

**Current State of Economics of Southwest
Michigan Blueberries**

by

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ABSTRACT

Highbush Blueberries are a perennial crop that typically take 4-8 years to produce fruit and 6-12 years to produce as a mature bush. Highbush blueberries account for about 98% of fresh blueberries in North America and about 46% of the processed market for US blueberry consumption. In Southwest Michigan, the blueberry industry is experiencing narrower profit margin as a result of declining product prices through oversupply from global production and increased costs of production. The economic model developed examines historical data and analyses its implications to Michigan blueberry market. Results indicate that to be able to stay in business producers need to find ways to increase per unit average production, and/or find ways to reduce costs. A sensitivity analysis is used to show the effects of changes to some of the largest expenses, labor and chemicals, and also sensitivity to income fluctuations. Income is looked at with a 10% increase or decrease to total income and pounds produced. Labor and chemical expenses were looked at with a 20% increase or decrease in costs.

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CHAPTER I: INTRODUCTION

Highbush blueberries are a perennial crop that typically takes 4-8 years from planting a small cutting of nursery stock to produce fruit and 6-12 years to produce as a mature bush. Highbush blueberries account for about 98% of blueberries marketed as fresh produce in North America and about 46% sold to be further processed or used as an ingredient by food processors (processed) (Council 2017). Blueberry bushes will continue to produce for over twenty years, but production peaks are met by this time. The berries require an acidic soil with pH levels of 4.5 to 5.5. In the past twenty years blueberry production has increased significantly (ERS n.d.). Part of this increase is the trend of marketing benefits of blueberries as a healthy option. The uncertainty of the annual output of the non-mature bush and the growing popularity of blueberries have distorted the market supply and demand fundamentals. In 2005 – 2015, an overabundance characterized as “a blue wave” has changed the way growers manage operations. The “blue wave” is an overabundance of blueberries on the market, and it has changed the way growers have to manage operations (Longstroth, The Michigan Blueberry Industry 2018). The demand for blueberries can be attributed to the reported health benefits from USDA and nutrition advocates. It is widely agreed upon by food scientist that the antioxidants and phytonutrients quench the activity of free radicals. Free radicals adversely alter lipids, proteins, and DNA, and are suspected to have a role in cardiovascular problems and development of cancer (Burton, 2017). As of 2011 (ERS n.d.), the world produced 786 million pounds of blueberries, 55% of these are produced in the United States. In 2017, the US imported 321 million pounds of fresh blueberries and 137 million pounds of frozen blueberries. The US exported 112 million pounds of blueberries (53% fresh, 47% frozen).

The US is a net importer of blueberries every month of the year except July when US production is abundant in many of the regions of the country.

The US production was valued at 880 million dollars in 2011. Thirteen percent of this production came from Michigan. Michigan’s production of blueberries ranks second to Georgia. Production of blueberries goes into two product channels. The first is the fresh channel where blueberries are sold at grocery stores and farmers markets. The other project channel is the processed channel, where blueberries are frozen and used for industrial value-added production such as yogurts, baking, dried and sold as frozen packaged blueberries. Other notable production in the US comes from Washington, Oregon, North Carolina and New Jersey. Georgia’s crop is marketed 52% fresh and 48% processed; average yield is 4,670 pounds per acre. Washington’s production is used evenly for the fresh and processed markets. Average production in Washington is 8,750 pounds per acre. Oregon’s production is divided between 52% sold as fresh and 48% of the crop is processed. The average production is 9,110 pounds per acre. New Jersey’s production is 83% fresh and 17% processed. New Jersey’s average annual production is 6,870 pounds per acre. North Carolina’s production averages 7,020 pounds per acre and 75% are sold as fresh; 25% as processed (ERS n.d.).

Table 1.1: Top Blueberry States Production

State	Fresh	Processed	Average Production
Georgia	52%	48%	4670
Washington	50%	50%	8750
Oregon	52%	48%	9110
New Jersey	83%	17%	6870
North Carolina	75%	25%	7020
Michigan	50%	50%	4364

Michigan harvests about 20,000 acres of blueberries. Blueberries are native to Michigan. Michigan blueberry growers on average yield about 4,364 pounds per acre. There is a wide variety of yields. Older, minimally managed varieties yield 2,000-3,000 pounds, and newer plantings and varieties can yield 10,000 pounds or more. In Michigan there are approximately 600 blueberry growers, however about 350 of these growers are small and have less than ten acres in production (Longstroth, Michigan State University Extension Educator 2018). Typically, Michigan blueberry farmers need at least 50-100 acres to produce enough income for this to be a livelihood, although that weighs heavily on the growers production and management ability. Michigan's production is currently split evenly between the fresh market and processed blueberries, but historically relied heavily on processed production. Typically, growers either market as fresh with a portion of the production going to the processed market since it lacks the desirability of size or firmness desired by consumers. Other growers have tried to rely on just the processed market. It is difficult to profit from the processed market due to the overabundance of global supply and the distributors' ability to hold product in frozen storage for several production cycles.

Michigan growers vary in the production practices and marketing abilities. The following examples illustrate a grower's income based on 50 acres of blueberries but managed and marketed differently. Example 1: A 50-acre farmer with production above the average at 7,500 pounds per acre would receive revenue of \$601,500 if 80% is sold as fresh. Assuming recommended expenses generates an expense ratio of 92% this could provide a net earnings of \$50,092. Example 2: A 50-acre farmer with an average production of 5,000 pounds per acre and selling one half of the crops as fresh and the other half as processed would earn \$320,000 in revenue but would experience a net loss of -

\$129,940. Example 3: A 50-acre farmer with the lower end of production of 2,500 pounds per acre that sold exclusively processed blueberries would receive \$92,500 in revenue and would have a net loss of -\$188,325. This characterization of growers shows the different marketing plans that have historically been used by Michigan Growers. The price used in this example is an average price from the past 24 years.

Table 1.2: Basic Blueberry Earnings Effect from Fresh vs. Processed and Yield

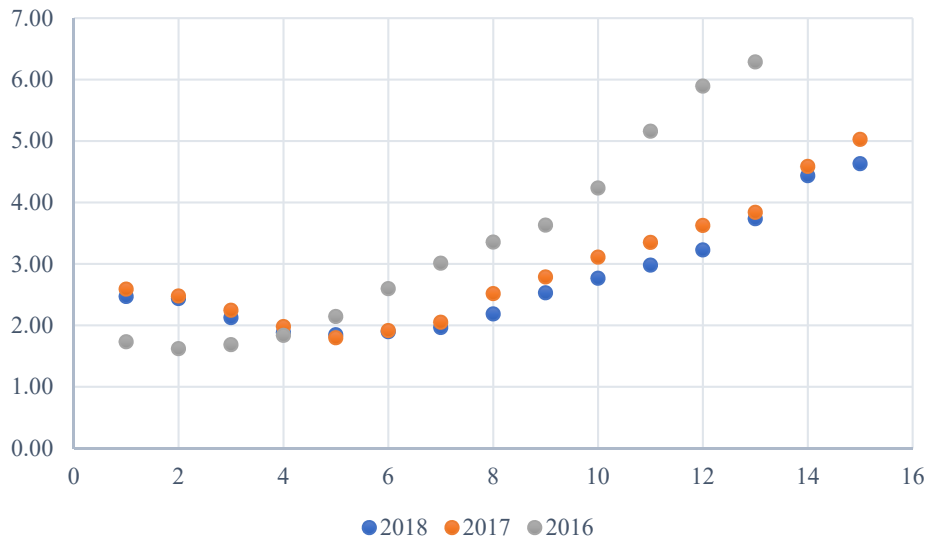
Farm Size	Yield/Acre	Total Yield	Fresh Pounds	Processed Pounds	Fresh Revenue	Processed Revenue	Total Revenue	Expense Ratio	Operating Expense	Net Earnings
50 Acres	7500	375000	300000	75000	\$546,000	\$55,500	\$601,500	92%	\$551,408	\$50,092
50 Acres	5000	250000	125000	125000	\$227,500	\$92,500	\$320,000	141%	\$449,940	(\$129,940)
50 Acres	2500	125000		125000	\$0	\$92,500	\$92,500	304%	\$280,825	(\$188,325)

KEY	
Processed Price	\$0.74
Fresh Price	\$1.82

Source: Expense data is from Michigan State University Extension BB costs Mark Longstroth & USDA Average price data.

A typical Michigan blueberry farmer does not have very much diversity in crops. Some growers have small production of other fruits, grains, etc.: however, the majority of producers spend time and resources entirely on managing the blueberry crop. Growers are typically located within a few miles of Lake Michigan since the lake provides some level of protection from Michigan's harsh winters that can lead to winterkill. In the spring, growers often use solid-set irrigation or windmills during the budding stage to prevent frost damage on cold spring nights. Blueberries are susceptible to pests and disease, so growers spend a lot of time after the spring budding spraying to prevent damage to the bush. This is particularly the case as the fruit starts to ripen. Over the past ten years, the largest pest has been Spotted Wing Drosophila (SWD) (Fan, et al. 2016). This pest came into the area and is now always present. It requires growers to spray at least every five days and more often depending on weather and individual grower management. Blueberries are harvested from the end of June to the end of August. Some wholesales/cooperatives are able to store fresh blueberries in a controlled atmosphere (CA) storage to be able to supply Michigan blueberries into the beginning of October. The price of fresh blueberries is typically adjusted on a weekly basis. This is set by the wholesaler/cooperative and is based on the supply of blueberries throughout the US and globally. Actual timing varies slightly in 2018, the Michigan fresh price of blueberries ranged from \$1.85 – \$5.43 per pound from one wholesaler (MBG Cooperative 2018). Figure 1.1 shows the last three years how the price typically starts out a little higher; and as more fruit is produced both in Michigan and domestically, it goes down before tapering up at the end of the season. This is where the profitability exists where the price per pound is above \$2.00.

Figure 1.1 Weekly Fresh Blueberry Price



Source: MBG Cooperative 2016-2018 Great Lakes Pool Postings and Actual Harvest Advance

In the fall and winter growers are trimming the bushes. Growers trim the old wood out since blueberries produce on the year prior's new growth.

Michigan grower management varies widely, but many growers have bushes that are 30-60 years old. Ideally, peak production is achieved about 20 years into production. These older varieties and older bushes are not nearly as productive and generally produce a softer fruit more suitable for processing. Varieties that are typically found at this mature age include: Jersey, Rubels, and Blue Crop. Jersey and Rubel are considered processed varieties, and Blue Crop is used for both fresh and processed markets.

1.1 Problem Statement

Michigan has been one of the largest regions in the country for blueberry production. Historically, more than half of the production went to processed blueberries (frozen blueberries sold to bakeries, yogurt, wineries etc.). The production practices to grow processed blueberries had been profitable to producers historically; however, as other

regions' production increases, blueberries are becoming more of a commodity and less of a specialty crop. Despite the increased production in other parts of the country, and internationally during the period from 2006-2017, Michigan's blueberry production is moderately unchanged. Meanwhile the price, particularly of processed blueberries, has decreased, and production costs have increased. What this means is blueberry producers need to reduce expenses or increase revenue to stay profitable. How do Michigan growers shift the management practices to remain profitable?

1.2 Research Objectives

There are management practices that fresh market producers use to try and time the product's availability when the supply of blueberries on the market globally is low. For example, producers plant varieties that are late season (harvested in August and into September) and then work with a wholesaler that uses a marketing plan that utilizes Controlled Atmosphere (CA) storage to store fresh blueberries until no other domestic blueberries are in the market. This delayed timing increases demand, and, in turn, the unit price is as much as three times higher. Growing organic blueberries is another niche management practice used. The demand for organic blueberries is mostly fresh, and there is a premium paid for the blueberries.

Michigan's establishment of older varieties decreases the average per pounds per acre. As the older bushes are taken out of production and new bushes are planted, productivity should increase. Newer varieties produce more upon maturation and are often planted at higher densities. Management practices such as spraying and fertilizer application will be

very similar on bushes that are ten years old or sixty years old. Thus, an increase in efficiency and productivity is expected.

The objectives of this study are: 1) Understand the production costs for blueberry production. 2) Determine the market price range that will provide a sustainable market for blueberries. 3) Determine what yield is needed to cover fixed or variable costs of the breakeven yield. 4) Identify significant supply chain issues that could disrupt the industry.

1.2.1 Why is this research important?

This research is important to the Michigan economy and agricultural lending institutions with loan portfolios that support blueberry production. GreenStone Farm Credit Services has extended a significant amount: \$114 million, to 572 customers. The majority of this production is in Southwest Michigan and along the Lake Michigan shoreline. With this financial exposure, it is important as a responsible lender GreenStone Farm Credit Services understand the nature of the blueberry market. Blueberries contribute approximately 100 million pounds or \$130 million (2016) to Michigan's economy annually.

Growers, brokers, and lenders would benefit from the research trends. Understanding the history of the industry, the market supply and demand today will influence future management ideas, are important to savvy managers, lenders and salespeople that want to continue to see Southwest Michigan continue to produce blueberries.

CHAPTER II: LITERATURE REVIEW

2.1 Domestic Consumption and Global Markets

The USDA ERS reports show that domestic consumption of blueberries is increasing and is estimated at 573.5 million pounds as of 2016. North America has the most developed access to fresh blueberry market year-round (Park and Cook 2018). The US imports blueberries primarily from the following countries: Chile, Canada, Argentina, Mexico and Peru. Domestically, production occurs in specific regions of the country. The Pacific Northwest (Washington and Oregon) produces almost half of the domestic crop. Southern and Midwest are increasing production, and the Northeast's production has varied widely. Cook & Park's conclusion recommends U.S. growers to continue to market to European markets (Park and Cook 2018). This will require conquering some challenges as the European market demands fruit be Global-GAP certified (different requirements and maximum residue levels). Cook also posed the question, Is supply developing more rapidly than demand? Recommendations include focusing on quality, thinking globally, investing in marketing in Europe. Cook (IBID) also warns that the demand growth rate has slowed or is growing slower than the blue wave, which may contribute to a supply-side consolidation in the North American market.

2.2 Blueberry Profitability With the Rabbiteye Bush in Georgia

In Georgia an economic analysis of the Rabbiteye blueberry bush production found that growers have an 86% chance of obtaining profit. (Fonsah, et al. 2011) This study identified the Best, Optimistic, Median, Pessimistic and Worst yields and price along with fixed and variable costs to identify profitability of the Rabbiteye blueberry production in

that area. It also stated the Rabbiteye bush is declining in popularity due to the influx of the southern highbush that is sold to the fresh market and are sold at a premium. Rabbiteye production usually goes into the two market segments fresh and processed equally. The article also stated that a shortage of migrant labor is impacting the production of Rabbiteye blueberries in Georgia.

2.3 Seasonality of Regions for Domestic Consumption

The limited marketing and seasonal effects on demand for fresh blueberries was studied and determined that wholesale buyers routinely substitute purchases of blueberries from a region currently supplying the market to another region with production just coming on. It is perceived that the quality available declines. The assumption is that consumers care about total consumption of quality units when purchasing blueberries. The southern production is harvested first. As the northeast production becomes available for harvest wholesalers focus on that area and pay less for blueberries from the southern area. As the Midwest & Pacific Northwest crop starts to harvest the northeast production price falls (Hoelper and Marra 1991).

2.4 Chilean Fruit Stress for Grower Leading to Vertical Integration

The Chilean fruit production has undergone economic stress over the past twenty years, including issues with handpick labor, currency issues, rising costs of energy (oil and electricity). (Retamales and Sepulveda, Fruit Production in Chile: Bright Past, Uncertain Future 2011) The agricultural labor statistics show that between the 1997 and 2007 censuses, fruit orchards increased 32% to 308,445 hectares (761,859 ac) of fruit orchards, meanwhile agricultural employment decreased from 19.5% to 10.8%. Direct labor accounts for about

450,000 jobs (180,000 year-round, and 270,000 seasonal). “The grower receives about 12-16% of the total price the fruit obtained upon sale in the final destination.” (Retamales and Sepulveda, Fruit Production in Chile: Bright Past, Uncertain Future 2011). This created stress for the grower and resulted in economics that cannot continue long term since many growers are operating at a loss. The Chilean fruit composes about 40% of the agricultural gross product and 1.07% of the country’s GNP. The overall fruit industry shows signs that vertical integration is taking place, 50% of the fruit exported is controlled by 16 companies. These companies have bought or planted orchards and, in some cases, own nurseries. Limited research is conducted in the Chilean economy.

2.5 Profitability of Blueberries in Chile

Profitability among blueberry producers is an issue on a global scale. Research in Chile conducted in a regression study of 1,019 hectares (2,516 acres) of highbush blueberries surveyed growers on management practices including field age, planting design (with or without pollinizers), use of mulch, weed control practices, conventional or organic, type of plant material and origin of the plant material, age of the plants, varieties and row orientation. The purpose of the study was to identify the farm management practices that improved yields. The study defined a good yield as greater than 10.1 ton per hectare (equivalent to 8,174 pounds per acre). The findings from the survey and the regression model found that older establishments fared better and produced up to 14.7 years, planting design that included pollinizing variety, soil covered with mulch within the row, conventional production system and a mixed system for weed control were the formula for the best chance at a high yield (Retamales, Mena, et al. 2015).

2.6 Emergence of Spotted Wing Drosophila Leads to Higher Production Costs

Cost of production has increased with the emergence of Spotted Wing Drosophila (SWD), a pest of soft skinned fruits, in 2010 in Michigan (Longstroth, Michigan State University Extension Educator 2018). The SWD is native to eastern Asia, and feast on ripe or ripening fruit (mostly berry crops). The pest have a short life and a formidable reproduction capacity. A female can produce 350 eggs in a lifecycle. Monitoring is primarily on imperfect observation of population density with monitoring traps. Detection of any infestation in a shipment will result in rejection of the whole shipment, so growers have to spray diligently. A dynamic bioeconomic model of SWD control was studied to identify economic outcomes of alternative strategies involving insecticide spraying and monitoring. The study found that SWD management may be enhanced by using traps as opposed to just a spray only strategy. The research was limited because of the controls and only using one year (Fan, et al. 2016).

2.7 Summary

To summarize the research there is some evidence profitability is an issue within the global blueberry and fruit industries. Overall consumption of blueberries is increasing; however, given the seasonality of the fresh market and increased production, blueberries may become less of a specialty crop and more of a commodity. There are management practices that growers are using to minimize costs, such as vertical integration, managing spraying to minimize spray application when possible and reducing costs associated with hand labor.

Researchers are also studying the industry to help growers determine what management practices lead to good yields. Methods used in research included surveys of

growers, regression, budgeting, and expert opinion were sought to understand where the industry best practices are and how to maximize profitability.

CHAPTER III: DATA ANALYSIS & METHODS

The method used for this analysis of the blueberry industry is budgeting. Data came from primary and secondary sources. Income data came from yield and price data averaged from historic yields and prices Michigan producers have received from 1992-2016. Expense data per acre came from institution information from Michigan State University Extension. This university data was validated using a peer comparison data set of seven medium to large operations. These producers were chosen because of a variety of different marketing and management programs, and five years of data were available for analysis. The data were extracted from yearly financial records but did not provide the detailed fixed and variable costs. However, it does provide costs per acre information. Secondary data collected for this study has been in large part shared from work Michigan State University's Extension Fruit Educator, Mark Longstroth, has conducted. He has collected data and studied the blueberry industry. Longstroth's "2018 BB Costs Spreadsheet" year six provided baseline data from which to examine the year-to-year expenses of cultivating blueberries (Longstroth, 2018 BB Costs Spreadsheet 2018). The spreadsheet used also goes into each year of recommended costs during the planting and juvenile years. By year six, production and expenses are considered stagnant since the bushes are mature. This year six spreadsheet is the baseline for this analysis. Over the course of his career, Longstroth has taken the data originally constructed from a bulletin published in 1994 converted it to an Excel spreadsheet, and has updated it with current costs and the university recommendations for management practices. The researcher also works with over 100 blueberry farms and has interviewed several local producers to verify assumptions given in the data. The researcher reviewed different price and yield estimates to determine the

current economic state of blueberry industry and a break even analysis. The researcher will identify the fixed and variable cost factors commonly used to examine the production costs of blueberries. (The method used is a budgeting model to determine where profitability exists in mature bushes.) Different yield models were run to determine what yield is needed.

Michigan yield average yield has been lower than the average. This variance appears to be widening over time. Figure 3.1 gives a history of the US and Michigan yields from 1992-2016 to give the reader a reference for average yields. The researcher believes this is due to the amount of older planting that have not been taken out of production.

Figure 3.1: US vs Michigan History Yield Fresh Blueberry (bushels/ acre) (1992-2016)

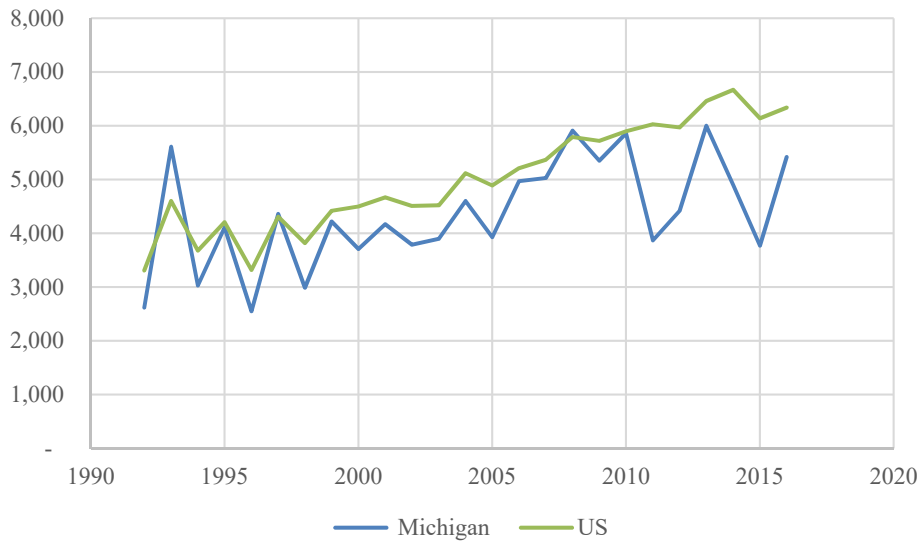


Table 3.1 gives more analysis of the range and variance of Michigan production and how it stacks up among the US production as a whole.

Table 3.1: Comparison Blueberry Yields (pounds/acre) U.S. and Michigan (1992-2016)

	Mean	Standard Deviation	Minimum	Maximum
Michigan	4368.16	960.67	2550.00	6000.00
US	5019.20	967.63	3310.00	6670.00

The biggest change in the industry other than oversupply is treating the SWD. Since its emergence in 2010, producers have found a spray regiment necessary. This regiment comes with additional costs to the producers. It is estimated by growers that the cost is about \$20 per acre for each application. Application is at least ten times during the season without rainfall requiring re-spray. This results in \$200-300 in additional costs per acre. The other option is to have blueberries rejected, since packers test the micros for detection of pests. This gives growers no option other than to increase production costs.

The model will show expenses classified as variable and fixed costs and calculates a cost of production per acre. This does not include any principle payments, income taxes or family draw. Variable expenses vary depending on production. Many of these expenses such as, packing labor and materials, are directly correlated to the pounds of production. Fixed costs are more uniform regardless of the level of production, such as insurance and pruning. For the purposes of this model, this is measuring the break-even point. Breakeven will be reached when income equals the sum of fixed expenses and variable expenses. Other than the management labor, there is no income from the business.

3.1 Expenses for Fresh Production

Costs for fresh production on a per acre basis include chemicals used for weed control costs of \$25.60 and spot weed control to clean up any weed of \$7.61. Fertilizer including a blend of 46-0-0 200 pounds per acre costing \$55 per acre and lime spread on

10% of the acreage yearly this expense is \$2.25. Pesticides include \$550.67 for insects and disease a large part of that is the expense of spraying SWD. \$8.35 for the final cover for blueberry maggot, and \$25 for pest management and consulting. Pruning is a cost allocated to pruning back the old canes of the bushes this is necessary to keep the plant vigorous since production comes off the previous year's new growth, \$726. The expense for bee hives includes two hives per acre or \$180. Blueberry growers work with apiaries to place the bees in the field before pollination, and stay until pollination is complete. Plant inspection is an inspection of the plants by a Michigan Department of Agricultural and Rural Development (MDARD) consultant. The United States Highbush Blueberry Council does have a checkoff of \$18 per ton broken down this is \$0.01 per lb. Marketing through the cooperative or wholesalers is charged back to the grower this on average is about \$0.14 per pound. Picking labor includes \$0.60 per lb. for the picking labor, \$0.05 per lb. for the supervisor labor, \$0.10 per lb. for Federal Insurance Contributions Act (FICA), unemployment, & workman's compensation and \$0.10 per lb. for housing. Packing Labor costs about \$0.17 per lb. Packing materials are \$0.17 per lb.

Fixed expenses include gas, fuel, and oil of \$120.44 per acre. Gas, fuel and oil costs are equipment costs in mowing and tillage, insect and disease management and weed control. Insurance is an average of the farmers' insurance on the buildings and equipment allocated back per acre \$169.37* (insurance expense was not included in the Extension spreadsheet and was added based on an Olympic average of the producers in the peer comparison). Management is the money that would be paid for management per acre of blueberries \$161.48. Labor payroll and taxes are average per acre \$109.23 this is labor that is hired for the off season work, (i.e. fertilizer spreading, brush removal, weed control,

tillage, irrigation repairs). Food safety inspection is a cost per acre that growers incur when the operation undergoes the food safety inspection at \$100 per acre. The repairs are a part (45%) of the equipment expense that the university spreadsheet allocated to equipment. This is \$100 per acre. Property taxes are an average cost of \$50 per acre of blueberries. Utilities includes the irrigation costs of \$250 per acre. Other expenses included \$50 per acre of miscellaneous expenses as well as \$4.45 of rototilling. Interest expense is an operating capital cost with 6% interest assuming to borrow the whole amount of production per acre.

The Table 3.2 is a budget for Michigan's average production (1992-2016) and price as the baseline for the budget. At this point the farmer is losing \$393 per acre. As production increases, so do costs but at about 5,500 pounds per acre shows a positive earnings and have made it to the point to yield the grower out of negative earnings. This is just a break even cost of production and does not include principle payments, income taxes or family draw.

Table 3.2 Typical Income & Expenses Fresh Blueberries

INCOME				
<u>Crop Sales</u>	<u>Acres</u>	<u>Yield</u>	<u>Price</u>	<u>Gross Sales</u>
			\$	\$
Blueberries Fresh Pack	1	4364	\$1.82	7,942.48
			\$	\$
TOTAL INCOME				\$ 7,942.48
Variable Expenses				
				Total Expense
Chemicals			\$	33.21
Fertilizer			\$	57.25
Pesticides			\$	575.67
Bird Control			\$	15.00
Prune			\$	726.00
Bee Hive			\$	180.00
Plant Inspection			\$	11.00
USHBC		\$0.01	\$	43.64
Marketing		\$0.14	\$	610.96
Fresh pick		\$0.80	\$	3,491.20
Packing labor		\$0.17	\$	741.88
Packing materials		\$0.17	\$	741.88
Total Variable Expenses			\$	7,227.69
Fixed Expenses				
Gas/ Fuel/ Oil			\$	120.44
Insurance (not crop)			\$	
Fixed Labor			\$	109.23
Food Safety Inspection			\$	100.00
Repairs			\$	100.00
Taxes - Real Estate			\$	50.00
Utilities			\$	250.00
Other:			\$	54.45
Interest - Operating			\$	154.00
Total Fixed Expenses			\$	938.12
TOTAL OPERATING EXPENSES (Variable plus Fixed)			\$	8,165.81
Income - Expenses			\$	(223.33)
Management (opportunity cost)			\$	161.48
NET FARM INCOME (Total Income less Total Operating Expenses)			\$	(384.81)

3.2 Expenses for Processed Production

For processed production recommend expenses are the same for the production.

However in practice growers tend to spend less on inputs with the exception of labor,

packaging, and housing. Wholesalers still charge the producers a marketing fee, a little less than fresh, \$0.12 per lb. sold. The cost to machine harvest blueberries is \$0.25 per lb.

Table 3.3 is a budget for Michigan's average production (1992-2016) and the average price as the baseline for the budget. At this point the farmer is losing \$1,198 per acre. As production increases, so do costs but at about 7,700 pounds per acre earnings are showing positive. According to Longstroth, it is likely that process producers in general do not spend as much on management and maintenance when operations are producing primarily processed blueberries (Longstroth, Michigan State University Extension Educator 2018). It is likely the spray schedule especially for pests is kept up, but other management practices such as pruning, mowing and management are likely overstated.

Table 3.3 Typical Income & Expenses Processed Blueberries

INCOME				
<u>Crop Sales</u>	<u>Acres</u>	<u>Yield</u>	<u>Price</u>	<u>Gross Sales</u>
			\$	\$
Blueberries Processed	1	4364	\$0.74	\$ 3,229.36
			\$	\$
TOTAL INCOME				\$ 3,229.36
<u>Variable Expenses</u>				<u>Total Expense</u>
Chemicals			\$	33.21
Fertilizer			\$	57.25
Pesticides			\$	575.67
Bird Control			\$	15.00
Prune			\$	726.00
Bee Hive			\$	180.00
Plant Inspection			\$	11.00
USHBC		\$0.01	\$	39.28
Marketing		\$0.12	\$	523.68
Machine Pick		\$0.25	\$	1,091.00
Total Variable Expenses			\$	3,252.09
<u>Fixed Expenses</u>				
Gas/ Fuel/ Oil			\$	120.44
Insurance (not crop)			\$	
Fixed Labor			\$	109.23
Food Safety Inspection			\$	100.00
Repairs			\$	100.00
Taxes - Real Estate			\$	50.00
Utilities			\$	250.00
Other:			\$	54.45
Interest - Operating			\$	154.00
Total Fixed Expenses			\$	938.12
TOTAL OPERATING EXPENSES (Variable plus Fixed)			\$	4,190.21
Income - Expenses			\$	(960.85)
Management (opportunity cost)			\$	161.48
NET FARM INCOME (Total Income less Total Operating Expenses)			\$	(1,122.33)

Table 3.4 Peer Comparison Data Five Year Average

	Producer 1	Producer 2	Producer 3	Producer 4	Producer 5	Producer 6	Producer 7
	Per Acre	Per Acre	Per Acre	Per Acre	Per Acre	Per Acre	Per Acre
TOTAL INCOME	\$ 5,110.83	\$ 10,653.63	\$ 9,930.30	\$ 7,032.24	\$13,739.96	\$ 2,278.90	\$ 12,852.73
<i>Operating Expenses</i>							
Car Truck	\$ -	\$ 27.04	\$ -	\$ -	\$ 0.73	\$ 0.20	\$ -
Chemicals	\$ -	\$ 744.62	\$ 692.54	\$ 207.82	\$ 381.95	\$ 409.96	\$ 553.74
Custom Hire	\$ -	\$ 90.69	\$ 93.24	\$ 60.69	\$ 295.68	\$ 183.46	\$ 271.56
Depreciation	\$ 1,121.90	\$ 893.34	\$ 1,210.09	\$ 365.34	\$ 803.54	\$ 329.78	\$ 741.39
Employee Benefits	\$ 93.38	\$ 38.27	\$ -	\$ 0.09	\$ -	\$ -	\$ -
Fertilizer & Lime	\$ 681.60	\$ 3.86	\$ 27.90	\$ 119.24	\$ 345.03	\$ 57.77	\$ 158.32
Freight & Trucking	\$ 22.19	\$ 24.36	\$ -	\$ 10.50	\$ 1.19	\$ 1.18	\$ 10.06
Gas/ Fuel/ Oil	\$ 94.23	\$ 159.98	\$ 128.78	\$ 143.31	\$ 114.41	\$ 94.11	\$ 221.37
Insurance Expense	\$ 121.02	\$ 361.43	\$ 178.77	\$ 152.19	\$ 196.88	\$ 90.50	\$ 198.01
Labor Hired	\$ 2,231.35	\$ 2,630.50	\$ 2,815.14	\$ 3,248.21	\$ 3,776.11	\$ 412.58	\$ 4,424.00
Compensation of Officers	\$ -	\$ 340.36	\$ -	\$ -	\$ -	\$ 150.25	\$ 538.39
Rent -							
Machinery/Equip/Vehicle	\$ 72.94	\$ 72.01	\$ 78.00	\$ 68.37	\$ 109.85	\$ 6.81	\$ 66.84
Rent - Land	\$ 170.06	\$ -	\$ 147.27	\$ 32.78	\$ 19.29	\$ 41.49	\$ -
Repairs & Maintenance	\$ 144.29	\$ 380.42	\$ 182.12	\$ 865.22	\$ 299.01	\$ 95.93	\$ 685.93
Seeds & Plants	\$ 1.68	\$ 1.55	\$ 114.84	\$ -	\$ -	\$ -	\$ 2.80
Storage & Warehousing	\$ 84.11	\$ 368.66	\$ -	\$ -	\$ 80.55	\$ -	\$ -
Supplies	\$ 164.78	\$ 913.60	\$ 855.31	\$ 338.48	\$ 959.64	\$ 103.30	\$ 465.44
Taxes - Real Estate	\$ 106.88	\$ 608.64	\$ 385.82	\$ 111.85	\$ 589.56	\$ 82.93	\$ 316.82
Utilities	\$ 138.30	\$ 210.49	\$ 99.16	\$ 162.84	\$ 127.62	\$ 37.15	\$ 212.24
Other Expenses	\$ 376.71	\$ 487.90	\$ 886.52	\$ 598.82	\$ 3,840.19	\$ 166.78	\$ 1,518.30
Interest Expense	\$ 696.16	\$ 56.72	\$ 484.23	\$ 120.88	\$ 429.62	\$ 339.27	\$ 314.40
TOTAL EXPENSES	\$ 6,321.57	\$ 8,414.45	\$ 8,379.73	\$ 6,606.62	\$12,370.86	\$ 2,603.45	\$ 10,699.59
NET FARM INCOME (Total Income less Total Operating Expenses)	\$ (1,210.75)	\$ 2,239.18	\$ 1,550.57	\$ 425.63	\$ 1,369.10	\$ (324.56)	\$ 2,153.14

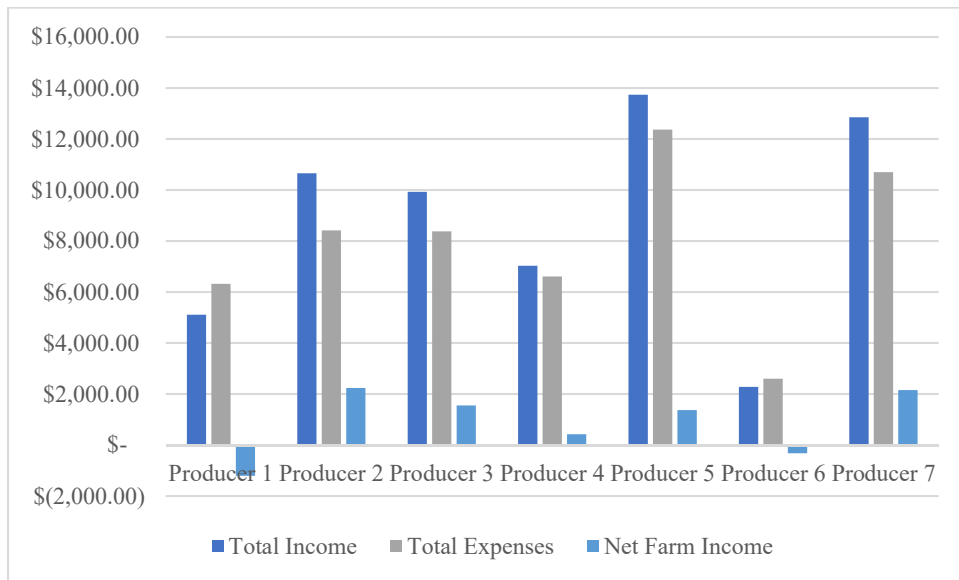
A sampling of seven producers with production of 111– 617 acres of blueberry production were studied. Average data for income and expenses from 2013-2017 were used in the study. Expenses ranged from \$2,603 per acre to \$12,370. Two of the seven sell primarily processed blueberries (Producers 1 and 6). One grower has both a fresh and processed line (Producer 2). The other four focus production on fresh production and on packing those blueberries into clam shells for fresh market. Expenses that are analyzed further are shown with the highest expense in red and the lowest expense in blue to show the reader a quick look at the range.

Two of the seven growers are losing money on the five year average, both primarily sell processed blueberries. The average expense from the growers is \$7,913 with a standard deviation of \$3,176. All producers in the peer comparison study that sold primarily fresh production are making money. When the researcher examined the cost per acre of the fresh producers and compares it with the cost from Michigan State University (MSU) it comes in within the range of error. In the peer comparison study the fresh producers expenses ranged from \$6,606-12,370 per acre. The MSU data recommended model has expenses at \$9,970 with a yield of 5,500 pounds per acre. The researcher would conclude that the MSU data is significant with what producers are spending. With some of the variable expenses and producers varying a little in the production practices this data for fresh production is a recommendation, there will always be a margin of variability since each operation is slightly different.

With the three processed blueberry growers production expenses per acre range from \$2,603-8,414 per acre. The expense per acre model based on MSU recommendations calculated \$4,427 per acre with the average yield of 4,363 pounds per acre. This is within

what the peer comparison data showed, but the researcher also notes the producer data given can tell that some producers do not spend as much per acre shorting some of the recommendations and in turn in the case of producer 6 not having much income per acre. This particular producer does not have a processing line resulting in sales made directly to a wholesaler. The wholesaler then will offer the producer a price the wholesaler feels is fair given the market conditions, the producer has little power at the time of delivery and grading the fruit.

Figure 3.2: Example of Seven Producers Income Per Acre, Expenses per Acre and Net Income per Acre



3.3 Introduction to Supply Chain

This research identified the factors used to motivate the organizations in the processed and fresh blueberry supply chain. Furthermore, the study will carry out an examination of each link of the supply chain and how the links are coordinated in the industry. This will help to determine future opportunities for the industry and to identify

ways for producers of medium or large scale to increase their earnings potential. Each link in the supply chain is explained.

Within the blueberry industry a Cournot oligopoly may exist. With the added fruit both domestically and globally the output of blueberries on the market has increased. This is causing marginal revenue to fall. With the increase in output and stagnant demand, the equilibrium price exceeds marginal cost. “The amount by which price exceeds marginal cost depends on the number of firms in the industry as well as the degree or product differentiation.” (Baye 2017) The blueberry industry is becoming more concentrated and especially has little product differentiation. North American consumption peaked in 2016 with 1.4 billion pounds consumed and then declined, particularly in the processed consumption that went down by 215 million pounds. Overall fresh consumption increased 52 million pounds during the same period. Particularly in the processed market, both in the model using university recommendations and the peer comparison of processed blueberries are not a product differentiated enough to demand a premium price. With global demand stagnant or decreasing for this product, there is an abundance on the market and will continue to be an abundance until the market adjusts.

3.4 Supply Chain – Fresh Pack

Growers are upstream in the supply chain. Growers are independent businesses managing production, and harvest of the business, often those growers have planted bushes and invested a lot of time and capital, including adding irrigation systems, mowing between rows and maintain bushes with until bushes are mature enough to harvest.

The packing line for fresh blueberries is not very complex when compared to processed blueberries. In a food grade packing house, blueberries are commonly cooled as close to harvest as possible. The blueberries are put onto a stainless steel food grade packing line that includes sorters that, reject fruit that does not meet the desired color and softness product specifications. Once the blueberries are sorted they are then moved onto a conveyor belt where the blueberries are viewed/examined by quality inspectors as part of a final quality check. The blueberries are then packaged in ‘clam shell’ containers and weighed to be shipped to the wholesaler and/or retailer.

In Michigan wholesalers include a few wholesalers/cooperatives: Naturipe-MBG, Alpine Fresh, North Bay Produce, and True Blue. Wholesalers work with retailers to get the desired size and specifications to meet what customers are wanting to buy at retailers. Product is then shipped out to retailers.

Retailers are located where consumers are buying blueberries. Larger stores such as Costco and Sam’s Club offer larger sizes, and smaller grocery retailers offer the smaller ‘clam shells’.

3.5 Supply Chain – Processed Blueberries

Similar to the fresh production the producer is an upstream link in the supply chain. Growers are managing production and harvest. Blueberries are typically machine harvested, although some of the product may be may be sorted out from a fresh line that are too soft to be sold to the fresh market.

A processing line for processed blueberries is similar to the fresh line without sorting as much for softness or aesthetic product attributes. Soft blueberries would be considered a grade B and would not command a higher price from the wholesale market. In

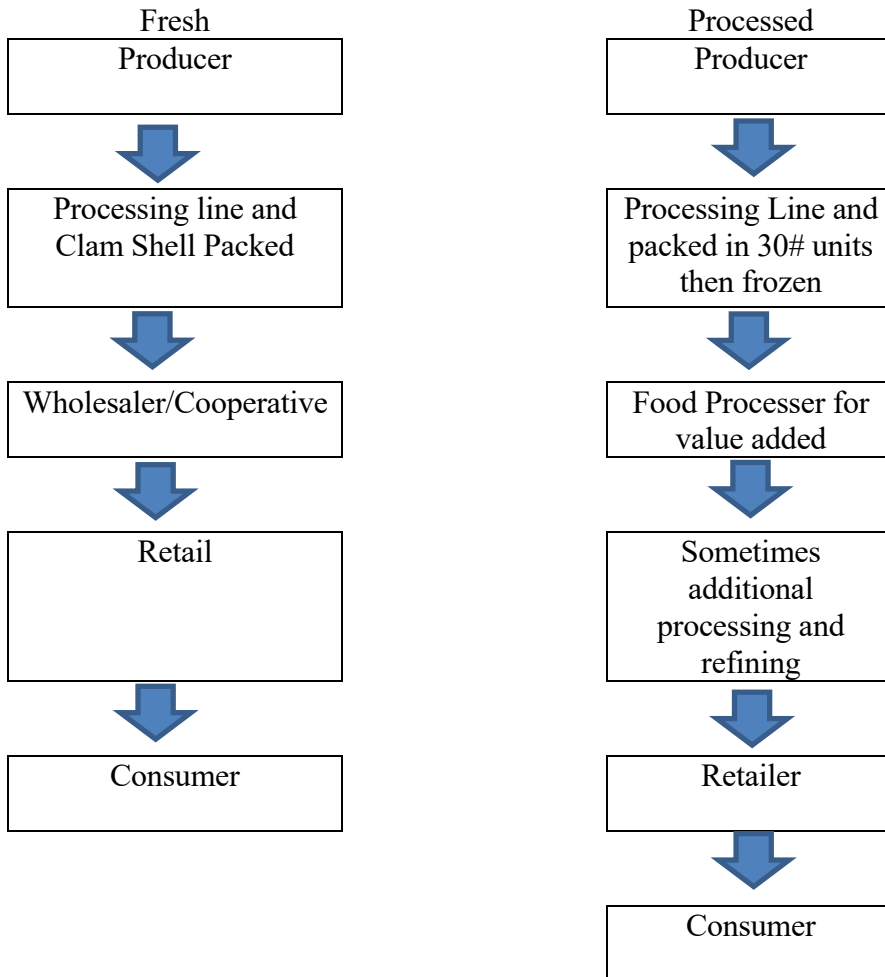
a food-grade packing house blueberries are cooled in a facility located close to where blueberries are harvested. The blueberries undergo a wash. Then the blueberries are placed onto a stainless processing line that packs and weighs in 30 pounds increments of frozen blueberries. Some processing facilities have Instant Quick Freeze (IQF) processing lines. IQF allows the blueberries to not stick to each other and look more like fresh fruit.

From the freezer, the blueberries are sold to processors or wholesalers that use the processed blueberries in many food related, value added industries.

From the processed fruit the final product is derived either directly or value added and then continued for more processing. For example: frozen fruit may be dried and then the dried blueberries may be sent to Bisquick TM to be added to pancake mix.

The final product is taken to retailers for distribution and consumption.

Figure 3.3: Blueberry Supply Chain for Fresh and Processed Production



Growers that can pack fruit are better able to market the production at a higher price. Just like in many other industries, becoming more vertically integrated and controlling more than one link on the supply chain gives producers an advantage that pays off. As seen in the peer comparison study, the producer that did not have a processing or packing line had lower gross sales. In the opinion of the researcher, there are several factors that influence this. First, without a packing line you are a price taker. Second, without a packing line, you

are not able to sort the fruit, which means longer time before the fruit is sorted and likely more will be graded poorly or thrown out. It is also sent to a facility and graded by a packing line that is paying the producer based on the grade, which gives power to the processor and incentivizes them to grade production hard. The processor may be able to blend some of the damaged soft or poorer quality fruit and then package it as grade A fruit. Having a processing line for the supply chain producers are specializing in allows producers to be able to control the fruit marketing and grading.

CHAPTER IV: RESULTS

When comparing the data from MSU Extension versus the peer comparison group, the conclusion is that data is within the same range per acre. One of the things to point out of the MSU recommendation is that the data is based on recommended rates, and practices. When the gross income decreases, managers make changes to operations. The researcher noted producers find ways to cut costs. An example of that is producer number 6, in table 3.3 which still averages a loss, the loss is far less because that producer is a lower cost producer.

It appears that in the peer comparison the growers with a processing line have a greater chance of being profitable. This is because those producers are positioning the operations to be vertically integrated. The vertically integrated producers are using the processing lines for several advantages, sorting and grading blueberries. Sorting and grading product directly is an advantage from the simple logistics of hauling blueberries and sorting off the softs right away before spoilage can occur. Having control over this process gives the producers an advantage. The abundance of blueberries on the market has impacted price over time. What was a premium years ago is no longer particularly processed blueberries that at one time averaged over \$1 per pound.

In the study of profitability of blueberries in Chile, the study based different practices on if blueberry bushes had “good yield” for that study the equivalent yield is 8,174 pounds per acre (Retamales, Mena, et al. 2015). In the opinion of the researcher, this should be what Michigan producers are striving for as average yield. In both the fresh and the processed blueberry models production of 8,174 pounds per acre the operation meets

the breakeven and has additional income for principal payments, re-investment, family draw, or whatever the producer deems necessary.

Table 4.1 Sensitivity of Labor

Labor is one of the biggest expenses for a grower selling in the fresh market. Labor makes up 35% of expenses in the peer comparison model. As the researcher evaluates the average costs and what is going on with labor in the US, it is imperative expenses from labor are evaluated. Growers have not had too much of an issue finding labor to pick blueberries for the whole season, but at the end of the season, it has been an issue when other crops such as apples come on and offer this migrant labor work that will last them the next few months. This is a real issue with other commodities and could soon become an issue for blueberry growers. Growers look at what it would take to protect the commodity and get it harvested. Two different labor programs are realistic for growers. The first option is the H-2A program that may cost more for producers, but would allow them to be able to secure the workforce the entire season. The other option is to be less dependent on migrant labor and to use machines to pick and then fresh pack. The engineers that manufacture blueberry pickers are hearing the request from growers to develop a machine that will pick blueberries and be gentle enough on the blueberries so growers can run the fruit on the fresh lines and pack it for fresh market. This is becoming more common in the Northwest part of the U.S. This sensitivity analysis Table 4.1 shows a look at what the economics of a 20% increase in labor would be and what a 20% reduction in labor would look like. It

shows the range of increased or decreased expenses looking at what both of these scenarios do to the bottom line of producers.

Another large expense for producers is the cost of chemicals. Many producers try to find ways to cut expenses, chemical expenses are an area that producers may be able to reduce costs, or surplus product due to rain and chemical reapplication or the emergence of the next pest that will increase the costs. Table 4.2 it shows the net effect of chemical expenses with a 20% increase and decrease. If expenses can be decreased by 20% the expenses reduce the annual costs by \$800.59. That could amount to four applications for SWD that are not needed because of the perfect timing of rains, and not needing to re-spray or this could be if the spray program can be modified with generics. If prices increased by 20% because of the need for additional spray application the cost would increase to \$971.41.

Table 4.2 Sensitivity of Chemical Expenses

	Average	Chemicals 20% Increase	Chemicals 20% Decrease
	Per Acre	Per Acre	Per Acre
TOTAL INCOME	8799.80	8799.80	8799.80
<i>Operating Expenses</i>			
Car Truck	4.00	4.00	4.00
Chemicals	427.23	512.68	341.78
Custom Hire	142.19	142.19	142.19
Depreciation	780.77	780.77	780.77
Employee Benefits	18.82	18.82	18.82
Fertilizer & Lime	199.10	199.10	199.10
Freight & Trucking	9.93	9.93	9.93
Gas/ Fuel/ Oil	136.60	136.60	136.60
Insurance Expense	185.54	185.54	185.54
Labor Hired	2791.12	2791.12	2791.12
Compensation of Officers	147.00	147.00	147.00
Rent - Machinery/Equip/Vehicle	67.83	67.83	67.83
Rent - Land	58.70	58.70	58.70
Repairs & Maintenance	378.99	378.99	378.99
Seeds & Plants	17.27	17.27	17.27
Storage & Warehousing	76.19	76.19	76.19
Supplies	542.93	542.93	542.93
Taxes - Real Estate	314.64	314.64	314.64
Utilities	141.11	141.11	141.11
Other Expenses	1125.03	1125.03	1125.03
Interest Expense	348.76	348.76	348.76
TOTAL EXPENSES	7913.75	7999.20	7828.31
NET FARM INCOME (Total Income less Total Operating Expenses)	886.04	800.59	971.49

2018 was a unique year with Michigan blueberries, at the end of the pollination season, Michigan experienced extreme heat. This affected the late blueberries significantly. In a year similar to 2018 where there is a significant loss to late season blueberries with varieties such as Elliot and Draper the loss is huge. To simulate a scenario similar to this it may bring down the entire average income per acre of the farm by 10% or more. In Table 4.3 it shows the impact of a 10% reduction in income per acre. In this case the reduction of

income makes the income \$6.06 per acre. If the grower experienced a year that the fruit sized up very well it would be very possible to have a 10% increase in reference and then almost double the net income to \$1,766.02. Table 4.3 shows the effects of both an increase in income of 10% and a decrease in income of 10%.

Table 4.3 Sensitivity of Income

			10%	10%	
		Average	Increase	Decrease	
		Per Acre	Per Acre	Per Acre	
Yield /Acre		4835	5319	4352	
TOTAL INCOME	Price	1.82	8799.80	9679.78	7919.82
<u>Operating Expenses</u>					
Car Truck		4.00	4.00	4.00	
Chemicals		427.23	427.23	427.23	
Custom Hire		142.19	142.19	142.19	
Depreciation		780.77	780.77	780.77	
Employee Benefits		18.82	18.82	18.82	
Fertilizer & Lime		199.10	199.10	199.10	
Freight & Trucking		9.93	9.93	9.93	
Gas/ Fuel/ Oil		136.60	136.60	136.60	
Insurance Expense		185.54	185.54	185.54	
Labor Hired		2791.12	2791.12	2791.12	
Compensation of Officers		147.00	147.00	147.00	
Rent - Machinery/Equip/Vehicle		67.83	67.83	67.83	
Rent - Land		58.70	58.70	58.70	
Repairs & Maintenance		378.99	378.99	378.99	
Seeds & Plants		17.27	17.27	17.27	
Storage & Warehousing		76.19	76.19	76.19	
Supplies		542.93	542.93	542.93	
Taxes - Real Estate		314.64	314.64	314.64	
Utilities		141.11	141.11	141.11	
Other Expenses		1125.03	1125.03	1125.03	
Interest Expense		348.76	348.76	348.76	
TOTAL EXPENSES		7913.75	7913.76	7913.76	
NET FARM INCOME (Total					
Income less Total Operating					
Expenses)					
		886.04	1766.02	6.06	

This financial budgeting tool and the peer comparison study data is limited in its scope, both of these analysis tools are set up to determine the breakeven point. A true picture also needs to factor any principal payments and family draw into the spreadsheet to fully account for profitability and sustainability of the operation.

The financial budget based on the university recommendations looks at a year by year income and expense model. This model is good for a producer trying to determine the breakeven point, growers could perform an analysis to determine if it makes sense for the operation to continue farming or to sell. It also could help to determine at what yield and price is the breakeven point. Using the financial breakeven point could help direct management decisions. Further limitations include that the model does not take into consideration the startup costs, planting and maintaining bushes from the young stock until production.

CHAPTER V: CONCLUSIONS & RECOMMENDATIONS

The blueberry industry is experiencing significant financial stress. The researcher believes, based on her experience with over 100 customers in the blueberry sector, the economic outlook from Michigan State University is accurate. The average of the producers studied shows their average slightly above the state average, in the sensitivity study with a 10% decrease the yield works out to 4,352 pounds per acre and net farm income as \$6.06 per acre. The peer comparison is slightly lower on expenses per acre to the model using university's data. The university-based model gave the researcher a clear understanding of the production costs for blueberry production. In this model, it shows that being average does not make money. It also supports the idea that the blueberry industry is not the specialized market it once was. There are many producers and little demand for the product to flow for the grower to benefit from the market. Producers will need to be diligent in finding ways to be low cost producers. Finding the balance between spending money to increase production on the bushes and not spending too much on production is challenging. Producers will need to plant varieties that can be marketed when there are no or limited other domestic markets. Also, producers must market their blueberries when the price is the highest, which will help the fresh market to be a specialty product. The objectives established in the beginning to determine the yield needed to cover fixed and variable costs and determining the price really effect each other. From these models it is evident that producers need to be low cost producers and strive for a high yield.

It seems many producers are experimenting more and more with machine harvesting and fresh packing. This is a savings of about \$0.55 per pound if there is no yield

loss due to machine picking. Likely there would be a loss but the gain may still be significant and with the unknown of the future of the reliability of labor and the different new machines that are being designed and entering the market it appears that machine picking and fresh packing from that will part of Michigan's future.

The researcher has also identified significant supply chain issues that could disrupt the flow. Owning a packing line seems to be one method of controlling your production and marketing. This is a form of vertical integration in the industry, and the researcher believes that more integration will occur. Future studies may find further integration occurring between nurseries, growers, packers and wholesalers.

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