Economic feasibility of alternative crops in Northeast Iowa to sustain family incomes

by

KENDAL QUANDAHL

B.S., University of Wisconsin-River Falls, 2012

A THESIS

Submitted in partial fulfillment of the requirements

for the degree

MASTER OF AGRIBUSINESS

Department of Agricultural Economics

College of Agriculture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2017

Approved by:

Major Professor
Dr. Vincent Amanor-Boadu

ABSTRACT

The purpose of this thesis is to identify which alternative crops could be enhance the income of Quandahl Farms the most by moving the smallest acreage from the farm's traditional corn and soybean enterprises into its production. The considered crops are grapes, raspberries, and black currants. The objectives of this study included assessing the technical feasibility of producing the selected crops in Northeast Iowa given the agronomic conditions in the region and the agronomic requirements of the crops. The other was the assessment of the economic feasibility of the selected crops and determining the minimum acres required for each to enhance the farm's financial situation and still allow for corn and soybeans to be the main crops.

The analyses were conducted using secondary data on the selected crops from published budgets and government and extension reports as well as the historical financials of Quandahl Farms. The analyses were conducted over a 10-year horizon to ensure a significant duration of cash flow and allow the establishment of the alternative crops. In that 10-year period, the net present value of Quandahl Farms income is $214 per acre per year. Additionally, the analyses were evaluated under four alternative scenarios of prices and yield for each of the crops in addition to the base scenario.

The results shows that grapes and black currants were not economically feasible in Northeast Iowa even though they were agronomically feasible. On the contrary, raspberries were found to be both technically and economically feasible in Northeast Iowa. The net present value under that base scenario for raspberries was $23,267 at a discount rate of 4.5%. Based on the net present value of corn and soybean revenue of the same

period, it is estimated that taking 22 acres from the current production and putting it into raspberries would increase average farm income by $60,000.

The study shows there is an opportunity to allocate a relatively small proportion of current corn and soybean acreage to raspberries to significantly increase farm incomes. As a result, it is recommended to the principals of Quandahl Farms to consider making this small investment in raspberries to protect the farm from the frequent vicissitudes of farm incomes. The next step after their agreement is to develop the business plan to implement such an investment.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

The author wishes to thank a number of people for support during this journey. First to my family: from a young age you encouraged the quest for learning and to never take for granted the opportunities that present themselves. Undertaking a masters program was a new experience for us and I was glad to have your support throughout the entire process—especially the 'thesising'. A thank you is also in need to my biggest cheerleader—not many two-year-olds can tell their Aunt to "Finish your thesis!"

To the MAB Staff, Mary, Deborah, and Gloria: Through the ups and downs of this entire program, I think I can speak for the entire Class of 2017; we would not be where we are without you. From the application process to the thesis writing, you were there when we needed to be talked off the ledge! Thank you! And to my advisory committee I express my utmost gratitude. I thank Dr. V. for the conversations and the numerous edits and helping make this possible. Dr. Featherstone and Dr. Harris were very kind and supportive.

To the Class of 2017: Through job changes and moves, we hung in there! Nancys all around!

CHAPTER I: INTRODUCTION

The client for this thesis is Quandahl Farms. Quandahl Farms is a family venture that currently raises row crops in Northeast Iowa. With the downturn in the agricultural economy, Quandahl Farms is interested in adding other crops to the farming portfolio to increase income and help manage risk. Alternative crops have been on the rise as commodity prices plummet. Currently, Quandahl Farms is unable to support additional family members living off the income from corn and soybeans. Quandahl Farms is not currently planning to expand the family operation in acres, so to potentially increase, it is considering adding other enterprises through reallocation of land from corn and soybeans in hopes to bring additional income and in the future expand the family living generated by the farm.

The three enterprises Quandahl Farms is considering are grapes, raspberries, and black currants. However, to implement this initiative, Quandahl Farms would first like to know if the climate and growing conditions of Northeast Iowa would support any or all of these alternative crops. If black currants are a good fit agronomically, Quandahl Farms needs to understand if there are any residual regulations around cultivating black currants. At least once in United States' history, black currants were not legal to grow based on their potential for harboring pathogens deadly to other berries and trees. If the crops are technically feasible for the region, then Quandahl Farms would then like to know if the farm is able to achieve their economic objective of increasing farm income more than the corn and soybeans that would been planted on the land reallocated to the new enterprises.

Quandahl Farms has been interested in these three potential alternative crops for different reasons. Grapes draw interest because the family has recently developed a passion for homebrewing and could potentially be interested in expanding to larger-scale production. For the immediate future, Quandahl Farms would be looking only at establishing a vineyard and contracting grapes with a local vineyard. In recent years, Northeast Iowa has become home to several new wineries that are rapidly growing. Quandahl Farms is making an assumption for the initial development of this thesis that one of these wineries would be the outlet for the grapes. Raspberries are under consideration because they are a popular fruit to sell at local farmers markets and can be marketed as a popular activity—pick your own—to reduce Quandahl Farms' labor costs. Black currants are of interest to Quandahl Farms for two reasons: they are a unique berry and would not commonly be found in the grocery stores and markets in Northeast Iowa. Similar to grapes, black currants can be used to make a unique liqueur that local wineries may be interested in producing. Black currants are also becoming more popular in the heath-conscious market and can be made into many products. There is not a local black currant producer in the Upper Midwest.

The objective of this research is to identify which crop or crops will grow in Northeast Iowa agronomically and from there, which crop or crops could lead to the highest Net Present Value (NPV) and future profits for the farm. Agronomic properties are the first concern. Quandahl Farms needs to understand what each crop requires in climate, support structures, and pesticide use. After agronomic choices have been established, Quandahl Farms is interested in understanding the profitability of the alternative crops from a berry standpoint i.e. which crop can be the most profitable selling the fresh fruit. This

question must be answered before the third question can be identified. To create a competitive advantage, Quandahl Farms is interested in producing wine or liqueur. Preliminary survey has not found a locally produced option in the Upper Midwest. Quandahl Farms is aware of several companies that produce this nationally with various types of berries. A local consultant has informed Quandahl Farms black currant liqueur is very popular overseas, but there are not many options in the Midwest. Quandahl Farms feels like this may be a way to develop a competitive advantage. Rather than being another local vineyard, Quandahl Farms could produce local liqueurs made from various berries. In summary, Quandahl Farms is asking for a study of the profitability of grapes, raspberries, or black currants over the current row crops.

Quandahl Farms is particularly interested in the outcome of this investigation for several reasons. As a small family farm, Quandahl Farms is aware of the profitability challenges in the corn and soybean markets today. Quandahl Farms is also aware of the challenges of supporting multiple families off a small operation and is looking to diversify the income streams. Locally produced products are becoming more popular with some consumer groups. Quandahl Farms is excited about the idea of producing liqueurs but wants to make sure this is a viable option. This is the primary reason they want to explore the opportunities between liqueurs and wines in the Upper Midwest. Quandahl Farms has done a brief competitive survey and has located several local wineries. These wineries have tasting rooms, show rooms, and some have a restaurant. This is not something Quandahl Farms is currently interested in, so this could put them at a competitive disadvantage in the area. As noted earlier, several larger companies are producing liqueurs at regional and

national levels, but so far, the competitive landscape appears to be open for locally produced options.

1.1 Research Problem

The foregoing background information establishes the research problem for this research. How can farm businesses increase income in low commodity price periods to ensure sustenance of the farm family unit? Suppose diversification of enterprises is a credible strategic alternative, how feasible is it in achieving the goal of income enhancement? The problem this research seeks to address is to explore the economic potential of farm enterprise diversification for Quandahl Farms, a Northeast Iowa business.

1.2 Objectives

The overall objective of this research is assess the technical and economic feasibility of adding grape, raspberries or black currants to a corn and soybean farm operation in Northeastern Iowa. The specific objectives are as follows:

1. Assess the technical feasibility of the three crops related to growing these crops in the U.S. or in the region.
2. Assess the economic feasibility of each of the three crops and compare their potential economic performance under alternative biotic, abiotic, edaphic and climatic stress conditions with the view to identifying the one with the most resilient potential in contributing to the total farm income situation.
3. Evaluate the economic performance of the best-performing crop within the total farm production system to project the potential net farm incomes from the reorganized farm enterprises over the next decade.

1.3 Methods

The study employs three principal methods:

- Agronomic analysis of cultivating grapes, raspberries and black currants in Northeastern Iowa. This will involve a review of the literature on the agronomic conditions for achieving acceptable and competitive performance from these crops and assessing the conditions in Northeastern Iowa to determine their suitability for the crops. This will provide insights into the technical feasibility of the three crops and address Objective 1.
- Using budgetary information for previous research on the three crops, we will use Excel spreadsheets to develop alternative financial projections of growing each of the three crops in Northeastern Iowa, recognizing the performance challenges and opportunities identified under Objective 1. We will use a simulation method to assess the performance under alternative biotic and abiotic, edaphic and climate stress conditions. This will address Objective 2.
- We will select the best performing crop among the three under consideration and develop a complete pro forma financial performance of the whole farm with the selected crop to determine how well it contributes to farm income objectives under alternative risk scenarios for both the traditional and the new crops. This will be compared to the status quo situation of cropping corn and soybeans alone. We will use financial indicators, such as net present value and the internal rate of return, to determine the economic feasibility of incorporating the selected crop in the farm operations and compare the results with the status quo.

CHAPTER II: LITERATURE REVIEW

In this chapter, we present a review of the literature from the perspective of the agronomic and economic aspects of the alternative crops under consideration. The chapter is organized into three main section—one for each crop. Under each section, we assess the available agronomic and economic information for each crop that provides a context for an assessment of the contributions that they could make to Quandahl Farms.

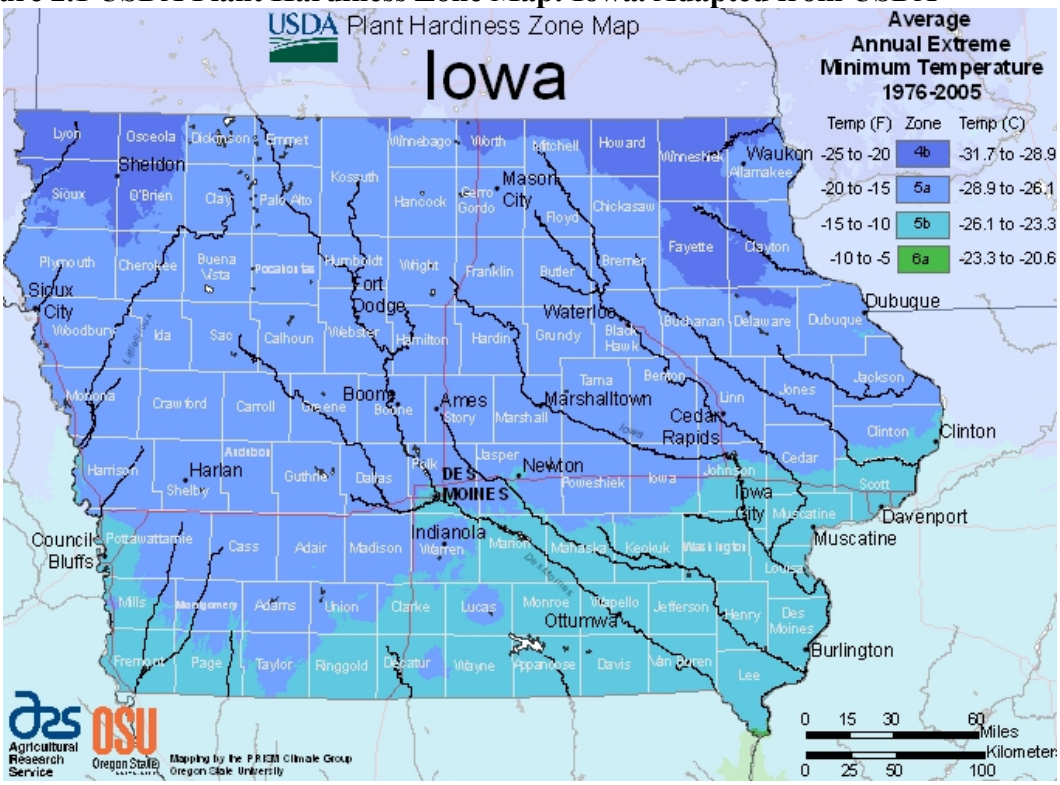
2.1 Agronomic conditions in Northeast Iowa

The climate of Northeast Iowa have been shown to be conducive to the production of row crops such as corn and soybeans. As such, these crops have been the mainstay of many farms in the region. The changes in farm economy are causing farmers to consider alternative crops to manage their income risks. The crop scope available for consideration is defined by the agronomic needs of those crops and the extent to which they are able to thrive in Northeast Iowa climate as well as edaphic and biotic conditions.

Quandahl Farms is exploring the production of three crops as income risk management options: raspberries, black currants, and grapes. Temperature is the first condition to consider in assessing the suitability of the Northeast Iowa region for these crops. According to the United States Department of Agriculture (USDA), Winneshiek County in Northeast Iowa (specifically where Quandahl Farms is located) is in Zone 4b of the USDA Plant Hardiness Zone Map (Figure 2.1). The Plant Hardiness Zone Map measures the extreme cold temperatures received by specific locations across the country. The extreme cold temperatures in this zone are -25 to -20 degrees Fahrenheit (Agriculture Research Service; USDA Plant Hardiness Zone Map 2012). Northern Iowa summers are not as intense as southern parts of the country. According to the Iowa Environmental

Mesonet, Winneshiek County accumulates between 2,500 and 2,650 growing degree units between May 1st and September 30th (Iowa Environmental Mesonet 2014).

Figure 2.1 USDA Plant Hardiness Zone Map: Iowa. Adapted from USDA



Source: http://planthardiness.ars.usda.gov/PHZMWeb/. Accessed Feb. 23, 2017.

2.2 Agronomics of Grapes

University of California-Davis presents five growing regions for grapes based on growing degree-days. Region I encompasses all areas receiving less than 2,500 growing degree units per year. Region II includes those areas with 2,500-3,000 growing degree-days per year. Northeast Iowa falls between Region I and II—receiving approximately 2,500 growing degree-days per year—suggesting that the region receives sufficient sunlight and heat throughout the summer to produce several different types of grapes (Calwineries n.d.). Northeast Iowa's cold rating requires a grape to have a 'very hardy' winter rating.

Twenty-three of the 76 cold hardy grapes had a rating of very hardy (Smiley and Cochran 2016). Apart from degree-days and temperature, the other variable important for grape growing is soil pH. Grapes thrive in soils with pH between 4.0 and 8.5, with ideal soil pH being between 5.5 and 6.5. For successful growth, soil organic matter should be between 2 and 3 percent (Brown 2013).

2.3 Agronomics of Raspberries

Raspberries are widely adaptable to numerous growing locations and conditions. As with grapes, there are many cold-hardy varieties of raspberries to choose from. Despite their adaptability, they require well-drained soils, with soil pH values of 6.0 to 6.8 being the most ideal. Because they are very susceptible to pests and diseases, developing an effective Integrated Pest Management strategy is very important for successful production of raspberries (Jauron and Sternweis 2012). Washington State University has developed a scouting guide that addresses many of the concerns with raising raspberries. The good news for considering raspberries in Northeast Iowa is that many of the insects and diseases are similar to those that plague corn and soybeans and have established methods of treatment that do not interfere with neighboring corn and soybean production (Coyne, et al. n.d.).

2.4 Agronomics of Black Currants

Black currants are similar to raspberries from an agronomic standpoint and are very versatile plants. The plant will excel in well-drained soils and do well in partial sun with plenty of moisture. Ideal soil pH for black currants is 6.5 (Department of Horticulture 2016). Several currant cultivars have been developed in Minnesota and Canada, indicating winter hardiness and growing season length should not be an issue in Northern Iowa. White pine blister rust is a common disease for currants—the primary reason for regulations

around black currant cultivation. Consort, a variety developed in Canada, is resistant to white pine blister rust and is available for cultivation in the United States (Jauron 1995).

2.5 Economic Overview of Grapes

Grapes traditionally have a high startup costs and have a longer time to revenue and even longer time to full revenue potential. Iowa State University, Cornell University and Ohio State University, among others, have developed various economic analyses for grape production. Ohio State published an enterprise budget in 2001 used in this study to estimate crop yield and income. This budget illustrates the income and expenses through the projected twenty-year life of this vineyard and gives Quandahl Farms a baseline to make comparisons regarding expenses and income associated with grape production. Ohio State projects the grapes will not come into fruition until year three at a rate of 60% of maximum yield. The yield in years four through twenty is estimated at five tons per acre. The assumed selling price of grapes in $950 per ton. At full production, a gross profit of $4,750 per acre is possible with a net profit of $2,436 per acre.

2.6 Economic Overview of Raspberries

Large-scale raspberry production in Northeast Iowa is probably not feasible without significant transport of raspberries to a larger metropolitan area. The local market outlet channels must be considered when establishing the size of a raspberry patch. According to the Leopold Center for Sustainable Agriculture, raspberry production can reach up to 5,000 pounds of fruit per acre per year as a mature plant. The Leopold Center's pricing from 2010 estimates raspberries in Iowa sell for $2.00-3.00 per pound (Naeve and Nonnecke 2010). Using this analysis, a conservative price of $2.00 per pound is assumed. Projected yield for a raspberry patch will increase over the establishment of the plants in the first five years. In year three, the raspberries will begin producing a measurable amount of fruit at a projection

of 1750 pounds per acre. This increases to 5000 pounds per acre by year five and for the remaining lifespan of the raspberry enterprise. The highest expense for a raspberry patch per acre is labor. Selling through a wholesale channel in this budget is what makes the labor the most expensive portion of the cropping plan. If Quandahl Farms decided to make a portion of the patch available as a 'pick-your-own', some of the labor and storage costs could be reduced as well as Quandahl Farms could charge a premium for the farm-direct strategy.

2.7 Economic Overview of Black Currants

Black currants are still a relatively unknown fruit in North America due to regulations from the United States Government in the early 1900s so there is little documentation and not a large, well-known market for black currants. The Ministry of Agriculture, Food, and Fisheries out of British Columbia has developed an enterprise budget that lends itself to Quandahl Farms. The budget is presented in a per acre basis in Canadian Dollars (CAD). In 2001, the CAD to USD exchange rate was 0.64. This indicates that for every one CAD, $0.64 of USD would have the same purchasing power. Yield increases are taken into consideration as the plants become established. Black Currants begin fruiting in the second year of cultivation at a projected yield of 1000 pounds per acre. In years three and four, assumed yield increases to 2000 and 3500 pounds per acre respectively. In CAD, the projected selling price is $0.50 per pound. Using the 2001 exchange rate, Quandahl Farms can project to receive $0.32 per pound of black currants. Outside of the purchase of the plants, machinery and labor costs are the highest recurring expenses. Quandahl Farms would already have access to some of the machinery needed, but may need to account for rental of smaller equipment better suited for the row spacing of the plants. Labor costs are required from a picking standpoint. As black currants are

unlikely to garner a large pick-your-own market in Northeast Iowa, Quandahl Farms must take a wholesale approach initially.

CHAPTER III: ECONOMIC METHODS

In this chapter, we present the data and analytical methods that are used to assess the potential contributions that raspberries, black currants and grapes might make to the overall farm financial situation on Quandahl Farms. The chapter begins with a background on Quandahl Farms to contextualize the situation. It is followed with the data and a discussion of the methods employed.

3.1 Quandahl Farms

Quandahl Farms is currently wholly owned by Dean and Linda Quandahl and they make all business decisions. Consultants including lenders and agronomists are brought in when major decisions are being considered. The farm has been in the family for four generations and the plan to continue the farm remains. Dean and Linda have three children: Carmen, Krista, and Kendal—all of whom are interested in keeping the family farm structure in place. In 2010, Quandahl Farms was operating 654 acres. In 2012, prior to the planting season, Quandahl Farms was outbid through a competitive land rent market on 298 acres being rented from a neighbor. Currently, Quandahl Farms owns 332 of the 356 acres farmed. In addition, Quandahl Farms custom plants and harvests 120 acres for Carmen Quandahl. Of the 356 acres, Quandahl Farms operates a corn-soybean rotation allocating half of the acres to each crop each year.

Recent yield trends in Northeast Iowa indicate Quandahl Farms has average production for the area. Average corn yield in Northeast Iowa between 2006 and 2016 is 173 bushels per acre. Within those ten years, the highest average corn yield was in 2015 at 203 bushels per acre and the lowest in 2012 at 126 bushels per acre. Winneshiek County falls just above the corn average for the entire growing region at 175 bushels per acre (Ag Decision Maker 2016). Quandahl Farms had an average corn yield of 171 bushels per acre

from 2006-2016. Soybeans yields for Northeast Iowa for the ten-year period of 2006-2016 average of 51 bushels per acre. The lowest yield in that ten-year span was in 2013 at 41 bushels to the acre and the highest in 2016 at 60 bushels to the acre (Ag Decision Maker 2016). Quandahl Farms is consistent with Winneshiek County in soybean production with a 10-year average of 48 bushels per acre.

3.2 Data and Analytical Methods

This study references financial data for Quandahl Farms from 2006-2015 as the benchmark against which the projected feasibility of the alternative crops are measured. The financial information collected includes average prices for corn and soybeans, acreage and yield as well as production costs. Production costs are organized into variable costs and fixed costs. Variable costs include seed, chemicals, temporary labor and marketing costs. Fixed costs are simplified and captured with total depreciation of farm assets. We collect future price and yield information for corn and soybeans from Iowa State University Extension. Through informal conversations between Dean, Linda, and the three children it has been established that Dean and Linda intend on keeping ownership of the 332 acres currently owned for at least the next ten years. Any expansion in acres farmed will come from Carmen, Krista, and Kendal purchasing land. All three are open to purchasing if the opportunity presented itself, but have no impending plans at this time.

We use secondary sources for the production and financial information for the alternative enterprises. We collect these from a number of organizations and institutions. They include Iowa State University, Ohio State University, and the Ministry of Agriculture, Food, and Fisheries of British Columbia.

The data collected are analyzed using Excel spreadsheet. We employ projected financial analysis for the current operation of corn and soybean over the next 10 years and

compare them with the projections for the alternative crops over the same period. The primary decision tool used in this research is Net Present Value (NPV). Employing NPV allows Quandahl Farms to analyze the difference in projected profitability between the current cropping plan and the three alternative situations. NPV takes the difference in the present value of the cash inflow and the cash outflow.

$$NPV = -C + \frac{R_1}{(1+d)} + \frac{R_2}{(1+d)^2} + \frac{R_3}{(1+d)^3} + \ldots + \frac{R_T}{(1+d)^T} = -C + \sum_{t=1}^{T} \frac{R_t}{(1+d)^t} \qquad (3.1)$$

where R is the net cash flow from the investment under consideration (the difference between revenues and expenses), d is the discount rate, t is time and C is the initial investment in the project. NPV is a useful tool for assessing the economic feasibility of an investment over time. The investment with a positive NPV is considered economically feasible. When comparing multiple investments, the one with the highest NPV is the most preferred, all other things remaining constant.

We also used Internal Rate of Return (IRR) analysis to determine the risk compensation capacity of the alternative enterprises against the benchmark enterprises. IRR is a measure of potential profitability of an investment. IRR is the discount rate that results in a zero NPV. IRR allows investments of different sizes be compared more easily. IRR should not be used exclusively as the only economic analysis value. It is best to use IRR in conjunction with NPV to establish a projects feasibility.

For each of the crops Quandahl Farms is interested in exploring, three scenarios will be analyzed: alternative price, alternative yield, and alternative discount rate. Multiple scenarios must be evaluated because of the nature of agriculture. Highly dependent on weather, the yields and prices can change and Quandahl Farms will have little control over

these changes. Three different scenarios will give Quandahl Farms the ability to make a decision based on scenarios that are all likely to occur in the life of the venture.

CHAPTER IV: ANALYSIS

Large swings that follow the commodity market have created significant variations in annual profits of Quandahl Farms. Income in Quandahl Farms current scenario include the income from the corn and soybeans sold in that calendar year. Expenses Quandahl Farms' is accounting for include seed, chemical, and fertilizer purchases; fuel, oil, and maintenance costs, and capital purchases including equipment as well as other required costs included insurance and interest. Table 4.1 shows Quandahl Farms' income and expenses for the six-year period: 2010-2015. The net profit swings over the six-year time frame illustrate the concern Quandahl Farms has. The highest net profit Quandahl Farms experienced was in 2011 at $289,094. In 2014, Quandahl Farms took a $25,780 loss.

Table 4.1 Quandahl Farms Net Farm Profit 2010-2015 ($)

	2010	2011	2012	2013	2014	2015	6-Year Average
Income	$448,244	$614,648	$446,409	$331,413	$159,416	$180,055	$363,364
Expenses	$289,610	$325,554	$209,391	$201,133	$185,197	$188,261	$233,191
Net Profit	$158,633	$289,094	$237,018	$130,280	-$25,780	-$8,206	$130,173

Quandahl Farms looks at income and expenses across the whole farm rather than by crop as many expenses benefit both crops. The farm currently has two main revenue sources: sales of corn and soybeans. The largest expenses are fertilizer, seed, and chemical costs, respectively. However, there are some expenses that are shared with the household but they are captured under farm expenses. It is virtually impossible to extract these expenses and allocate them independently to the farm and to the household. Despite the foregoing, farm expenses are estimated on a per acre basis because only a small acreage of Quandahl Farms is anticipated to be allocated to the alternative crops under consideration in this research. Table 4.2 details the acres farmed each year by Quandahl Farms and the income, expenses

and net profits by acre. An assumption is made that the net farm income will remain stable for the next ten years at $270 per acre. The NPV of corn and soybean production over the next ten years is $214 at a discount rate of 4.45%. This creates an income requirement of $76,245 for Quandahl Farms.

Table 4.2 Quandahl Farms' net returns by acre from 2010-2015 ($)

	2010	2011	2012	2013	2014	2015	6-Year Average
Net Farm Profit	$158,633	$289,094	$ 237,018	$130,280	$ (25,780)	$ (8,206)	$ 130,173
Total Acres Farmed	654	654	356	356	356	356	$ 455
Income/Acre	$ 685.39	$ 939.83	$1,253.96	$ 930.94	$ 447.80	$ 505.77	$ 794
Expenses/Acre	$ 442.83	$ 497.79	$ 588.18	$ 564.98	$ 520.22	$ 528.82	$ 524
Net Profit/Acre	$ 242.56	$ 442.04	$ 665.78	$ 365.96	$ (72.42)	$ (23.05)	$ 270

4.2 Economic Analysis of Grapes on Quandahl Farms

Ohio State University presents a straightforward expected cash flow for vineyard establishment. No additional equipment will be purchased that Quandahl Farms does not already own. There is opportunity within Quandahl Farms to repurpose materials already owned by the entity. For the purpose of this report, Quandahl Farms is assuming they purchase everything new. Finally, an assumption is made that Quandahl Farms is selling the grapes to a processor or local winery and not undertaking any processing themselves. Using Ohio State's expected cash flow numbers from Chapter 2 and tailoring this to Quandahl Farms' scenario, an income statement can be estimated. Table 4.3 indicates the net profit possibilities of a standard example Quandahl Farms could expect.

Table 4.3 Projected Income Statement for one acre of Grapes on Quandahl Farms

Year	0	1	2	3	4-20
Revenue	**$ -**	**$ -**	**$ -**	**$ 2,850**	**$ 4,750**
Total Variable Costs	$ 195	$ 5,004	$ 1,148	$ 2,578	$ 1,877
Total Fixed Costs	$ 250	$ 7,944	$ 300	$ 300	$ 438
Total costs	**$ 445**	**$ 12,948**	**$ 1,448**	**$ 2,878**	**$ 2,315**
Net Profit	**$ (445)**	**$ (12,948)**	**$ (1,448)**	**$ (28)**	**$ 2,435**

Yield and prices are estimated using Ohio State University's projections. Included in this projection is the cost of establishment, including vines, trellis, and land preparation costs. The highest cost within the grape production is labor, machinery costs, and trellis supplies. By year four, Quandahl Farms could expect to have a positive cash flow and begin paying down debts taken to establish a vineyard.

The NPV calculation of grapes is found in Table 4.4. In the ten-year projections of grapes, the NPV is -$1,578 with an IRR of 2%. Using the values from Ohio State and a discount rate of 4.45%, grapes appear to be an unworthy investment for Quandahl Farms in the base scenario.

Table 4.4 Net Present Value Calculations over ten years: Grapes

Year	Price ($/t)	Quantity (t)	Revenue ($/t)	Unit Variable Cost Per Quantity	Total Variable Cost	Gross Margin
0	0	0	0	0	0	-445
1	0	0	0	0	0	-12948
2	0	0	0	0	0	-1448
3	950	3	2850	959	2877	-28
4	950	5	4750	463	2315	2435
5	950	5	4750	463	2315	2435
6	950	5	4750	463	2315	2435
7	950	5	4750	463	2315	2435
8	950	5	4750	463	2315	2435
9	950	5	4750	463	2315	2435
10	950	5	4750	463	2315	2435

Discount Rate	4.45%
NPV	**($1,578.30)**
IRR	**2%**
PMT	($198.97)

4.3 Economic Analysis of Raspberries on Quandahl Farms

Raspberries is the second solution that Quandahl Farms is interested in pursuing. Using the estimates from Iowa State University presented in Chapter 2, an income statement can be presented for Quandahl Farms. Labor is the highest projected expense. Quandahl Farms is assuming in this scenario as all raspberries are harvested and sold wholesale which means all labor costs would need to be absorbed by members of the Quandahl Family or hired externally. By year three, Quandahl Farms could have a positive cash flow based on production increases as the plants become established. Table 4.5 gives a projected cash flow statement based off Iowa State University's enterprise budget. This gives a picture of the first four years where inputs are high and production is increasing and an estimate of full production in year 5 and beyond.

Table 4.5 Projected Income Statement for one acre of Raspberries on Quandahl Farms

	0	1	2	3	4	5+
Revenue	0	0	3500	5260	9000	10000
Total Variable Costs	1599	2701	3315	3261	3286	3286
Total Fixed Costs	880	1520	880	880	880	880
Total costs	2479	4221	4195	4141	4166	4166
Net Profit	-2479	-4221	-695	1119	4834	5834

Using the assumptions from Table 4.5, the NPV can be calculated for raspberries. In the base scenario found in Table 4.6, we assume that the price received remains constant and we have a consistent yield of 5000 pounds per acre at full production. The NPV of this investment is $23,267 and the IRR is 36%. For Quandahl Farms, the base scenario uses a discount rate of 4.45%.

Table 4.6 Net Present Value Calculations over ten years: Raspberries

Year	Price ($/lb)	Quantity (lb)	Revenue ($/lb)	Unit Variable Cost Per Quantity	Total Variable Cost	Gross Margin (thousands)
0	0	0	0		0	-2479
1	0	0	0		0	-4221
2	2	1750	3500	2.4	4200	-700
3	2	2630	5260	1.57	4129.1	1130.9
4	2	4500	9000	0.93	4185	4815
5	2	5000	10000	0.83	4150	5850
6	2	5000	10000	0.83	4150	5850
7	2	5000	10000	0.83	4150	5850
8	2	5000	10000	0.83	4150	5850
9	2	5000	10000	0.83	4150	5850
10	2	5000	10000	0.83	4150	5850

Discount Rate	4.45%
NPV	**$23,267.85**
IRR	**36%**
PMT	$2,933.34

4.4 Economic Analysis of Black Currants on Quandahl Farms

Black currants have little documented economic information in the United States. Using the information from the Ministry of Agriculture, Food, and Fisheries out of British Columbia, a similar analysis as grapes and raspberries can be presented. An assumption is made that all of the berries are picked and sold at a wholesale rate. Black currants appear to have the smallest investment costs as well as the lowest labor costs. Table 4.7 illustrates the potential cash flow statement for Quandahl Farms. Just like grapes and raspberries, black currants increase in production over the first few years of establishment. This example is adapted from the enterprise budget out of British Columbia. The exchange rate was taken into account based on the rate in 2001 when the budget was released. Black currants are projected to have a small crop by the end of year 2. As there is little cost required in trellising, black currants have the lowest start-up costs and could offer the most flexibility from a transitioning standpoint.

Table 4.7 Projected cash flows for one acre of Black Currants on Quandahl Farms

Income/Acre	0	1	2	3	4+
Black Currant Yield	0	0	1000	2000	3500
Price ($0.32/lb)	0	0	320	640	1120
Total Projected Expenses	243.2	2001.16	620.68	675.72	747.4
Expected Revenue (USD)	-243.2	-2001.16	-300.68	-35.72	372.6

Using the projections from Table 4.7, the NPV for black currants can be calculated. Table 4.8 illustrates the ten-year projections for black currants. The assumed black currant price is $0.32 per pound. At this price and quantity with a discount rate of 4.45%, the investment

has a negative NPV and a very low IRR. Over the course of ten years, this project would return a negative $58 per acre per year.

Table 4.8 Net Present Value Calculations over ten years: Black Currants

Year	Price ($/lb)	Quantity (lb)	Revenue ($/lb)	Unit Variable Cost Per Quantity	Total Variable Cost	Gross Margin
0	0	0	0		0	-243.2
1	0	0	0		0	-2001.16
2	0.32	1000	320	0.62	620	-300
3	0.32	2000	640	0.33	660	-20
4	0.32	3500	1120	0.21	735	385
5	0.32	3500	1120	0.21	735	385
6	0.32	3500	1120	0.21	735	385
7	0.32	3500	1120	0.21	735	385
8	0.32	3500	1120	0.21	735	385
9	0.32	3500	1120	0.21	735	385
10	0.32	3500	1120	0.21	735	385

Discount Rate	4.45%
NPV	**($457.09)**
IRR	**1%**
PMT	($57.62)

4.5 NPV/IRR Analysis

NPV and IRR is used to compare these projects together. A discount rate of 4.45% will be used in the base scenario. Quandahl Farms' current cost of operating capital is 4.45%. The base scenario, using the discount rate of 4.45% with prices and yields from the enterprise budgets presented is presented in Table 4.9. In the base scenario, grapes and black currants do not have a positive NPV and comparatively, a low IRR. Raspberries have a positive NPV and IRR in the mid-thirties. The high IRR for raspberries indicate this has a high potential from an investment standpoint. Raspberries would indicate a productive investment in our initial expected cash flow projections.

Table 4.9 Base Scenario comparing NPV and IRR on Quandahl Farms

	Yield/Acre	NPV	IRR
Grapes	5 ton	($1,578.30)	2%
Raspberries	5000 lb	$23,267.85	36%
Black Currants	3500 lb	($457.09)	1%

4.5.1 Scenario 1: Adjusted Yields

Yield adjustments are a large portion of the volatility Quandahl Farms could incur through starting a new venture. Two evaluations have been run using a discount rate of 4.45%: increasing the yield by 10% and decreasing the projected yield by 10%. Table 4.10 presents the adjusted yield scenario. Grapes and black currants have a negative NPV and a comparatively low IRR. In a yield decrease scenario, raspberries still have a positive NPV and a high NPV. This is a positive result for Quandahl Farms as this indicates through some yield volatility raspberries could offer stability.

Table 4.10: Adjust Yield Scenario comparing NPV and IRR on Quandahl Farms

	Yield Increase:10%			Yield Decrease:10%		
	Yield/Acre	NPV	IRR	Yield/Acre	NPV	IRR
Grapes	5.5 ton	($316.81)	4%	4.5 ton	($2,839.79)	1%
Raspberries	5500 lb	$27,162.39	39%	4500 lb	$21,038.29	34%
Black Currants	3850 lb	($286.88)	2%	3150 lb	($627.29)	-1%

4.5.2 Scenario 2: Adjusted Prices

Price adjustments are also another large source of volatility within all commodity-based industries. Two evaluations have been run using a discount rate of 4.45%: increasing the price by 15% and decreasing the price by 15%. In table 4.11, the adjusted price scenarios are presented. A price increase of 15% puts grapes in a more favorable investment position compared to the base scenario. A price increase is the only scenario where grapes are projected to be profitable with a positive NPV. If Quandahl Farms wanted to continue

pursuing grapes, understanding the market for a specific variety of grapes might lend itself to a higher price and could lead to grapes being a profitable choice. Black currants are also only profitable under a price increase scenario. Raspberries have a positive NPV and a strong IRR in all alternative price scenarios.

Table 4.11 Adjusted Price Scenario comparing NPV and IRR on Quandahl Farms

	Price Increase: 15%			Price Decrease: 15%		
	Price	NPV	IRR	Price	NPV	IRR
Grapes	$1092.50/t	$2,112.91	7%	$807.50/t	($5,269.51)	-3%
Raspberries	$2.30/lb	$32,086.41	44%	$1.70/lb	$14,449.30	26%
Black Currants	$0.37/lb	$541.51	8%	$0.27/lb	($1,455.68)	-9%

4.5.3 Scenario 3: Adjusted Discount Rate

Using NPV to establish a projected investment potential is not a science. A secondary discount rate must be evaluated. The base scenario used a discount rate of 4.45%. As entering a new venture, could drive the cost of capital up, a high discount rate will be used test the validity of the investments. Table 4.12 shows the NPV and IRR of the base scenario and using a discount rate of 12%. Grapes and black currants still indicate a negative NPV and a small IRR. Through a high discount rate, raspberries have a positive NPV and still appear to be a productive investment.

Table 4.12 Adjusted Discount Rate Scenario on Quandahl Farms

	Base Discount Rate: 4.45%		Discount Rate: 12%	
	NPV	IRR	NPV	IRR
Grapes	($1,578.30)	2%	($5,270.15)	2%
Raspberries	$23,267.85	36%	$12,344.50	36%
Black Currant	($457.09)	1%	($1,032.71)	1%

4.6 New Enterprise Contribution to Quandahl Farms' Profitability

Finally, to be certain that switching acres from current production into one of the three alternative crops, Quandahl Farms must take the opportunity cost of not producing

corn and soybeans into consideration. Using the payment function in Microsoft Excel 2013 creates a yearly payout model of the different scenarios. The key financial measure is the yearly payout from the alternative crops is greater than the profit Quandahl Farms would have otherwise garnered from producing corn and soybeans. The six-year average profit per acre on Quandahl Farms is $270. Using the base scenario, the payment schedule breaks down to a negative $198 for grapes. Over the ten-year projection, Quandahl Farms would lose $198 per acre per year by producing grapes—not including the opportunity costs associated with that. This supports the NPV and IRR with another financial measure; grapes do not appear to be a financially sound decision with the information Quandahl Farms has today. When comparing raspberries to the current production, raspberries would lend $2,933 per acre per year, exceeding the opportunity cost for Quandahl Farms by $2,663. Black currants break down to a $57 per acre per year loss without acknowledging the opportunity costs for Quandahl Farms. Raspberries have a positive NPV in all scenarios considered, including the alternative price and yield scenarios. Black currants present a negative NPV and return in five of six scenarios. The scenario with the lowest return for raspberries is a reduced price alternative. Raspberries still have a return of $14,179 per acre more than the projected profit from producing corn and soybeans. Raspberries are the only alternative crop presented that have financial backing that could improve the bottom line of Quandahl Farms.

4.6.1 Supporting an Additional Family Member with Raspberry Production

If Quandahl Farms was to pursue raspberry production, it is important to know what kind of financial gains the family may experience. It is important not to decrease the starting income of $76,245 if an additional family member was to return to the farm. Using a

requirement of $60,000 of additional income, the total net farm income needed is $136,245. Using the constraint of 356 acres, Quandahl Farms should convert 22 acres from corn and soybean production to raspberry production to achieve the total farm income of $136,245. Corn and soybeans will still be produced on the remaining 334 acres.

CHAPTER V: SUMMARY AND CONCLUSIONS

This thesis evaluates the feasibility of converting acres of Quandahl Farms from corn and soybeans into one of three alternative crops: grapes, raspberries, or black currants. Quandahl Farms is looking to add a level of income security to the family farm. In order to complete this, Quandahl Farms sought to understand the crops agronomically to determine the growing potential in Northeast Iowa. As all three are agronomically sound choices for Quandahl Farms, economic analysis must then be conducted.

By using NPV and IRR, we can compare different sized investments over a period of time and understand that projects investment worthiness. Through this evaluation, we have established that grapes pose the least investment opportunity at this time. In all but the price increase scenario, grapes yielded a negative NPV. Through multiple scenarios, price and yield increases and decreases, raspberries have a positive NPV. Raspberries have a higher NPV and IRR than black currants. Based on the foregoing, if Quandahl Farms is to remove ground from corn and soybean production, it must put it into raspberries. Under the base scenario, raspberries produced almost four times the NPV produced by black currants. Furthermore, its IRR was the highest among the three crops that were considered to manage income risks on Quandahl Farms.

Alternative scenarios also present a positive image for raspberries. In the yield decrease, price decrease and alternative discount rate, raspberries still show a positive return for Quandahl Farms over 10 years. During a period of poor crop yield, raspberries have an NPV of $21,038 and an IRR of 34%. If raspberry price was to decline by 15%, the NPV is $14,449 and the IRR is 26%. Both of these scenarios indicate that raspberries are still a profitable investment through times of price variability.

Using our payment function information, we see the yearly return information for raspberries. Compared to the average return of $270 per acre for corn and soybeans, raspberries exceed the yearly return by 986.4% per acre. Even in years of uncertainty, a suppressed price-decreased by 15%-would lend a 674.6% return over corn and soybeans. A 10% decreased yield would leave Quandahl Farms in a position of 982.3% return over having planted corn and soybeans instead. In comparison, if Quandahl Farms was able to receive a price 15% higher than the estimated $2 per pound wholesale price, the per acre return would be 1498.2% higher than producing corn and soybeans.

5.1 Future Studies

Given the foregoing results, it is anticipated that the principal decision-makers of Quandahl Farms will be interested in considering making the allocation to raspberries as a supplementary crop to the corn and soybean operation. The first step after such a decision is made is the development of a comprehensive strategic business plan that will explore the strategic issues involved with the whole value chain of the raspberry operation and th supply chain associated with getting product to market in the most efficient manner. The analyses did not explore the sensitivity of prices and yields using weather, pest and disease information. We envisage undertaking these explorations in the development of the business plan to enhance the veracity of the results.

There are, indeed, other opportunities that may be considered beside growing commodity raspberries. For example, Quandahl Farms may look into additional opportunities to add value to the raspberry enterprise. The pricing estimates were set using a wholesale price. To further increase the profit potential, additional market sources should be evaluated. Segmenting the operation into direct-to-consumer and wholesale and industrial sales could make a significant difference in the enterprise's profitability. These

opportunities need to be evalauted more extensively and intensively to enhance the operations' contributions. The direct-to-consumer opportunities may involve the production of value-added products such as specialty jams and jellies as well as strategic alliances with a winery to produce a unique wine or liquer product for a very well defined consumer market.

WORKS CITED

2001. "2001 Grape Production Budget." *Ohio State University Extention.*

2016. "Ag Decision Maker." *Iowa State University Extension.* March. http://www.extension.iastate.edu/agdm/crops/pdf/a1-14.pdf.

2012. *Agriculture Research Service; USDA Plant Hardiness Zone Map.* http://planthardiness.ars.usda.gov/PHZMWeb/.

Brown, Diane. 2013. *Soil sampling vineyards and guidelines for interpreting the soil test results.* http://msue.anr.msu.edu/news/soil_sampling_vineyards_and_guidelines_for_interpreting_the_soil_test_resul.

n.d. *Calwineries.* http://www.calwineries.com/learn/grape-growing/climate/heat-summation-scale.

Coyne, Dan, Goeff Menzies, Colleen Burrows, and Craig MacConnell. n.d. *Integrated Pest Management for Raspberries.* Accessed 1 26, 2017. http://whatcom.wsu.edu/ipm/manual/rasp/index.html.

Department of Horticulture. 2016. *Minor Fruits: Gooseberries and Currants.* 5 24. Accessed 1 16, 2017. http://www.fruit.cornell.edu/mfruit/gooseberries.html.

Doering, Christopher. 2016. "Farm income tumbles as crop, livestock prices stumble." *The Des Moines Register.* USA Today. 12 1.

Harris, Andrea, and Mark Sweeney. n.d. "Planning for Profit: Black Currants-Lower Frasier Valley Winter 2000." *British Columbia Ministry of Agriculture, Food, and Fisheries* .

2014. *Iowa Environmental Mesonet.* https://mesonet.agron.iastate.edu/climate/gs.phtml.

Jauron, Richard. 1995. *Growing Currants and Gooseberries in the Home Garden.* Horticulture and Home Pest News. 3 17. Accessed 1 25, 2017. http://www.ipm.iastate.edu/ipm/hortnews/1995/3-17-1995/curr.html.

Jauron, Richard, and Laura Sternweis. 2012. *Yard and Garden: Raspberries and Blackberries.* 3 12. Accessed 1 22, 2017. http://www.extension.iastate.edu/article/yard-and-garden-raspberries-and-blackberries.

Naeve, Linda, and Gail Nonnecke. 2010. "Enterprise Budget: Raspberries." *Iowa State University Extention.* http://lib.dr.iastate.edu/extension_pubs/46 .

—. 2010. "Raspberry Enterprise Budget." *Iowa State DIgital Repository.* Iowa State University Extension and Outreach. http://lib.dr.iastate.edu/extension_pubs/46/?utm_source=lib.dr.iastate.edu%2Fextension_pubs%2F46&utm_medium=PDF&utm_campaign=PDFCoverPages.

Smiley, Lisa, and Diana Cochran. 2016. "A Review of Cold Climate Grape Cultivars." Department of Agriculture Education and Studies, Iowa State University.

Smith, John, and Bill C. Jones. 2007. "The Impact of Subsidity Funding." *Agricultural Economics* 2 (4): 65-68.

2010. *USDA.* Accessed April 10, 2011. http://www.ers.usda.gov/StateFacts/.