of projects in section B of Scenario A excluding small-scale agri-food ventures
Small-scale project: A small-scale agri-food venture presented in section B of Scenario A.

***Ratio analysis based on 2002 Michigan data from the U.S. Census Bureau**

Step 3 then divides the total estimated 851 firms into a likely proportion of large and small scale ventures. Step 4 refers back to the prior work of this section to link the individual project estimates for investment, output, and employment to the new Scenario B.

The results of these assumptions are shown in Exhibit 4 which presents the fully expanded estimates of Scenario B. In addition to the numeric assumptions of Exhibit 3, the following are also critical to scenario B:

- Based on exhibit 3, Scenario B can only be realized if the more general rates of enterprise growths are achieved in Michigan's agri-food system.
- It is thus assumed that there will be well-functioning policy and a fully-committed institutional support system that will enhance entrepreneurial activities within the agri-food sector of Michigan.
- Results are expected to reflect average impacts since the data assumes average output and employment per year (as opposed to peak year data).
- Businesses are expected to be realized within one year.

Exhibit 4: Scenario B - Potential impact of forming 851 new businesses per year in the agri-food sector of Michigan

		Capital Inv.	Output Impact (Million $)			Employment Impact (# of jobs)		
	Number of Businesses	Million $	Direct	Indirect*	Total	Direct	Indirect*	Total
Establishing 851 businesses								
Large-scale projects	2	41.2	41.0	20.09	61.09	248	444	692
Medium-scale projects	83	277.9	769.9	1047.1	1817	3403	8201	11604
Small-scale agr-food ventures	766	61.3	153.2	383	536.2	3830	6894	10724
One-year impact of 851 businesses	***851***	***380.4***	***964.1***	***1450.2***	***2414.3***	***7481***	***15539***	***23020***
Scenario B three-year impact	***2553***	***1141.2***	***2892.3***	***4350.6***	***7242,9***	***22443***	***46617***	***69060***

* Includes induced impacts

Exhibit 4 presents the relevant details of the economic impact analysis under this scenario. If Michigan's agri-food sector invests $380.4 million per year on structures, machinery and equipment, and supplies needed to support the establishment of 766 small-scale entrepreneurial ventures and 85 medium-to-large-scale production and processing facilities, this will create an output of $964 million as a direct impact. The infusion of this $964 million in Michigan's agri-food sector will generate an additional indirect effect of nearly $1.5 billion in output from other supporting businesses in the state.

The 851 businesses will create 7,481 jobs per year as a direct impact. As a result of these activities, an additional 15,539 jobs will be created in other businesses, for a total of over 23,000 jobs in the state. Again, the impact of the 766 small-scale ventures is noticeable in this scenario. A capital investment of $61.3 million in 766 small-scale entrepreneurial activities will generate $536.2 million in total output and the ventures will create over 10,000 jobs as a direct, indirect and induced impact. ***If the state can establish new agri-food ventures at the rate of 851 per year, the model shows that there is a potential to generate over $7 billion in total outputs and create nearly 69,000 jobs from a total capital investment of about $1.1 billion in a three year period. Given a potential workforce of 4.64 million, 69,000 new jobs would reduce the state's unemployment rate by almost 1.5 percent.***

Comparing Scenarios A and B

Overall, the two scenarios are based on significantly different information about the economic impact of new investment in the agri-food sector of Michigan, but result in very comparable outcomes. Scenario A is based on known examples and indicates the magnitude and direction of economic impact that can be expected if those currently known projects are realized in the next 3-5 years. ***The annual addition to economic output of Scenario A would be $995.4 million direct and $1571.9 million total, and direct and total job creation would be 3,738 and 12,231 respectively.*** Scenario B is based on a more generic set of venture creation figures and shows the general patterns of total economic impact, if the state pursues the establishment of 851 ventures with a probably mix of small-, medium- and large-scale agri-food ventures on an annual basis. ***The annual addition to output from Scenario B would be $964.1 million direct and $2,414.3 million total, and direct and total job creation of 7,481 and 23,020 respectively.*** Both scenarios have similar direct economic impacts on output, while the greater job creation of Scenario B reflects a greater reliance on small firms as the engine of growth. Either scenario shows that investing in a large number of agri-food businesses would contribute significantly to Michigan's economic development. For the most part, Scenario A reflects projects that are fully committed. Yet the sustainability of this rate of development is not assured, particularly given the limited additional capacity for ethanol. Scenario B however shows that the rate of development could be sustained by other means and other mixes of businesses. Realizing this more sustained scenario for development requires a well-functioning agri-food policy and business development support system committed to generating the appropriate number and mix of new ventures.

Agri-Toursim

Agri-tourism is believed to have a substantial impact on the Michigan economy. Current trends at the MSU Product Center show an increasing interest by nascent entrepreneurs to start farm-based tourism businesses. In the present analysis, some of the proposed new agri-food businesses are expected to include agri-tourism related activities. For example, baseline estimates for small-

scale agri-food entrepreneurial ventures included some example of agir-tourism businesses in the averages.

Until now Michigan's agri-tourism industry has not been analyzed and studied separately and there is no reliable and dependable public information that could be used as a source to estimate the contribution of this industry. There are two steps that need to be considered to analyze the economic impact of the agri-tourism industry. Since agri-tourism has implicitly been part of (rural) tourism until now, the first step in the process is to develop a methodology that defines and analyzes the industry as a separate segment of Michigan's agri-food economy. This approach would help to identify the distinct characteristics of Michigan's agri-tourism, rural-tourism, and the tourism sector as a whole that could eventually lead to some kind of policy decisions and recommendations. The second step involves identification and categorization of the tourism part of the agri-food sector. Because agri-tourism involves a variety of activities that partly overlap with other production, processing or trade activities in the agri-food sector. These situations call for a careful approach and methodology to identify and categorize appropriate agri-tourism related activities. Therefore analyzing the overall economic impact of agri-tourism requires detailed feasibility studies that help conceptualize and understand the components of Michigan's agri-tourism industry. These studies need to be undertaken to establish the appropriate economic impact data.

The Potential Impact of the Bio-Economy

Although both Scenario A and B either explicitly or implicitly consider bio-energy examples, neither scenario fully incorporates the potential impact of a full-fledged "bio-economy." In such an economy, bio-based inputs would replace petroleum and non-renewal inputs in a wide variety of applications that include fuel, industrial chemicals, fine chemicals, building materials, and other related products. The economic potential of such a bio-economy is believed to be immense. However, economic estimates are very difficult to create given the level of uncertainty that surrounds the emerging technologies and intellectual property necessary to achieve these new products. As a result, the estimates found in this report may be dramatically understated if the bio-economy becomes reality. Separate studies are underway that attempt to estimate the potential in these new uses of agricultural products. As these estimates become available, an update of this report is envisioned.

Concluding Remarks

The present analyses estimated potential economic impacts associated with new investment in the agri-food sector of Michigan. Overall the results from new investment show the fact that growth and expansion in the agri-food sector has powerful leverage on the broader state's economic growth. Most of the direct and indirect impacts of outputs and employment are analyzed based on conservative estimates in order to have some control on the effects of future changes, and uncertainties about key parameters. Given the simplified assumptions in the analyses, however, results need to be interpreted with caution and economic relationships and impacts should be considered as general estimates that approximate the direction and scale of impacts from alternative approaches. Additional detailed economic impact studies have to be done to more accurately and reliably determine the economic impacts associated with new production and processing facilities in different counties and regions within the state. In addition, the economic impact analysis does not assess the long-term effects of the proposed new

businesses and the approach assumes linear relationships between changes in demand for products and services and the resulting changes in output, and employment. Overall, the creation of actual products and services in the agri-food sector requires a strong institutional support system and coordination of agri-food entrepreneurial capabilities and potentials at the local, regional and state level. This has to be integrated with an established and well-functioning entrepreneurship policy in the agri-food sector of Michigan.

APPENDIX I: RESEARCH METHODOLOGY FOR PART I

Overview

To the greatest extent possible, the research methodology in this paper is the same as 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.

One shortcoming to this study is that different year's were used for the analysis. The most recent data available was used to generate the estimates. However, for processing and manufacturing, the most recent available numbers were from the U.S. Economic Census and are based on 2002 figures. Farm employment is based on the 2002 Agriculture Census and is also somewhat dated. Nonetheless, this analysis does generate a good perspective on the size and scope of the agri-food and agri-energy sector.

The Farm Sector and Food Manufacturing

The output on farms is a three year average from 2002 through 2004. 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 the same that Professor Ferris used.

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

Food manufacturing output figures come from the 2002 U.S. Economic Census, the employment figures are for 2004 and come from the Bureau of Labor Statistics in most cases. In those industries were disclosure of employment would identify specific firms, estimates were obtained from the U.S. Census 2003 County Business Patterns. Output and employment multipliers were the same as those used by Professor Ferris in his study.

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 2004. 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. Professor Ferris' estimate that 43 percent of total consumption is derived from Michigan farms is maintained. The proportion of seafood and imported food consumed in Michigan are also maintained from Professor Ferris' study and are adjusted upward to be consistent with food consumption in the state for 2004. Proportions of wholesaling and retailing margins are also maintained from the Ferris study.

The multipliers are also from the Ferris 2000 study.

Employment in wholesaling is derived from the BLS employment data for 2004. Employment in retailing is based on retail sales per employee in 2002 and adjusted for food inflation. The proportions of employees engaged in different activities such as retailing imported food, food service etc. is based on the Ferris study. This figure is higher than that reported by the BLS. The BLS figures are provided in the following table

Appendix Table 1: Retail Employment in the Michgian Agri-Food System 2004

Industry	Direct Employment	Total Employment
Supermarkets and Other Grocery Stores	71,500	89,089
Convenience Stores	6,550	8,161
Food, Health, Supplement Stores	1,525	1,900
Warehouse Clubs and Supercenters	44,875	55,914
Specialty Food Stores	8,949	11,150
Beer Wine and Liqour Stores	7,268	9,056
Nursery, Garden, and Farm Supply Stores	4,111	5,122
Florists	4,540	5,657
Community Food Services	652	812
Full Service Restaurants	129,121	160,885
Limited Service Eating Places	127,900	159,363
Special Food Services	26,808	33,403
Drinking Places, Alcoholic Beverages	21,015	26,185
Government Food Service	339	422
Total	455,153	567,121

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

The estimate in the analysis is considerably higher than the figures reported by the BLS. However, the BLS figures do not capture all the outlets and employment in the agri-food system. Gas stations, bookstores, hotels etc. that sell food would not be counted by the BLS.

Agri-Energy and Investment

The estimates for both economic activity and 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.* Economic impacts were adjusted upward to reflect actual production in Michgian.

The farm level investment figures were based on GreenStone Farm Credit Services and were adjusted to include the entire lending market. An additional 20 percent was added to this figure to include the estimated amount of self financed investment carried out by farmers themselves.

The figure for investment in other sectors was provided by the Michigan Department of Agriculture (MDA) and is based on investment activities that they were aware of. This figure likely understates the level of investment. Most of the investments listed by the MDA required some level of public sector support or aid. Many investments that do not meet the criteria for public sector intervention were probably not captured by the MDA.

APPENDIX II: METHODOLOGICAL APPROACHES AND ASSUMPTIONS FOR PART II

Economic impacts vary considerably depending upon two factors: (1) baseline estimates used for outputs, employment and capital investment, and (2) economic multipliers assumed in the analysis. This section describes the methods, and information sources used in estimating economic impacts of new investment for model facilities and entrepreneurial activities in the agri-food sector of Michigan.

Ethanol: For this report, investment and employment data from four Michigan agricultural processing renaissance zones and investment-output ratios based on the experience of the MSU Product Center for agriculture and natural resources have been used. Based on the center's activities, a four year average output from an ethanol facility with a capital investment of $77.5 million has been calculated to be $95.2 million. This is a dry milling process that will produce about 54 million gallons of ethanol per year. In addition, the facility is expected to produce distillers grains and carbon dioxide as major co-products. Total multipliers of 1.16, and 3.87 calculated from and applied for an economic impact analysis of an ethanol production facility in Iowa (Swenson, 2005) has been used to measure indirect and induced output, and employment impacts respectively.

Biodiesel: A biodiesel plant with 15 million gallon capacity was considered. This appears to be the appropriate size facility that captures most of the economies of scale (e.g., Shumaker, et al. 2005). This will require 10 million bushels of soybean. Capital investment was estimated based on economic analyses of soybean-based biodiesel production plants in South Dakota (Leatherman and Nelson, 2002), Mississippi (Frazier Barnes and Associates, 2003), and Kentucky (Bowman, 2003). The capital investment for the South Dakota biodiesel operation included only industrial facility construction and plant equipment and assembly. Thus some adjustments have been made for additional startup costs (e.g. required initial working capital, etc.). Finally, an inflator has been used to present the values at 2005 dollars. Using capital investment data from the three studies, an average capital investment of $1.71 per gallon (a total of $25.7 million) was assumed.

Total receipts include revenues from biodiesel and outputs from coproducts. These were calculated based on output data from the Minnesota biodiesel economic impact study. In some of the reviewed impact analyses studies, the capital investment-output ratio for an integrated soybean crushing and biodiesel production plant ranges from 1:5 to 1:8. The proposed biodiesel production plant assumes a ratio of 1:2.4, which is a conservative estimate. In this way, it is possible to control some adverse effects that may lower the output level or cause an increase in capital investment requirements. The employment data (35 for biodiesel refinery and 22 for soybean processing) was estimated based on information from a bioidesel impact analysis study for Minnesota (Ye, 2004). This appears to be consistent with other economic impact studies for integrated biodiesel facilities (e.g., 79 jobs from a 24 million gallons capacity facility in South Dakota). Other studies show higher number of jobs (e.g., 87 jobs for a 5 million gallon capacity in Kentucky). The biodiesel facility may not be operating its full capacity in the first few years. The model thus considers an average annual output. Multipliers in the biodiesel impact analyses vary widely. For example, in Minnesota, impacts were analyzed using a total multiplier of 3.06 for output, and 27.8 for employment. This report considered coefficients developed from the

economic impact analysis in South Dakota. Total multipliers of 1.49, and 6.0 were used for output, and employment respectively.

Michigan bio-diesel demand projection: According to the Energy Information Administartion, Michigan's biodiesel consumption in 2003 was 1.3 billion. This was 5% higher than the consumption in 2002. This annual growth rate was applied to calculate the consumption level in 2006 (1.5 billion gallons).

Large-scale dairy farm: Coefficients on capital investment, milk production, price and other related data have been developed based on available public information. A capital investment of $3,740 per cow (Hook, 1998) resulted in a total capital requirement of $3.7 million to establish a large-scale dairy farm. Average milk production per cow was assumed to be 20,135 pounds per year (average Michigan production for 2000-2004) (MDA, Michigan Agricultural Statistics 2004-05). The 2003 Michigan average milk price ($13.20 per cwt) has been applied to calculate the direct total output from the dairy farm. These data were scrutinized, cross-checked, compared and evaluated for their reliability and applicability. Based on multipliers from a dairy farm economic impact study in Minnesota (Minnesota Department of Agriculture, 2002), total multipliers of 2.67, and 4.25 were used to estimate the indirect and induced impacts of output and employment from the farm respectively.

Small-scale animal slaughtering: Considered is a small-scale animal slaughtering facility (10,000 cattle per year). This capacity was estimated based on the existing and potential business activities of clients at the MSU product center. Capital investment and employment data was calculated based on information and data used for a beef plant expansion in Minnesota (Saunders, 2005). A capital investment of $298 per cattle has been assumed. Output from the facility has been estimated using detailed beef carcass yield coefficients (e.g. carcass weight and carcass yields) developed in Iowa (Iowa State University, 2005) and based on an economic impact analysis made for the Iowa cattle industry (Lawrence and Otto, 2005). The facility is expected to produce high quality meat.

In calculating the indirect impacts, total multipliers used for a beef processing plant in Minnesota have been considered. These are calculated to be 2.5, and 5.65 for output and employment respectively. These are conservative estimates compared to multipliers used to calculate economic impacts of other beef processing plants in the same study. The multipliers, and output and employment coefficients used in this analysis show similar patterns with results from an economic impact study of the U.S. beef industry conducted by Otto and Lawrence (2005).

Large-scale food processing facility: Capital investment, output, and employment data have been derived from different sources. Average capital investment and employment data have been calculated from 12 existing and planned processing facilities within Michigan's agricultural processing renaissance zones and 2 large-scale food processing facilities based on the activities of the MSU Product Center. Average output was calculated based on the activities of the Product Center. Total multipliers for indirect and induced economic impacts were derived based on economic impact studies of a vegetable production and processing facility in New Mexico (Hall, T.Y and Skaags, 2005) and Florida's fruit and vegetable industry (Hodges, A. et al. 2005). Total multipliers of 1.49 and 2.79 have been applied to estimate indirect and induced impacts of output and employment from the major food processing plant. This is a conservative model compared

to multipliers calculated from an economic impact study of the tree fruit industry in Washington state and the Northwest (Jensen, 2004).

Large-scale nursery and greenhouse facility: The model assumes the production of both floriculture and nursery products. Baseline output and employment estimates for this facility were developed based on information from economic impact studies for the green industry in Florida (Hodges, et al. 2002), California (Carman and Rodriguez, 2004) and the U.S. (Hall, et al. 2005) that includes data on Michigan nursery and greenhouse industry. The data from the impact analysis in Florida provided a better picture of investment-output relationships in the floriculture and nursery industry. Therefore, based on this study, an average capital investment of $1.13 million that generates $1.5 million in sales and creates 33 jobs has been calculated and applied for the analysis. The establishment will have a production area of about 34 acres. Total multipliers for the analysis were also derived from the Florida impact study (2.32, and 2.27 for output, and employment respectively). These multipliers do not show significant differences from multipliers calculated for Michigan in the U.S. green industry study. They were also consistent with multipliers derived from the California nursery industry impact analysis.

Small-scale food and agriculture entrepreneurial activities: Economic impact estimates for these ventures are based on the following sources of information and assumptions: (1) Average actual sales, employment, and capital investment data from the product center's six startup clients have been taken as a basis. Start-ups with sales of less than $500,000 and fairness of information have been considered in selecting the businesses for the analysis. Multipliers were calculated based on information on economic impact studies in agri-tourism industry in San Diego County, California (Lobo, et al. 1999) and other small-scale rural tourism activity impacts (Stynes, 1999). Multipliers of 3.5 and 2.8 have been used to estimate indirect and induced impacts from direct outputs and employment activities respectively. These coefficients were relatively consistent with multipliers calculated from agri-tourism impact analysis in New Hampshire (Goss, 2003).

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