An investment analysis of planting sweet cherries in Washington

By

MICHAEL RATTRAY

B.S., Washington State University, 2014

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. Mykel Taylor

ABSTRACT

Choosing a viable long-run crop investment can be risky and time consuming for farmers. The high establishment costs and risk for perennial tree crops like cherries require producers to conduct careful analysis prior to investing. Farmers must not only look to prices today but to the long term price trends that are likely affect the investment profitability. This thesis is an investment analysis on planting twenty-five acres of Sweetheart cherries in Washington State. The purpose is to calculate the total net present value over the commercially productive life of the cherry trees. Prices received by growers for sweet cherry production can fluctuate. Sweet cherries are also susceptible to yield volatility. Therefore, a sensitivity analysis was calculated that shows the changes in price and yield and its effect on net present value. Sweet cherry production for fresh market is also labor intensive. Changes in labor supply and minimum wage can affect a farmers profit margins. This thesis evaluates the risk of a wage shock to the total net present value of the investment.

The net present value calculated was found to be positive, making planting Sweetheart cherries a viable option for Hillslide Orchards. The internal rate of return was favorable at 12.30% return. Yield risk was relatively low in this model showing positive net present values at 60% over base yield and still positive at 40% below base yields. The price risk was found to be slightly higher with negative net present values below $1.00 or 20% below the base price. It is important to note that this model represents planting a block of Sweetheart cherries within an existing operation. There are additional costs that would be incurred for other farm operations, not modeled here that could decrease the overall profitability under alternative planting scenarios.

TABLE OF CONTENTS

List of Figures v
List of Tables vi
Acknowledgments vii
Chapter I: Introduction 1
1.1 Purpose and objectives 3
1.2 Background Information 3
1.2.1 First Year Establishment: 4
1.2.2 Second Year Establishment: 5
1.2.3 Third year to Maturity 5
1.2.4 Limitations 6
1.3 Theory 6
Chapter II: Literature review 8
2.1 Farm level Price Formation for Fresh Sweet Cherries 8
2.2 An Analysis of Price Determination in the Sweet Cherry Markets of British Columbia, Washington, Oregon, and California. 9
2.3 Cost Estimates of Establishing and Producing Sweet Cherries in Washington 10
2.4 Cherry Training Systems 11
2.5 Crop Regulation and Cytokinin Sprays to Improve “Sweetheart” Sweet Cherry Fruit Size 11
Chapter III Data and Methods 13
3.1 Conceptual Model 13
3.1.1 Establishment Costs 14
3.1.2 Variable Costs 16
3.1.3 Fixed Costs 20

3.1.4 After Tax Cash Flow 22

3.2 Sensitivity Analysis 22

Chapter IV discussion 25

4.1 Results 25

4.2 Conclusion 26

Bibliography 28

LIST OF FIGURES

Figure 1.1 Sweetheart Block Specifications..4

LIST OF TABLES

Table 3.1 Sweet Cherry Season U.S. Average Grower Price 1980-2015 14

Table 3.2 Establishment Costs for Planting Sweetheart Cherries.................................. 16

Table 3.3 Variable Costs for Planting Sweetheart Cherries 19

Table 3.4 Fixed Costs for Planting Sweetheart Cherries.. 21

Table 3.5 Total Net Present Value for Sweet Heart Cherries 21

Table 3.6 Assumtions of After Tax Cash Flow and Net Present Value 22

Table 3.7 Changes in Price and Yield and the Effects on NPV 24

Table 3.8 Effects of Increases in Minimum Wage to Net Present Value 24

ACKNOWLEDGMENTS

The author would like to acknowledge George and Kristy Rattray for financing the continuation of Michael's education. Without their continued support, completion of a Masters in Agribusiness would not have been possible or even feasible. The author would also like to acknowledge Dr. Mykel Taylor for her help in the development and completion of this thesis. Dr. Allen Featherstone provided a wealth of knowledge throughout the thesis process and proved a valuable asset. The author would also like to give special thanks the Deborah Kohl who was a beacon of guidance throughout the MAB program. Deborah showed incredible patience and diligence in her support throughout the entirety.

CHAPTER I: INTRODUCTION

Washington State is the leader in sweet cherry production in the United States. There are two main types of cherries grown in the U.S., sweet and tart. Sweet cherries are typically marketed as dark, red or white sweet. In 2013 Washington led the nation in sweet cherry production, with 264,000 tons, followed by California (92,300 tons) and Oregon (56,000 tons) (Washington State University 2015). Cherry Production contributed 385 million dollars to the state economy in 2013 and is ranked as the seventh most profitable agricultural commodity (Washington State Department Of Agriculture 2014). The Bing cherry is the most commonly known cherry because of its long history and strong demand. Today research and hybridization has allowed for producers to pick from a wide variety sweet cherry cultivars. Typically newer cultivars are compared to the Bing's in characteristics by size, firmness, harvest time, rain split susceptibility, and pollination.

The Sweetheart cherry is a popular later cultivar with harvest time in early July in Washington State. Producers in later districts can grow Sweethearts and extend the market for sweet cherries. Sweetheart is medium to large in size with excellent firmness and a red flesh. The Sweetheart cherry is self-pollinating and is somewhat resistant to rain splitting due to its small stem bowl. Sweetheart blooms 2-3 days before Bing and ripens 20-22 days after Bing allowing for a large crop load (Washington State University 2015). In a report given to growers at the North Central Washington Stone Fruit Convention, Sweetheart has overtaken Bing in total production. The president of the State Fruit Commission and Northwest Cherry Growers noted that the largest shippers are reporting that Sweetheart cherries surpassed Bing in total shipping quantities for 2015 (Wheat 2016). Growers in

Washington like Hillslide Orchards, see this as a sign that trends are shifting and overseas buyers are changing preferences for sweet cherry varieties. With the growing demand both overseas and in local markets, the return for farmers investing in suitable areas for perennial crops increases.

Hillslide Orchards is looking to expand its current fruit operation on existing land currently in annual crop production. Hillslide Orchards operates five different fruit cropping systems; concord grapes, peaches, cherries, apples, and apricots. Hillslide Orchards would like to increase overall profits by converting land that is under row crop operation to perennial crops. Perennial crops yield higher profits per acre, but at a much higher risk and initial capital investment. Therefore, Hillslide Orchards would like to know if, and by how much their overall profitability may increase by converting row crop ground to permanent crop production. Hillslide orchards operates many different fruit crops, making a systems thinking approach to the investment decision appropriate. After considering the current production system requirements for labor, soil types, and management constraints, sweet cherries appears to be the best fit for the operation. Sweet cherries also fit with the overall business strategy of the firm to increase diversity and improve profit margins. Typically, sweet cherry prices are uncorrelated with concord grape, apple, apricots, and peaches. Cherry yield however, may be correlated to apple production yeilds due to the same risk exposure to mother nature. By increasing acreage in cherry production, we can hire larger crews more easily for harvest as well as more efficiently utilize our current equipment and infrastructure. The analysis presented here, will estimate if Sweetheart cherry production is likely to result in profits to the firm. Also presented is an assessment of the price and yield risk associated with planting Sweetheart cherries in Washington.

1.1 Purpose and objectives

The purpose of this thesis is to evaluate the economic feasibility of planting a Sweetheart sweet cherry block at Hillslide Orchards in Washington State. The net present value of the Sweetheart cherry block is calculated to be used as a comparison to other perennial crop investments. The internal rate of return is also calculated to determine the investment yield. Finally, a sensitivity analysis is presented to illustrate the different levels of risk exposure due to fluctuations in for price and yield. The objectives of the thesis are:

1) Estimate the total costs of planting a Sweetheart cherry block, including establishment costs and operating costs.
2) Gather data on past prices received by growers to estimate future potential earnings.
3) Calculate the net present value of planting a twenty-five acre block of sweetheart cherries and determine the internal rate of return on the investment by Hillslide Orchards.
4) Provide a sensitivity analyses to estimate profitability risk due to fluctuations in output, price, yield, and wages.

1.2 Background Information

To estimate the model, assumptions governing the scope and scale of the analysis must be set. For this thesis, a 25-acre block of Sweetheart cherries is considered. The cherry block is on a mazzard rootstock and sourced from C&O nursery. The plantings use a

16-foot by 8 foot spacing, which results in approximately 340 trees per acre. Therefore, the 25-acre planting is an investment in approximately 8,507 trees. It is estimated that 2% of the trees will not survive or grow adequately for commercial production. Therefore, 8,700 trees with a 5/8-inch diameter are ordered at a price of $9.39 each. The sprinkler pattern is on a 32x32 diamond under tree low arc wind fighter rotators. For this analysis, the area to be planted is square in shape and absent of slope or aspect greater then 2%. The block is evaluated as a 20-year investment.

Figure 1.1 Sweetheart Block Specifications

Architecture	Central leader, three-dimensional
In-row Spacing	8 feet
Between-row Spacing	16 feet
Rootstock	Sweetheart on Mazzard rootstock
Block Size	25 acres
Life of Planting	20 years
Tree Density	340 trees per acre
Trellis System	No support or trellis
Irrigation	Under Tree, Solid Set

1.2.1 First Year Establishment:

First year investments include field preparation, fertilizer application, planting, irrigation setup, pruning, and weed control. The land used for the cherry block has been in alfalfa for the last four years, eliminating the costs that would be incurred if planting back to a field previously planted to perennial crop. Field preparation for this block includes: disking at a rate of $25 per acre, per pass; marking tree rows and spacing at $15 per acre; and ripping tree rows at $20. Planting is done by hand immediately behind the ripper. Irrigation is hand glued above ground then plowed in two feet from the tree row. The trees are pruned by hand at a 45-degree angle approximately 2.5 feet above the ground. Weed control will includes maintenance disking or tilling and weed spraying. One application of Surflan is applied though a backpack sprayer. Irrigation costs will begin the day of planting.

1.2.2 Second Year Establishment:

In the second year, the dormant trees are pruned into a 3-leader spread with two branches growing on one side of the row and a single on the other. Each three-leader tree has the third leader facing every other side. Each is scored by slicing the cambium layer at eighteen to twenty-four inches from the crotch of the tree to induce branching. Any strong wood is thinned out and weaker smaller branches are chosen for permanent liters. Any blooms are removed to promote growth to the tree. Other costs incurred during the second year include maintenance weed control and irrigation during the growing season and dry fertilizer application during the fall after dormancy.

1.2.3 Third year to Maturity

In the third year, unwanted branches are dormant hard pruned. Soft pruning to shape the tree is done to create a standard steep leader tree by cutting the head leader extension at 24-36 inches from its previous season point of origin. As the tree matures, it begins to take the shape of an inverted pyramid. Regular fall pruning is required to renew fruiting branches. On the third year, a wind machine is installed with auto-start. Spraying is done with a turbo-mist air sprayer pulled by a cabbed New Holland tractor. Spraying is done on an as needed and preventative basis. Sweetheart cherries become productive in the third year based on the block specifications used for this analysis.

1.2.4 Limitations

For the purpose of this analysis, the analysis is tailored to the operation of Hillslide Orchards. Therefore, fixed costs from irrigation ponds, irrigation mainlines, tractors, and a pump station are ignored in the costs of planting the cherry block because existing assets are adequate to accommodate the additional cherry production. Only maintenance costs associated with those assets are taken into consideration. Producers looking to invest in Sweetheart cherries without existing assets will incur greater fixed costs then those presented here.

1.3 Theory

Prices were projected using USDA-ERS data. Cherry prices typically are highly volatile, changing daily thoughout the season and for different sweet cherry cultivars. Furthermore, sweet cherry price received by growers is a combination of the price for fresh pack cherries, as well as price received for cull briner and juice cherries. This thesis uses the average price received by growers across all varieties thoughout the given harvest season.

This analysis estimated the variable and fixed costs from establishment planting through the twenty-year life of the investment. Net present value (NPV) is calculated by finding the total, after tax cash flow for each year and discounting it to the present value. The NPV measures todays value of a series of future payments. The internal rate of return (IRR) is a way of measuring the break-even return of the investment. IRR is the discount rate at which the NPV is zero. These calculations estimate the financial profitability of an investment across multiple years. Internal rate of return is a popular method among companies when evaluating an investment because it can be easily compared to other investments (Liljeblom and Vaihekoski 2004). According to J. R. Gram 79.4% of all CFO's use NPV always or almost always and 75.7% of CFO's use IRR always or almost always (Graham and Harvey 2001) in the U.S. For long-term investments such as cherries, net present value is critical to evaluating the estimated worth of a future investment.

The sensitivity analysis measures the impact on NPV of changes in the price of cherries received by growers and harvest yield risk. Wage risk is evaluated under various wage scenarios that show how the NPV is affected by changes in minimum wage. Payback period was not selected for the economic theory because, for long-term investments like cherries, it does not take into consideration the profits obtained after the payback period.

CHAPTER II: LITERATURE REVIEW

2.1 Farm level Price Formation for Fresh Sweet Cherries

Determining future prices and how prices are affected by supply and demand is one of the ways farmers can estimate the expected profitability of an operation. Washington and California are the leading producers of sweet cherries in the U.S. (Flaming, Marsh and Wahl 2007). Cherry prices tend to be volatile due to the nature of the market. U.S. cherry supply is easily affected by weather conditions, while demand is volatile due to international and domestic market fluctuations.

Fleming et al. modeled how production in Washington, California, Idaho, Utah, and Oregon affects domestic prices as well as own-price flexibilities and elasticity (Flaming, Marsh and Wahl 2007). The data used in the study for farm-level prices were collected from the USDA-ERS. The primary source for the per-capita consumption and aggregate annual production was obtained from USDA-NASS. Using an inverse demand function with farm level price and quantity data, they found that between 0.60 and 0.78 of the variation in cherry price is explained by domestic production. Interestingly, they found that cherry prices in California and Washington are complements and not substitutes. The study found that a one percent increase in California production results in a 0.263 percent increase in Washington producer prices (Flaming, Marsh and Wahl 2007). That may be attributed to the harvest timing of Washington and California. The two states do not compete directly because their harvests are staggered. California enjoys an early market beginning in late April and finishing in late June. Washington's harvest overlaps Calinfornia's by beginning in early June finishing in late July. This information can be used to estimate price changes from increases or decreases in annual production.

2.2 An Analysis of Price Determination in the Sweet Cherry Markets of British Columbia, Washington, Oregon, and California.

The cherry market is difficult to predict and comes with a high risk. Farmers must predict future prices decades out to establish an orchard and bring it into production. Growers need information about price volatility, demand, and consumer preferences to make smart investment decisions. Expansion of Flaming's model (Flaming, Marsh and Wahl 2007) of price determination to include production in British Columbia allowed for the effects of imports on domestic cherry price (Florkowski and Carew 2011). British Columbia has seen tremendous growth from 4.5 million tons of cherry production in 1972 to 8,961 million tons in 2008. This growth is attributed to the hybridization and adoption of new late season cultivars, and technology developments in production management. The model used by Florkowski and Carew (2011) is an inverse demand function where prices of sweet cherries are a function of quantities sold, income, and prices of substitute fruit. The framework of the model begins by estimating four price-dependent equations for different regions including British Columbia, Washington, Oregon, and California. Second, an import supply equation is estimated for the given period. The results show coefficients with the predicted sign that are statistically significant. The model estimates for a one percent decrease in Washington and California's sweet cherry production, increases sweet cherry prices by 0.62% and 0.22% respectively. Washington and California being the two largest producers, have a greater effect on price than Oregon or British Columbia. Income flexibilities were also modeled. The results imply that income flexibility with regard to sweet cherry prices was relatively high. In Washington the model shows that cherry prices could increase by two percent in response to every one percent increase in real per capita disposable income.

2.3 Cost Estimates of Establishing and Producing Sweet Cherries in Washington

Studies estimating the establishment costs of sweet cherry production in the state of Washington address farm-level production decisions and investmens (Galinato, Gallardo and Taylor 2009). This study includes costs for equipment, materials, supplies, and labor required to establish and maintain a modern sweet cherry orchard (Galinato, Gallardo and Taylor 2009). The study employed similar assumptions to those made in this thesis. The assumptions made in the report limit the ability of a farmer to directly use the results as a cost estimate, but allow a farmer to use it as a baseline. A 10-acre block of sweet cherries total production cost was estimated at six years to be $11,824 per acre. Total production costs are broken down into fixed and variable where fixed costs occur whether the sweet cherries are grown or not. Total variable costs for a producing orchard was estimated to be $8,719 per acre and fixed costs were $3,106 per acre. As a comparison, the total variable cost estimated in this study is $6,331 per acre and total fixed costs at full production are estimated to be $1,212 per acre. The annual yield and prices are key factors in the decision because they can be difficult to predict and greatly affect overall profitability. As such, a table showing alternative prices and yields scenarios for an established orchard and the effect on net return is included in this study. Estimated net returns are negative for the first three years and turn positive after year four. The estimated net return for an established block is $7,376 per acre. The analysis in this thesis also includes a prediction of average price and yield to calculate the expected NPV of the investment.

2.4 Cherry Training Systems

There are a number of training systems that can be used to produce orchard crop (Long, et al. 2015). The systems include are kym green bush, Spanish bush, steep leader, super slender axe, tall spindle axe, upright fruiting offshoots, and Vogel central leader. For the purpose of this thesis, a steep leader tree is considered. The steep leader tree was developed in Washington and found to be well suited for the local growing environment. The tree consists of three vertical main leaders with horizontal fruiting branches resulting in a pyramid type shape. The tree is freestanding and best suited using a strong rootstock. The trees must be planted at a low density to ensure adequate space for growth to maturity.

2.5 Crop Regulation and Cytokinin Sprays to Improve "Sweetheart" Sweet Cherry Fruit Size

Sweetheart cherries are a cultivar known to be heavy bearing and can sometimes overproduce. When the crop load on a tree is too large, the tree struggles to produce enough sugar and nutrients for the cherries. This results in cherries that are small in size and low in sugar content. In a report to the International Symposium on Integrating Canopy, Rootstock, and Environmental Physiology the impact of pruning strategy and cytokinin sprays on crop load is explained (Reginato, Robinson, and Yoon 2011). The report is based on a study conducted from 2006 through 2007 and consisting of various Sweetheart cherry trees on two types of rootstocks. The control variety was lightly pruned while the others were hard pruned, spur extinction or flower budding extinction though cytokinin treatment. The cytokinin treatment was done on lightly pruned trees. The object of the study was to determine if bloom thinners are a more feasible way of controlling crop load compared to hand thinning. The study concluded that cytokinin had no effect on fruit size. Fruit size was affected by training system and crop regulation treatments. The study also found that fruit size was highly dependent on leaf area per fruit. The maximum fruit size was found when the leaf area per fruit was 200cm^2. The yield efficiency was calculated to determine how effective the treatments were compared to pruning techniques. It was found that greater efficiency, in terms of fruit per leaf area, in crop load and fruit size was maximized though light pruning. For the investment proposed in this thesis, Hillslide Orchards uses light pruning as a way of controlling crop load on matured trees. It is important to note that while the maximum crop load efficiency was found with light pruning, this may not be the maximum economic efficiency. Applying chemical bloom thinners is cheaper and can be done in a more uniform manner. As wages increase, the cost of hand pruning increases which may prove later on to sacrifice yield efficiency for increased cost savings.

CHAPTER III DATA AND METHODS

3.1 Conceptual Model

To set up the investment model, revenue is considered first. Yield is estimated using average per acre yield at full production, relied at year six, and yield per acre during establishment years is a linearly increasing percentage of full production. For example, yield in year four was estimated at fifty percent of the expected production, of 18,000 pounds per acre. Pack out rates, which measure the amount of harvested production that is packed and shipped to the fresh market, is estimated at 80% of annual field harvest. Yield at full production is based on average yields from Hillside's existing cherry operation.

The USDA ERS reports prices received by growers from 1980 through 2015 (USDA-ERS 2016). Price in the investment model five-year moving average of $1.41 per pound. Price have averaged a 7% annual growth rate from 1980 to 2015. Price received is net of the following charges: trucking, bin rental, sorting, packing, and sales costs assessed by Conrad Adams fruit packing facility. These estimates were gathered from historical records of previous crops delivered by Hillslide Orchards.

Table 3.1 Sweet Cherry Season U.S. Average Grower Price 1980-2015

	Grower price			
Year	Fresh	Processed	All	5-Year Mean Price
	------------ Dollars/ton ------------			
1980	723	375	554	
1981	936	447	685	
1982	969	427	699	
1983	785	430	630	
1984	799	377	609	$ 0.42
1985	1,190	515	799	$ 0.47
1986	1,090	552	823	$ 0.48
1987	953	536	748	$ 0.48
1988	1,100	509	788	$ 0.51
1989	932	453	713	$ 0.53
1990	1,310	424	894	$ 0.54
1991	1,300	667	968	$ 0.56
1992	1,200	630	915	$ 0.58
1993	1,700	685	1,190	$ 0.64
1994	1,480	566	1,040	$ 0.70
1995	2,250	551	1,260	$ 0.79
1996	2,120	730	1,470	$ 0.88
1997	1,680	784	1,250	$ 0.92
1998	1,520	635	1,100	$ 0.91
1999	1,500	556	1,100	$ 0.91
2000	1,900	536	1,340	$ 0.87
2001	1,590	527	1,230	$ 0.82
2002	1,940	562	1,550	$ 0.85
2003	1,700	631	1,410	$ 0.86
2004	2,060	597	1,570	$ 0.92
2005	2,610	620	1,990	$ 0.99
2006	2,130	616	1,620	$ 1.04
2007	2,310	527	1,820	$ 1.08
2008	3,080	518	2,390	$ 1.22
2009	1,600	439	1,330	$ 1.17
2010	2,800	486	2,330	$ 1.19
2011	3,080	538	2,530	$ 1.29
2012	2,340	761	2,020	$ 1.29
2013	3,250	809	2,610	$ 1.31
2014	2,630	676	2,140	$ 1.41
2015	2,760	680	2,250	$ 1.41

3.1.1 Establishment Costs

The model includes production costs separated into establishment and full production year costs. Establishment costs include all expenditures associated with planting in the first year. The fixed costs for this investment were site-specific and tailored to the Hillslide Orchards operation. Land is valued at $12,000 per acre (Galinato and Gallardo 2015). Land value is a representation of the opportunity cost of planting the next most profitable crop after sweet cherries. Soil preparation and other custom hired costs are based on local custom work rates. Fumigation costs reflect the total cost for material and application though custom hire. The trees are sourced from C&O nursery and priced at $9.36 each. Based on the expected planting density, a total of 8,700 trees are purchased. The total cost of the trees planted to twenty-five acres is $3,269 per acre. Irrigation costs include the design of the mainline and lateral placement, materials, and installation. Materials include sub-main and lateral lines with sprinklers. To minimize crop loss due to wildlife, a two strand hot wire fence is included. All establishment costs are fully depreciated in the first year using U.S. tax code 179.

Hillslide Orchard's existing irrigation, mainline, pond, and pump station are adequate to accommodate the additional cherry production, so these costs are not included in the analysis. When considering investments without these existing assets, additional costs would be incurred. The additional total costs of these assets are approximately $3,000 for the pond, and $7,000 for irrigation, mainline, and pump (Galinato and Gallardo 2015).

Table 3.2 Establishment Costs for Planting Sweetheart Cherries

	Establishment Years			
	Year 1	Year 2	Year 3	Year 4
Land	$300,000.00			
Soil Preparation	$1,500.00			
Trees	$81,724.50			
Fumigation	$18,750.00			
Irrigation	$53,750.00			
Fence	$1,500.00			
Planting Labor	$9,482.70			
Wind Machine				$ 26,000.00
Total Establishment Costs	**$466,707.20**			**$ 26,000.00**

3.1.2 Variable Costs

Variable costs use a base wage for all hand labor and the total number of estimated labor hours per acre for each job. This approach allow for shocks in the wage rate to be easily simulated. General labor costs are calculated using estimates of the amount of time typically required for each task. For example pruning typically takes 30 hours for every acre of cherries at full production. In the establishment years the figure is lowered to reflect a faster rate of pruning for smaller trees. Other variable cost calculations are made on a per acre basis including chemicals, fertilizers, hauling, water/power, and fuel.

Pruning costs are based in labor hours per acre. As the trees age and grow, total hours per acre increases until full production. Chemical costs consist of materials and application. Chemical rates typically do not reflect bulk pricing due to high variability in products and low total application quantities. Fertilizer rates do reflect bulk pricing for an operation the size of Hillslide Orchards. General Farm labor includes any odd jobs needed to maintain the orchard including, but are not limited to: tying trees, scarring, tagging, and gopher control.

For cherry harvest labor, a producer may choose to use piece-wise labor verse an hourly wage rate. Hillslide Orchards uses a piecewise rate for picking of $0.21 per pound. Table 3.2 reflects this by multiplying the per acre yield by the cost per pound and summing across total acres produced. Therefore, as the crop load increases with age of the trees, the cost of picking increases. Picking cost reflect the full cherry harvest, while packing costs are based on an assumed pack out of 80% of total harvest. All picking and pruning are done by hand with a ladder and without moving platforms.

Taxes are also included in the labor costs. The Federal Insurance Contributions Act (FICA) requires a 7.65% tax. The Employment Security tax rate and Federal Unemployment rate (FUTA) is 0.37% and 0.6% respectively. Multiplying the sum of FICA, FUTA, and Employment Securities tax by the state minimum wage of $11 per hour yields an additional $0.9482 per hour in taxes. Hillslide Orchards current tax rate for Labor and Industries is $0.6954 per labor hour is then added for a total tax of $1.64 per labor hour. Note that for operations with full time employees paid above minimum wage, additional taxes will be incurred. It was assumed for this investment all labor is paid at minimum wage.

Irrigation water is delivered to the existing pond by the South Columbia Irrigation District via canals. Irrigation water costs include total water allocated to each unit and averaged on a per acre basis. Electricity costs include the expense of pumping water through the irrigation system. Fuel and propane costs include tractor, ATV, and forklift fuels. Wind machine repair includes annual maintenance. Crop insurance costs are calculated on a per acre basis starting in the sixth year or production. Insurance cost reflect lower rates from being part of a larger operation. Increased insurance costs may incur with isolated cherry blocks.

Also included in variable costs are overhead expenses and interest on an operating loan. Miscellaneous costs capture any other costs associated with production, not specifically mentioned previously. Miscellaneous costs include fees for USDA GAP certification, transaction costs, and similar expenses. Miscellaneous costs are estimated to be five percent of total variable costs. The operating loan is 100% financed with a five percent interest rate. Therefore, interest is five percent of the total variable cost each year. For the purpose of this thesis, an establishment loan was not considered due to the zero net effect when considering net present value using the same discount rate as interest rate.

Table 3.3 Variable Costs for Planting Sweetheart Cherries

Variable Costs							
Year	0	1	2	3	4	5	6
Pruning		$ 5,152.27	$ 7,902.25	$ 9,482.70	$ 9,798.79	$ 9,798.79	$ 9,798.79
Chemicals		$ 4,625.00	$ 4,625.00	$ 10,000.00	$ 11,250.00	$ 12,500.00	$ 15,335.50
Fertilizer		$ 250.00	$ 1,925.00	$ 2,200.00	$ 2,475.00	$ 2,750.00	$ 1,512.50
General Farm labor		$ 8,297.36	$ 8,297.36	$ 8,297.36	$ 8,297.36	$ 8,297.36	$ 11,616.31
Picking				$ 36,288.00	$ 54,432.00	$ 72,576.00	$ 90,720.00
Supplies		$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00
Water		$ 1,875.00	$ 1,875.00	$ 1,875.00	$ 1,875.00	$ 1,875.00	$ 1,875.00
Electricity		$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00
Fuel/Propane		$ 2,500.00	$ 3,125.00	$ 4,071.25	$ 4,071.25	$ 4,071.25	$ 4,071.25
Machinery repair		$ 1,250.00	$ 1,250.00	$ 1,250.00	$ 1,250.00	$ 1,250.00	$ 2,500.00
Irrigation repair		$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00
Wind machine repair				$ 250.00	$ 250.00	$ 250.00	$ 250.00
Pond maintenance				$ 1,250.00	$ 1,250.00	$ 1,250.00	$ 1,250.00
Crop insurance						$ 7,328.13	$ 7,328.13
VC		$ 28,449.63	$33,499.61	$ 79,464.31	$ 99,449.40	$ 126,446.53	$ 150,757.47
Misc costs		$ 1,422.48	$ 1,674.98	$ 3,973.22	$ 4,972.47	$ 6,322.33	$ 7,537.87
Total Variable cost		$ 29,872.11	$35,174.59	$ 83,437.53	$ 104,421.87	$ 132,768.85	$ 158,295.35

3.1.3 Fixed Costs

The fixed costs associated with the investment are those costs accrued regardless of production. The wind machine cost does not enter the budget until year three because its not needed until the trees are productive. The wind machine is fully deducted 100% in the year it is installed using Section 179-tax code. Miscellaneous supplies include loppers, pruners, and other items needed for handwork or general maintenance of the operation. Property taxes, and insurance costs are estimated using data obtained from Hillslide Orchards' current operation. Management costs are based on an agreement with the manager and Hillslide Orchards for compensation equaling 8% of total revenue from full production. The commission is staggered at 5% for year three increasing to eight at full production due to lower management costs in the early years of production. Total fixed costs are estimated for each year.

Table 3.4 Fixed Costs for Planting Sweetheart Cherries

Year	1	2	3	4	5	6
Wind Machine			$ 26,000.00			
Miscellaneous Supplies	$ 1,250.00	$ 1,250.00	$ 1,250.00	$ 1,250.00	$ 1,250.00	$ 1,250.00
Property taxes	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
Insurance cost	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00
Management cost			$ 6,768.00	$14,212.80	$ 21,657.60	$ 27,072.00
Total Fixed Costs	$ 3,250.00	$ 3,250.00	$ 36,018.00	$17,462.80	$ 24,907.60	$ 30,322.00

Table 3.5 Total Net Present Value for Sweet Heart Cherries

Year	0	1	2	3	4	5	6
After Tax Cash Flow	-$411,693.82	-$22,191.81	-$25,744.48	-$6,764.00	$54,374.07	$75,739.18	$100,354.38
Net Present Value Annual	-$411,693.82	-$21,135.06	-$23,351.00	-$5,843.00	$44,733.68	$59,343.63	$74,885.98
Total Net Present Value	$571,276.70						
Internal Rate of Return	12.91%						

3.1.4 After Tax Cash Flow

Total cost was obtained by summing the variable costs and fixed costs per year. Taxes are estimated at 33% of taxable revenue, based on Hillslide Orchards' current tax bracket. For the establishment years where profits are negative it is assumed that losses incurred will help drive down the taxable income for the operation as a whole and be reflected as a gain in the model. With the annual after tax cash flow for each year the net present value is calculated for each year. The discount rate used is the cost of capital at five percent. Note that the land is not tax deductible and therefore is not taxed in year zero.

Table 3.6 Assumtions of After Tax Cash Flow and Net Present Value

Assumptions	
Wage Rate	$11.00
Actual Labor Rate w/tax	$12.64
Estimated Labor Tax Rate	$1.64
Discount Rate	5%
Tax Rate	33%

3.2 Sensitivity Analysis

Fluctuations in price and yield can significantly change the total net present value. To assess risk exposure, a sensitivity analysis is presented with various price and yield levels and the resulting net present value (Table 3.4). The base cherry price of $1.41 is the midpoint price, with prices increasing and decreasing by 20% for a range in 60% in prices. The same is done for the yield where the midpoint is the base yield of 18,000 pounds. Increases in minimum wage often discourage producers to invest. Table 3.4 shows that when the base price so $1.41 is set the NPV is positive from 60% less then the base yield and 60% above. Table 3.4 also shows the base yield of 18,000 pounds having a negative NPV for a price of $0.90 per pound.

A similar sensitivity analysis is presented in table 3.5 for wage rates. By using a data table we can see the long run impacts on net present value from increases in minimum wage. The base wage is the state minimum of $11 dollars and increases to $16. Other wage risks that are difficult to model are the transaction costs of securing a qualified labor force. At any given day during harvest things may change and alternative labor sources must be found. The miscellaneous cost category attempts to capture these transaction costs. Another risk not modeled, due to the difficutly of predicting, are the costs and availability of chemicals. With increasing regulation, many chemical products are taken off the market yearly and reformulated, which changes the price significalty.

Table 3.7 Changes in Price and Yield and the Effects on NPV

Yield (lbs/Acre)	$ 0.72	$ 0.90	$ 1.12	$ 1.40	$ 1.68	$ 2.02	$ 2.44
9216	$ (909,785.09)	$ (663,329.31)	$ (355,259.58)	$ 29,827.58	$ 414,914.74	$ 877,019.34	$ 1,431,544.85
11520	$ (926,466.45)	$ (618,396.72)	$ (233,309.56)	$ 248,049.39	$ 729,408.35	$ 1,307,039.09	$ 2,000,195.98
14400	$ (947,318.14)	$ (562,230.98)	$ (80,872.03)	$ 520,826.66	$ 1,122,525.35	$ 1,844,563.78	$ 2,711,009.90
18000	$ (973,382.76)	$ (492,023.81)	$ 109,674.88	$ 861,798.24	$ 1,613,921.61	$ 2,516,469.64	$ 3,599,527.29
21600	$ (999,447.38)	$ (421,816.64)	$ 300,221.79	$ 1,202,769.83	$ 2,105,317.86	$ 3,188,375.51	$ 4,488,044.68
25920	$ (1,030,724.92)	$ (337,568.03)	$ 528,878.08	$ 1,611,935.73	$ 2,694,993.37	$ 3,994,662.54	$ 5,554,265.55
31104	$ (1,068,257.97)	$ (236,469.70)	$ 803,265.64	$ 2,102,934.81	$ 3,402,603.98	$ 4,962,206.99	$ 6,833,730.60

Table 3.8 Effects of Increases in Minimum Wage to Net Present Value

Wage	NPV
$11.00	$ 520,826.66
$12.00	$ 506,013.33
$13.00	$ 491,200.00
$14.00	$ 476,386.67
$15.00	$ 461,573.34
$16.00	$ 446,760.01

CHAPTER IV DISCUSSION

4.1 Results

The investment analysis presented in this thesis indicates that, at a price of $1.41 per pound and a full production yield of 18,000 pounds per acre, the net present value of a 25-acre Sweetheart cherry block is $520,827. This indicates that the investment is not only feasible, but also profitable. For existing operations this investment will be much more profitable than a producer just starting out. There are many start-up costs not modeled that would greatly affect the profitability. Buildings, Tractors, and equipment used for production have high capital investment costs. The investment analysis shown is a representation of a larger operation looking to expand using existing resources.

Establishment costs are estimated at $466,706 for the first year. Variable costs at full production are $165,833 for twenty-five acres. The fixed costs are $30,322 at full production. The internal rate of return for this model was 12.30%, which indicates a profitable investment. The risk analysis revealed that with 60% increases or decreases in price or yield, the investment still results in a positive net present value. The swing from high prices and yields to low prices and yields represents a change in NPV from -$909,785 to $6,833,730.

Cherry markets are volatile and difficult to predict. As a price taker in this sector, a producer should monitor the markets to make educated decisions on future investments. Yield fluctuations are a bit more stable for Sweetheart cherry producers and can also be decreased through crop insurance to guarantee a payout and not incur a total crop loss. As a labor-intensive crop, wages can also cause shocks to overall profitability. Minimum wage increases, will drive up variable costs and is reflected in table 3.5. With a $16 minimum wage the net present value decreases from an estimated $520,826 to $446,760.

4.2 Conclusion

In many aspects this model is very specific. Every farm operation has different specialized assets working systematically. It is important to remember what your overall farm plan is when making decisions. How will this cherry production fit in with the logistics of my operation? For instance, are there timing issues that conflict with the overall operation causing labor shortages during peak months? If you are using existing assets like tractors and ladders are they currently underutilized? It may be beneficial to increase your acreage to increase efficiency. Another aspect to this model that is not addressed is the availability of markets. Producers must not only be able to produce a quality product, but have an outlet for their product. A good producer should use a systems thinking approach and take into consideration the financial implications well as the logistical implications when making decisions. This model indicates that for a larger operation with established assets, planting sweetheart cherries is a profitable enterprise. Sweetheart cherries are notable for yielding heavy fruit. However the sensitivity reports shows that even a drop in average yield by 60% to 9,216 pounds per acre still results in a positive net present value. Price, however has a greater impact on profitability where a 25% drop in the average annual price of cherries causes the total net present value of the investment to be negative. With this level of price risk exposure, a producer looking to invest must analyze what internal rate of return they would need to take on this level of price risk. This investments internal rate of return is reasonable and fairly high 12.30%, but this is expected for a crop such as sweet cherries. Just as table 3.4 shows the possible negative net present values it is also true that positive shifts in market demand could yield much higher profits and net presents values.

BIBLIOGRAPHY

Flaming, Stephen, Thomas L. Marsh, and Thomas Wahl. 2007. *Farm-Level Price Formation for Fresh Sweet Cherries.* Pullman, Washington, July.

Florkowski, Wojciech J., and Richard Carew. 2011. *An Analysis of Price Determination in the Sweet Cherry Markets of British Columbia, Washington, Oregon, and California.* Prod. EAAE 2011 Congress. Zurich, September 2.

Galinato, Suzette, and Katrina Gallardo. 2015. *2015 Cost Estimates for Establishing, Porducing, and Packing Sweetheart Sweet Cherries in Washington State.* Crop Enterprise Budget, Pullman: Washington State University.

Galinato, Suzette, Katrina Gallardo, and Mykel Taylor. 2009. *2009 Cost Estimates of Establishing and Producing Sweet Cherries in Washington.* Fact Sheet, Pullman: Washington State University Extension.

Graham, John R., and Campbell R. Harvey. 2001. "The Theory and Practice of Coorpreate Finance: evidence in the field." *Journal of Fincial Economics* 187-243.

Liljeblom, Eva, and Mika Vaihekoski. 2004. "Investment Evaluation Methods and Required Rate of Return in Finnish Publicly Listed Companies." *Finnish Journal of Business Economics* 53 (1).

Long, L., G Lang, M. Musacchi, and M. Whiting. 2015. *Cherry Training Systems.* Reserch, Reserch Exchange, Pacific Northwest Extension, Pullman: Pacific Northwest Extension Publications.

Lynn E. Long, Clive Kaiser. 2013. *Sweet Cherry Orchard Establishment in the Pacific Northwest.* Report, Oregon State University, Pullman: Pacific Northwest Extension.

Rattray, Kristy, interview by Michael Rattray. 2016. *Owner Hillslide Orchards* (12 5).

Reginato, G. H., T. L. Robinson,, and T. M. Yoon. 2011. "Crop Regulation and Cytokinin Sprays to Improve 'Sweetheart' Sweet Cherry Fruit Size." *International Symposium on Integrating Canopy, Rootstock and Environmental Physiology In Orchards Systems.* leuven, Belgium: Acta Horticulture. 903.

USDA-ERS. 2016. "USDA Economic Research Service." *United States Department of Agriculture.* December 12. Accessed Janurary 20, 2017. www.ers.usda.gov/data-products.aspx.#.

Washington State Department Of Agriculture. 2014. *Agriculture: A Cornestone of Washingtons Economy* . May 14. Accessed Janurary 26, 2017. agr.wa.gov/AglnWa.

Washington State University. 2015. "Varities-Cherries." *WSU Tree Fruit.* Feburary 10. Accessed Janurary 26, 2017. treefruit.wa.edu/web-article/cherry-varities/.

Wheat, Dan. 2016. "Sweetheart Overtakes Bing in popular Cherry Variety." *Capital Press* 1.