

**Economic feasibility of growing hops in
Nebraska**

by

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ABSTRACT

Nationwide, the craft brew industry has enjoyed massive growth. Hops are an important ingredient in craft brew beer and rapid growth of this industry has created many opportunities to grow hops. Currently, hops production is concentrated in the Pacific Northwest. That is beginning to change with new hops acres being planted every year across the country. The study looks at how economically feasible it is to plant hops in Nebraska. Is there enough local demand? Finally, given that Nebraska's weather is dramatically different than the Pacific Northwest, can hops flourish there?

The research begins by assessing all costs associated with a starting a three acre hops operation. Estimated yield and income is projected for ten years to establish cash flow. Instances of hail, wind and tornados for Clay County Nebraska for the years 2006-2016 were calculated to determine a probability of those weather events occurring. The probability was then used to determine the effect it could have on yield of hops per year. In addition to cost of production, the study also documented the growth of Nebraska's craft brew industry to establish demand for locally grown hops.

The researched concluded that if production stayed constant and our discount rate at 5%, assuming prices remain where they are or higher, then it is economically feasible to grow hops in Nebraska. Wind, hail and tornadoes do pose a threat in the Midwest but their effect on yield is not enough to deter someone from planting hops there. Access to reliable capital to begin and sustain a hops operation appears to have a greater impact. In addition,

Nebraska's craft brew industry continues to expand rapidly suggesting a strong market for locally grown hops.

This information is important for anyone who is considering planting a commercial hops yard. Given how expensive the start-up costs are and how labor intensive the crop is, this research can provide guidance to those seeking to add hops production to their new or existing farming operation.

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CHAPTER I: INTRODUCTION

1.1 Background

The steady growth of the craft brew industry has created opportunity for everyone along the supply chain who are involved in a single bottle of craft brew beer. Currently there are over 4,000 registered craft brewers in the United States. The Brewers Association estimates that an average of two breweries open per day (Watson 2016). This number does not include home brewers who sell in niche markets or brew beer for personal use.

Craft brew has been so successful that the Brewers Association has stated an ambitious goal of gaining 20% volume market share by 2020. In 2016, craft brews accounted for 12% of beer sales and 15% volume market share (Watson 2016).

In order for the Brewers Association to reach this goal, they need to brew more beer. They also need to innovate and not just brew the same craft beers that drinkers are used to. Market research conducted by the Brewers Association, shows that the average millennial or craft brew drinker tries five new beers per month (Watson 2016).

Brewing more beer means that there needs to be enough raw ingredients. The most important of which is being hops. Hops are a perennial plant that grows vertically on trellis systems referred to as bines rather than vines. If taken care of, hops can produce cones for 10 to 25 years. Currently, United States production of hops is concentrated in the temperate climate of the Pacific Northwest where they have been grown for decades. The state of Washington accounts for 75% of United States hops supply (National Hop Report, 2016).

There are nearly 45 varieties of American hops and can be divided into three categories: aroma, bitter and dual purpose. (Fresh Hops 2017) Similar to wine, the variety, soil, and processing method can affect the taste of the finished product. The cascade hop, for example, is a hybrid breed developed by the USDA-ARS breeding program, and is one of America's favorite varieties. Responsible for the very popular IPA style of beer that has been instrumental in catapulting craft brew beer into the national spotlight.

Variety of craft beer is not the only driving force in the hops production market. The "grow local" or "source local" movement that has been prevalent in all other aspects of food and agriculture is important to brewers as well. The ability to source locally for hops is important to the environmentally-conscious craft brew industry. Buying local helps the local economy as well as gives brewers a better management tool to monitor their hops inventory and availability.

The Brewers Association is recommending that hops growers and brewers form strong partnerships. In 2007-2008 crop year, bad weather in Europe severely decreased available imported hops at the same that American producers were destroying their hop plants due to extremely low prices from prior years. (Colby, 2008) A robust and uninterrupted supply of hops is vital in order to reach the goal of 20% market share by 2020.

The Brewers Association's commitment to maintain the supply chain is good news since the interest in hops production has become widespread and goes well beyond the Pacific Northwest. Called the New Wave by the Hops Growers of America, land-locked universities who are typically associated with corn and soybeans are beginning to take notice. (Hops Growers of America 2016)

There is a perception that hops will do well in Nebraska and support its emerging craft brew industry. Indeed, the idea is that not only will producing hops offer an opportunity for Nebraska farmers to diversify their production and income resources, it will reduce the operational cost of Nebraska's nascent craft brew industry. As a result of the potential economic benefits the University of Nebraska held the first ever grower and brewers conference in Lincoln in January 2016. The conference brought experts in the hops industry to help potential producers and brewers learn about the opportunities in hops production and craft brewing. Meanwhile, the university has partnered with several land-owners and planted test plots throughout the state in order to research which hops varieties grow best and what production methods work best in Nebraska. (Nebraska Hops, 2016)

1.2 Research Problem

Planting and growing hops requires a significant initial investment. Hops are perennial and can produce cones the first year, however full maturity and thus a full harvest can take nearly four years. The research problem being considered in this research is this: Is the production of hops feasible in Nebraska? Given the variability in its weather compared to the Pacific Northwest, what are the critical variables influencing the feasibility of hops production in Nebraska? Addressing this question will be critical in helping producers interested in this emerging industry in Nebraska understand their challenges and potential opportunities.

1.3 Research Objectives and Methods

The overall objective is to assess the economic feasibility of producing hops in Nebraska. The research is conducted from the perspective of green field production. The specific objectives are as follows:

1. Determine the economic feasibility of growing hops in Nebraska under alternative hop price conditions.
2. Evaluate the effect of hail, wind and tornadoes on the economic feasibility of growing hops in Nebraska.

1.4 Layout of the Research

Thus far in this chapter, we have provided a brief overview of the opportunity to grow hops in Nebraska and the rationale for this study. In Chapter 2, we provide an overview of the global and US hops industry and the agronomic requirements for a successful hops production system. In Chapter 3, we explore the economics of producing undertaking the development and operation of a three-acre hops yard. We also present the data and models used in the assessment of the economic feasibility of the production of hops production in Nebraska. Chapter 4 presents and discusses the results from the analysis and our conclusions therefrom. The chapter also discusses further research areas that we see as necessary to ensure that any investments in hops production in Nebraska is profitable for Nebraska farmers.

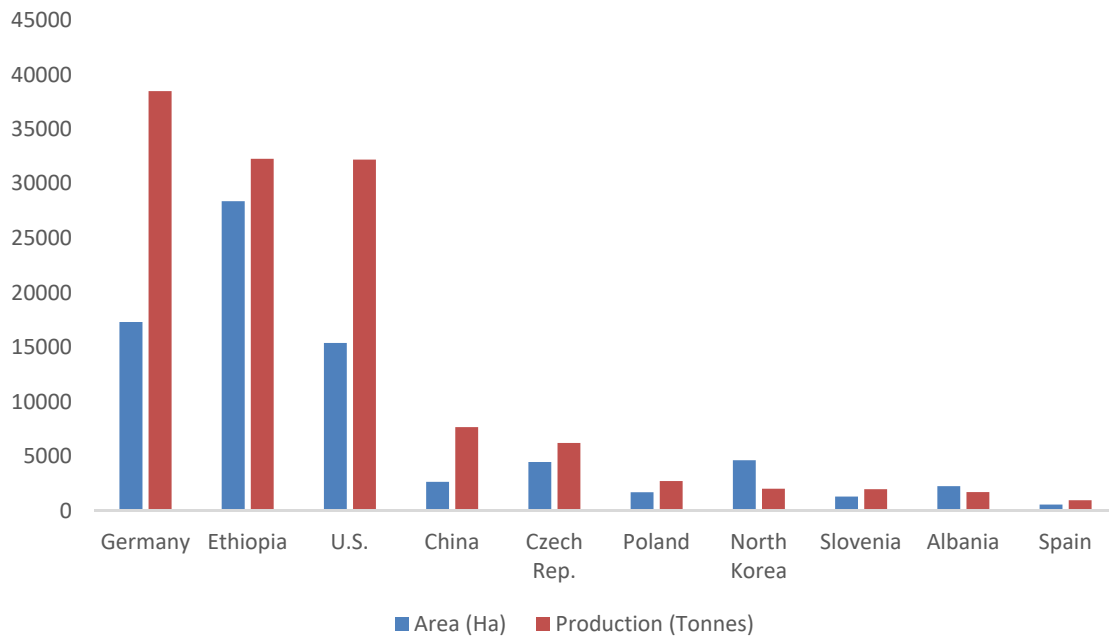
CHAPTER II: LITERATURE REVIEW

2.1 What are Hops

Humulus lupulus L., better known as hops is a perennial plant from the *Cannabaceae* family. (DeNoma, 2000) The moniker hops refer to the flowers of the plant. Due to their conical shape, they are also referred to as cones when discussing harvesting or processing.

Hops are a hearty plant that can grow in many places. However, the best growing conditions are found between the 30th and 50th parallel and at various altitudes that mimic these parallel boundaries (Fresh Hops, 2016). More than 30 countries produce hops and Figure 2.1 shows that production occurs in Europe, North America, Africa and Asia. The figure shows that hops production is very concentrated in a few countries. For example, the top-three global producers – Germany, Ethiopia and the U.S. – together account for more than 78% of the total hops hectares and more than 82% of total production in the top-10 countries. The three countries accounted for 73.6% of total global hectares in hops production and 78.8% of total 2014 hops output. The U.S. share of area and production in 2014 was 18.5% and approximately 23%.

Figure 2.1: Top Ten Producers 2014



Source: FAOStat (www.faostat.org).

The 2016 National Hop Report, released by the USDA in December, states that hops production is up 16% in the U.S. Hops acreage across the United States is around 50,000 acres with over 37,000 acres in Washington State alone. Washington grows around 75% of the United States hops supply. The Pacific Northwest has not always been the dominant producing region because New England, specifically Massachusetts, was the primary hops producing region in the country prior to Prohibition. When prohibition ended all alcohol sales, many hop yards around the country were closed down but because production in the Pacific Northwest was export oriented, it continued. (DeNoma, 2000) This orientation sustained hops production in the region while other regions had redirected their resources to other products. Following prohibition hops production in the Northwest exploded. As of 2016, only 12% of hops produced in the US was exported. (National Hop Report, 2016).

2.2 Growing and processing hops

Hops production requires substantial financial and labor investment. As a result, the threshold for commercial production is very low: one acre! In the Pacific Northwest, most hop yards average 450 acres or more. (Washington Beer Commission, 2016) Outside of the Pacific Northwest, the average hop yard is five acres or less. (Hops Growers of America)

Careful assessment of the location intended to grow hops is done before a single hole is dug. Midwest Hops Producers from Plattsmouth, Nebraska recommend a soil sample as step one. Hops need adequate drainage as well as a soil pH of between 5.5 and 8.0.

Nebraska soil ranges from sandy to clay, well drained to poorly drained (Dominy 2016). When growing hops, clay based soil is not considered ideal since they require proper water drainage. Scott Schmalken, an agronomist for Midwest Hops Producers, has found a way to combat drainage problems by planting hops using a mounding technique. Utilizing a mounding technique also helps smother weeds, reducing the amount of time spent on weeding throughout the summer. Although clay based soil is not considered ideal for hops, it does contain essential minerals and nutrients thus reducing the amount of fertilizer needed. An additional benefit of clay soil is that it can make hops more drought tolerant since the soil retains water.

Following the soil test, careful consideration must be given to location in terms of available sunlight, water and vertical space for the hops to grow. In Nebraska, proper hops placement can help mitigate damaging or prolonged wind.

Hops are climbing plants that can easily reach 25 feet in the first growing season. Commercial hops are typically grown on an eighteen-foot high trellis system. (Kemme,

2013) Growers need to provide twine for hops to grow and spend time training the plants to climb the twine.

In addition to needing space to climb, hops also require lots of sun and water. Drip irrigation is laid out near the plant and monitored accordingly. The main threats to hops are wind, hail, aphids and powdery mildew. There is little a grower can do to prevent nature's wrath in the form of hail or wind. However, pesticides and fungicides can protect against pests and diseases. Therefore, growers need to monitor hops plants daily in order to catch issues early. Midwest Hops Producers estimates that a grower should spend 20-25 hours a week monitoring plants for a 1-5-acre plot of hops.

2.3 Hops in beer

While hops have many uses, they are primarily used for preserving and adding flavor to beer. Each variety is classified in three categories: alpha, aroma and dual purpose which is a hybrid of aroma and alpha. Aroma hops have a lower acid percentage and are generally used for finishing. Aroma hop varieties are responsible for the taste of craft brew. Alpha or bitter hops have a higher acid percentage. These hops are used in the boiling process and result in a more bitter beer. Most commonly used varieties are a hybrid of both and used for both flavor and bitterness. Similar to wine, the variety of hops as well as the terroir or soil affects the taste of the beer (Fresh Hops, 2016).

2.4 How to sell hops

After planting, the first harvest will only produce a small number of cones. However, full production of each plant does not occur until year three to five. Once plants are mature and established, each plant should produce 1½ to two pounds of dried cones per plant.

Contracting with a brewer is the most efficient and profitable way to sell hops. This keeps the communication open between brewer and producer and helps evaluate the quality of the hops. Prior to 2008, communication between the two groups was not very strong and resulted in a hops shortage. As hops prices fell farmers began destroying their plants not understanding or being aware of what brewers needed. (Colby, 2008)

As with any commodity, establishing contracts is beneficial to growers so they can manage their cash flow and employees. For brewers contracting allows them to better manage their brewing schedules in order to maintain supply or plan for seasonal beer releases.

An additional benefit for brewers to contracting is that the price is somewhat lower than on spot markets. Spot markets tend to sell at retail prices. However, spot markets can provide hops that are not grown locally to a brewer, and thus add variety to their beer selection.

According to Curt and Stephanie Stensland, owners of Star Sisters Hop Farm in Iowa, organic hops due to their uniqueness can sell for between \$15 and \$18 per pound. Traditionally grown hops sell for between \$8 and \$12 per pound depending on the variety.

Many hops growers in Nebraska grow less than one acre of hops. Their operations began by growing hops for personal beer brewing use.

2.5 Nebraska Craft Brew Industry

Nebraska is not typically associated with craft beer or hops production. However, many growers and brewers along with the University of Nebraska and the state of Nebraska are working hard to change that.

According to the Agronomy department at the University of Nebraska –Lincoln, Nebraska brews an average of 33,939 gallons of beer annually, generating revenues of

\$424 million dollars in 2014. (Nebraska Hops, 2016) There are currently 32 commercial craft brewers in the state. There are also several non-commercial home brewers who are not officially registered as local brewers.

The Nebraska Legislature in 2016 passed LB 1105 which changed or eliminated beverage regulations and licensure provisions, allowing for a smooth transition for brewing companies' growth and expansion (Larson, 2016). Prior to 2016, regulations required brewers' tap rooms to close once their production reached 20,000 gallons. Tap rooms or tasting rooms are very important to the craft brew industry, since a hallmark of the craft brew industry is the opportunity to try several different beers throughout the year. In addition to beer variety, sales from tap rooms and merchandise help fund breweries.

The Nebraska legislature also passed a law establishing the Nebraska Craft Brewery board as well as creating tax credits for brewers who use locally grown hops (Larson, 2016). These changes to state laws have energized Nebraska brewers as well as potential growers.

Stacy Adams, an agronomist from the University of Nebraska, estimates there are roughly 50 acres currently in hops production in the state of Nebraska. Dr. Adams is spearheading an effort to determine which hop varieties and production methods work best in Nebraska. This research is also to determine which Nebraska soils work best.

Dr. Adams has partnered with many hop growers all over the state planting test plots (Brocius, 2016). One of those growers are Bruce and Annette Wiles. The Wiles saw an opportunity in hops production and started Midwest Hops Producers.

Midwest Hops Producers are located in Plattsmouth, Nebraska. The Wiles' also own Nebraska Hop Yards. They started by planting three acres and plan to have 130 acres by 2018. This expansion would make Midwest Hops Producers the largest hop producer in the state of Nebraska. Midwest Hops Producers offers harvesting, drying and pelletizing services making it one of the only commercial processors as well. Midwest Hops Producers also buys and sells hops from around the world, making them a valuable local supplier of all hops not only those grown in Nebraska.

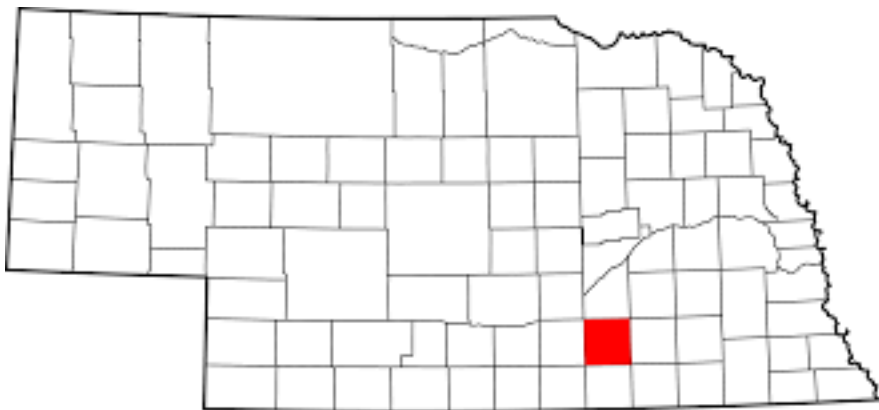
In addition to growing hops, the Wiles have also started Midwest Hop Yard Supplies which helps growers establish their hop operation while providing guidance and education. A fourth company currently under construction is The Hop Yard, a brewing facility and tap room open to drinkers of craft brew beer made especially with local hops.

CHAPTER III: DATA COLLECTION & ANALYSIS

Data for this research begins with a spreadsheet modeled after a generic budget designed by Michigan State University and the University of Vermont for the Hops Growers of America to be used by anyone interested in growing hops (Hops Growers of America 2016). The framework established for Hops Growers of America served as a checklist, which was modified to meet the specific criteria for this case. Processing and price information were obtained from Midwest Hops Producers in Plattsmouth, Nebraska. We also interviewed several growers and local brewers in Nebraska to verify this data.

The hop yard established for this study is a hypothetical hops yard situated in Clay County Nebraska and consists of three acres (Figure 3.1 shaded red). The land is already owned by the producer. Production, expenses and income were projected over ten years under the assumption that all plants will reach full production maturity by Year 5 and prices for dried hops will continue to increase.

Figure 3.1: Nebraska Map



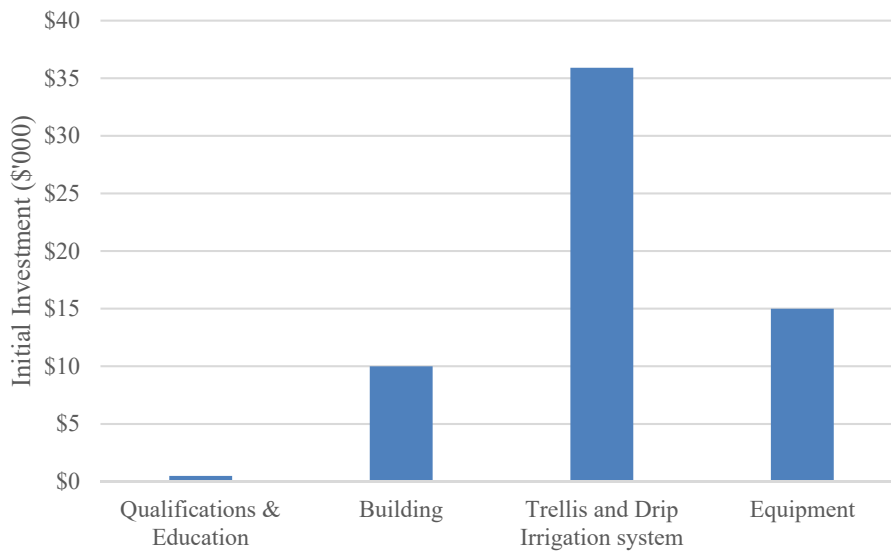
Midwest Hops Producers are the largest hops producers in Nebraska. They are also the only commercial hops processors and local supplier of hops materials in Nebraska. Due

to their expertise and experience, this study relied on their pricing and recommendations to establish a local hops production operation.

3.1 Fixed Costs

Figure 3.2 shows the items and distribution of the investment for the hops yard. The figure shows that the total investment of \$61,406 may be organized into four categories: Qualifications and Education; Storage Building; Infrastructure and Irrigation; Equipment.

Figure 3.2: Investment costs for the hops yard



Midwest Hops Producers have a prerequisite checklist that they require before working with a potential producer. Midwest Hops Producer is the only supplier of hop yard materials located in Nebraska. In addition, they have an agronomist on staff who helps a producer pick the best location for their hop yard. This combined with their own experience growing hops makes them a valuable resource. Their checklist includes an informational class, soil test and fertilizer application certification. The total for this expense is \$415 or 1% of the total investment costs.

It is also recommended that each hops yard have a building at least 10 feet x 10 feet with electricity to store extra supplies and dry harvested hops cones before processing. For this study, a brand new building was built rather than relying on a hypothetical existing building. The building priced includes electricity being added during construction. The total cost was \$10,000 or 16% of the total investment costs.

The bulk of the initial expenses are to build the trellis system, buy the hops plants, and set up the drip irrigation. This total came to \$35,916 or 59% of the total investment costs. The trellis system needs to be strong enough to hold the heavy hops bines. A standard commercial hop design was used to set up this hop yard. (Rainville Building a Hop Yard, n.d.)

There is debate among growers whether planting rhizomes or small plants has better results. Therefore, for pricing purposes I used an average cost that covered using either from an online commercial nursery. This model spent \$9,000 for 3,000 plants at \$3.00 per plant. For drip irrigation, I used a standard Toro system, which encompassed all the elements and functionality needed for a hops yard. The total cost for a drip irrigation system was \$1,300 per acre for a total of \$3,900 (Toro 2016).

For this study, a \$15,000 allotment for a smaller landscape tractor with implements was budgeted for in the event that the producer isn't engaged in row crop farming already. An acreage owner who wanted to plant three acres of hops, wouldn't need a large conventional tractor.

3.2 Operating Costs

Annual expenses are broken down into two categories: field and harvest/processing. Annual expenses for both categories are largely labor costs. Hops are very labor intensive and require at least 20-25 hours a week for a 1-5 acre hop yard. Costs for annual expenses

was taken directly from the USA Hops budget. Labor is one area where a potential producer could save costs. For example, this study included a line item for disking, however the producer might want to do that on his own. Every grower spoken with while researching hops production stressed the need to hire seasonal help for growing and harvest so a per acre estimate complete with how many laborers each task should take.

Field annual expenses totaled \$ 8,907.20 for production year 1 with a 20% increase for production years 2-10 due to increased fertilizer. Expenses include twine, labor, parts, fertilizer and pesticides. Labor includes new twine each year, time invested to train each plant to grow on the twine as well as apply necessary chemicals and fertilizer.

Table 3.1: Annual Field Expenses

Annual Field Expenses	Year 1	Year 2-10
Twine (2400 pre-cut 22' strings/bale=\$400. ~\$0.17/string)	\$979.20	\$979.20
Labor-Stringing ~(11.5 worker hrs/ac x \$30/hr) \$340/ac	\$1,020.00	\$1,020.00
Labor- Training (\$150/acre) *variety dependent	\$450.00	\$450.00
Fertilizer & leaf feed (N, P, K, S, Zn, B, etc.) yr 1=\$400/ac, yr 2+=\$650/ac	\$1,200.00	\$1,950.00
Chemicals (all pesticides) yr 1= \$500/ac, yr 2+=\$750/ac	\$1,500.00	\$2,250.00
Labor- Spraying (\$30/hr x .3 hrs/ac). Yr 1=12, yr 2+=20 sprays	\$324.00	\$540.00
Labor- Field Harvest (\$800/ac)	\$2,400.00	\$2,400.00
Disking (\$128/ac)	\$384.00	\$384.00
Tractor Fuel & Oil (gasoline, diesel, propane, etc.) \$150/ac	\$450.00	\$450.00
Parts/Repairs (equipment, irrigation, etc.). Yr 1=\$200/ac, yr 2=\$400/ac	\$200.00	\$200.00
Sub-Total Annual Expenses- Field	\$8,907.20	\$10,623.20

Harvest expenses begin at \$3,851.38 and increase to over \$10,000 per year due to increase yield needing to be processed. This amount does not include transport of dried hops cones to a processing facility. Since hops production is new to Nebraska, every grower either produces a small enough amount to transport via a pickup truck or they are

large enough to house their own drying and processing facility. Therefore, it was difficult to get an accurate sense of what it would cost to transport dried hops cones to a processing facility.

Brewers like to purchase pelletized dried hops. There is currently only processor in Nebraska, Midwest Hops Producers, and the charge is \$3.50 per pound. To overcome this expense, a potential grower could choose to vertically integrate their operation and purchase the necessary commercial drying and pelletizing equipment.

Table 3.2: Annual Expenses Harvest & Post-Harvest

Annual Expenses-Harvest & Post Harvest	Year 1	Year 2	Year 10
Drying Labor (8-12 hrs/acre; \$12/hr)	\$288.00	\$288.00	\$288.00
Transport to custom harvest & processing facility (variable)			
HQLT Pelletize with no packaging \$3.50/lb	\$2,782.50	\$8,241.03	\$20,915.36
Hop Quality Analysis \$125/sample	\$125.00	\$375.00	\$375.00
Marketing & Sales (10% of purchase price)	\$655.88	\$1,942.53	\$7,395.07
Sub-Total Annual Expenses -Harvest & Post Harvest	\$3,851.38	\$10,846.56	\$28,973.43

3.3 Income Projections

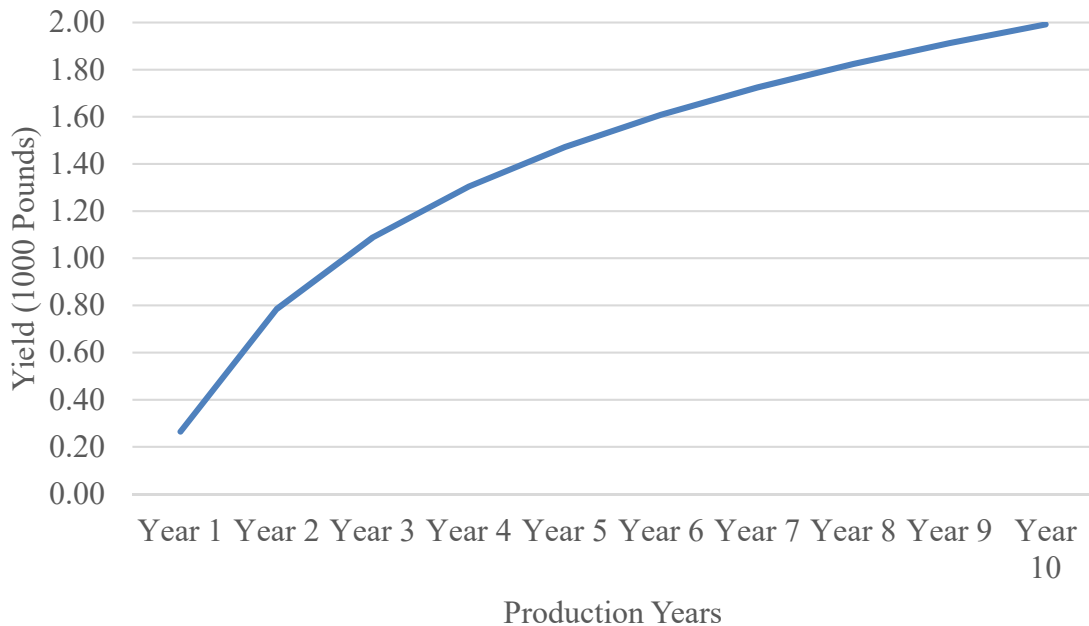
Production income is defined as the product of quantity produced and price. Pricing data were obtained from growers and brewers who attended the Nebraska Hop Cup. The typical current price is \$12 per pound. It is assumed in the base run that this price will prevail throughout the study period. However, we know that if the industry is successful, there might be two opposite directions for prices. First, the number of local brewers will increase because of the availability of hops in Nebraska. If this happens, then we expect prices to increase due to increasing demand for hops.

Alternatively, the success of the hops industry in Nebraska would create an expansion in production and an entry of more acreage into production. Should this production exceed demand, it is anticipated that prices would decline over time if demand does not strengthen to absorb the excess in production. Give the overall projections about the craft brewer industry, the increased production option is not expected to adversely affect prices in Nebraska because excess production will be exported. Therefore, in projecting income for this project, it has been assumed that prices would either be constant over time or increase over time.

Yield is assumed to increase over time according to the equation

$Q_t = 0.265 + 0.75 \ln(t)$, where t is time and q is yield. This function allows the hops yard to increase its production over time towards a maximum of 2,000 pounds per acre. The yield profile for the hops yard is presented in Figure 3.3.

Figure 3.3: Yield Profile of Hops Yard (Year 1-10)



3.4 Weather Analysis

Nebraska suffers from extreme wind, hail and tornado, so it was important to see what effect those various weather events could have on yield and hence operational performance. Using ten years of weather data from 2006-2016 in Clay County, Nebraska, it was assumed that the probability of various weather events over the 10 years of projections will be similar to the past decades. Historical data was retrieved from Storm Data, a website that tracks weather related events. (Storm Data, 2017). A random number generator was used to develop the hail, wind and tornado events that might occur in Clay County, Nebraska over the 10 years. The equation projected yield as a function of the probability, p , of that event occupying, and used it to determine the effect of those events on yield.

Figure 3.4: Hail Effect on Yield

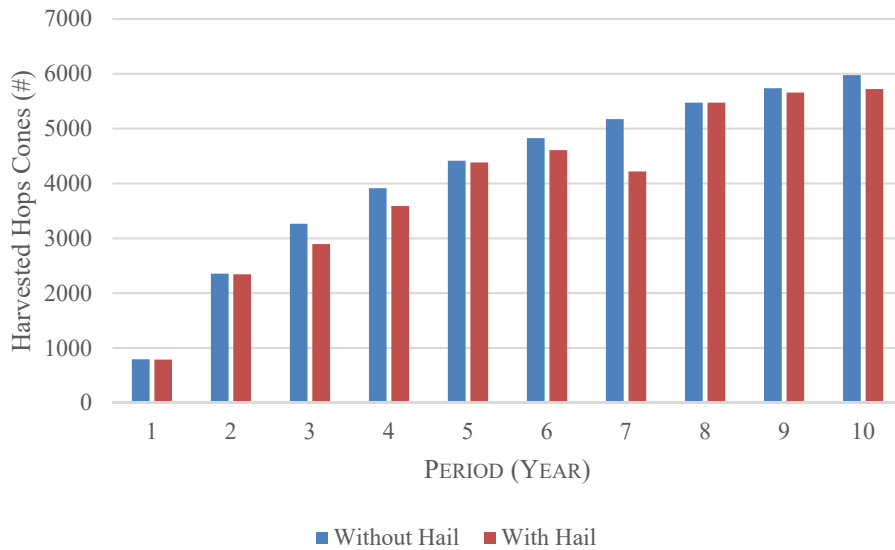


Figure 3.5: Wind Effect on Yield

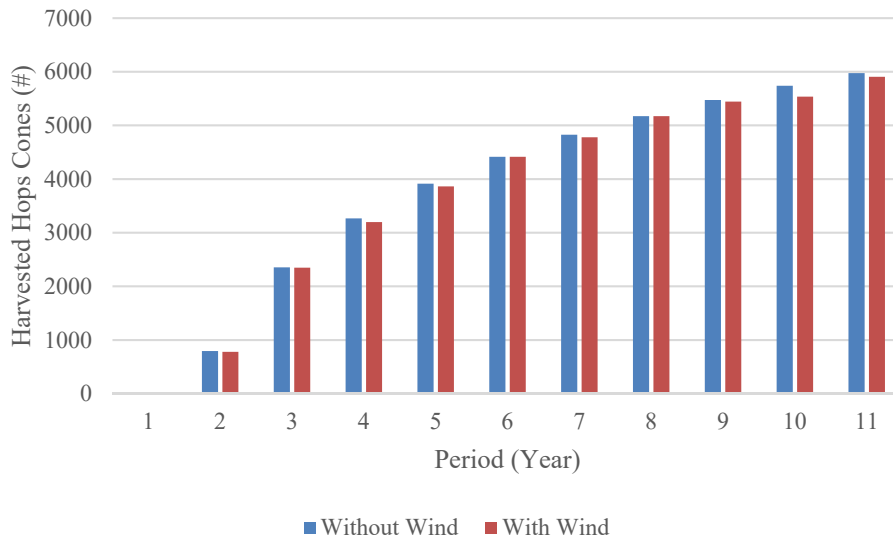
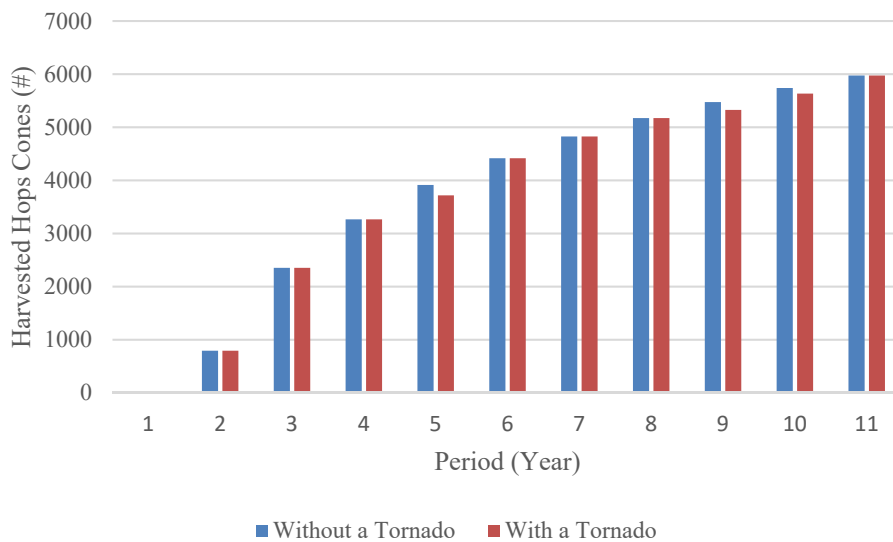


Figure 3.6: Tornado Effect on Yield



3.5 Net Present Value and Internal Rate of Return

Net Present Value (NPV) is a capital budgeting tool used to determine how profitable a potential investment might be. NPV is the difference between cash inflows and cash outflows. The equation for NPV is defined as follows:

$$NPV = -C + \frac{\sum_{t=1}^{10} NB}{(1+d)^t} \quad (3.1)$$

where C is the initial investment, NB is the net benefit in each year, t and d is the discount rate, assumed in this study at 5%. Internal rate of return is the discount rate that equates the NPV to zero.

NPV and IRR are both important capital budgeting tools to help investors make sound financial decisions. A positive NPV is seen as a sound investment. Additionally, an IRR that exceeds your discount rate is seen as positive.

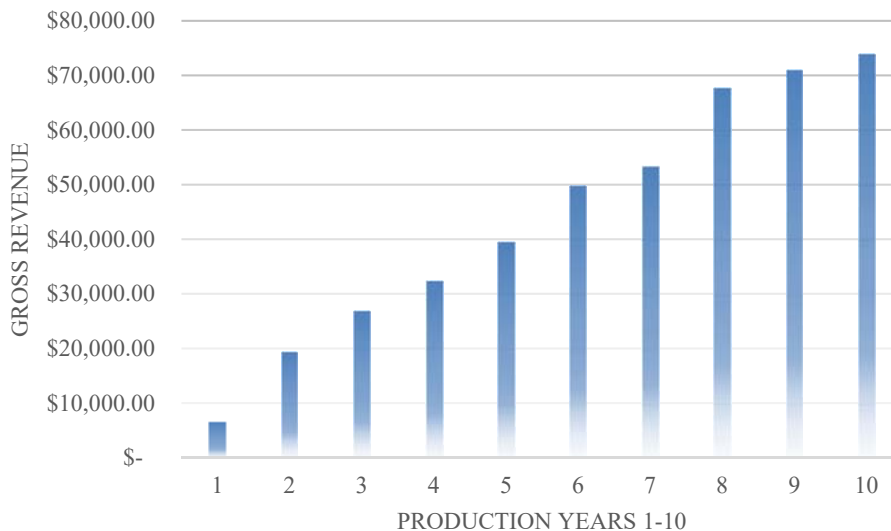
CHAPTER IV: RESULTS AND ANALYSIS

In this chapter, we present the results and their analyses. The chapter is organized into five sections. The first presents an overview of the assumed production trends used for the study and their effect on gross revenues. The second explores the expenditure profile for the project while the third section presents the results of the net revenue analysis. The final section presents the sensitivity of the foregoing to prices and discount rates.

4.1 Production and Revenue

Under ideal circumstances, three acres of hops with 3,000 plants, should produce 6,000 pounds of hops cones. Operating under the assumption that the momentum of craft brew beer and for locally grown hops will continue, it is expected that prices should increase over time. This model also assumes that as new producers entering the market that prices do not saturate the market thus decreasing prices. The model starts a base of \$12.00 per pound and works up to \$18.00 per pound of dried pelletized hops.

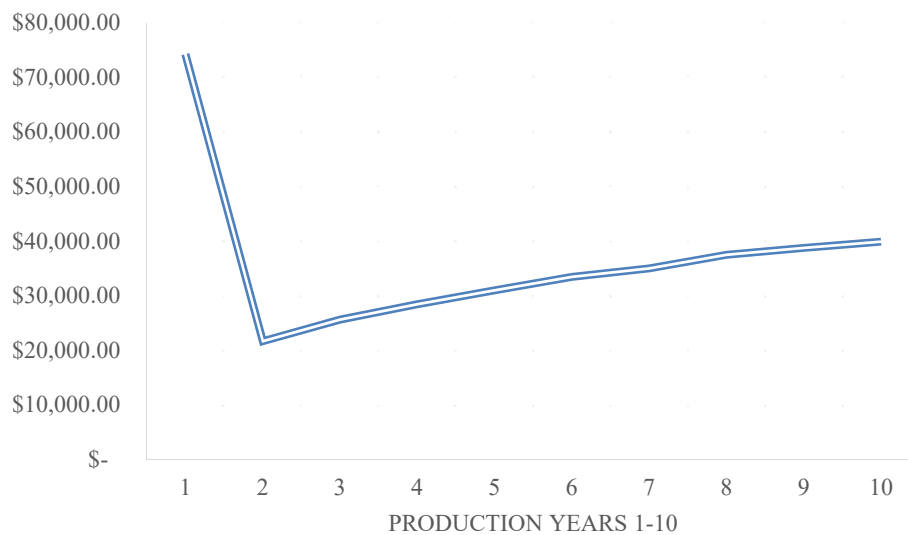
Figure 4.1: Gross Revenue Projections



4.2 Projected Expenses

Annual expenses are broken down into two categories: Fixed and Operating expenses. Fixed costs include the investment costs needed to begin our hops production and include building the trellis for the hops to grow on. Operating costs span field to processing costs. Initial expenses are every high for production year 1. Expenses slightly increase each year 2-10 due to higher yields of hops cones.

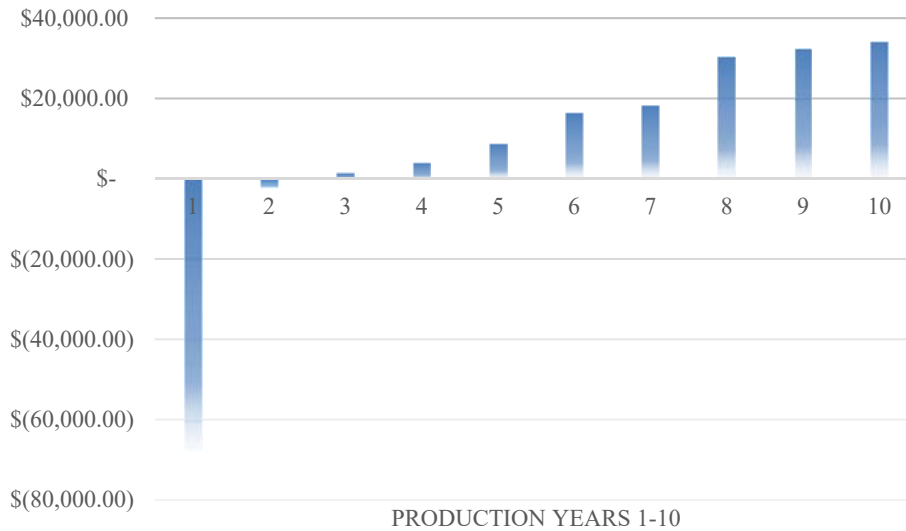
Figure 4.2: Projection of Annual Expenses



4.3 Net Income Situation

Net income is negative for the first year due to high investment costs. Assuming the hop yard starts producing even at 50% or a ½ pound of hops per plant, a very small profit can be realized starting with year 2 and increasing substantially by year 10.

Figure 4.3: Net Income



4.4 Sensitivity Scenarios

Three scenarios were ran to test the sensitivity effects of discount rates and price. The base rate of 5% was based off current market interest rates for operation loans. Assuming interest rates would rise during the ten-year model, two additional scenarios were run using discount rates of 6% and 8%. Price sensitivity was measured with a 10% decrease and 10% increase in the base prices across board.

The first scenario involved exploring the effect of prices on the NPV and the IRR. The NPV under the base scenario was \$31,842. When prices are reduced by 10% across board, the NPV at the same 5% discount rate declined to \$3,338. The internal rate was 5.7%, which is above the discount rate even though it leaves very little room to many any unforeseen risks. On the other hand, when prices are increased by 10%, the NPV increases nearly 20-fold to \$60,347 and the IRR increased by almost threefold to 16.3%. The price effects of 0.9 and 1.1 were tested against our base. Under this scenario, we show that the project is feasible at all the price levels.

Table 4.1: 5% Discount Rate Base Scenario

	Current Values:	Price Effect	P2
	1	0.9	1.1
	5%	5%	5%
NPV	\$31,842.45	\$3,337.56	\$60,347.34
IRR	11.27%	5.70%	16.28%

We explored the effect of the same price changes under Scenario 2 except that the discount rate was increased from 5% to 6%. The NPV when price was decreased by 10% across board was negative and the IRR was below this discount rate. Thus, the project becomes economically infeasible should our assumed prices decline by 10% and the discount rate increase by 1%. On the other hand, a 10% increase in prices produced a \$52,220 NPV with a 6% discount rate. This suggests that the project is more sensitive to prices than to the discount rate.

Table 4.2: 6% Discount Rate

	Current Values:	Price Effect	P2
	1	0.9	1.1
	6%	6%	6%
NPV	\$25,438.38	\$(1,343.29)	\$52,220.05
IRR	11.27%	5.70%	16.28%

The third scenario increased discount rate to 8%. As expected, the lower price led to economically infeasible outcomes but the higher price produced a positive NPV of about \$38,026 compared to the original price profile at the same discount rate producing an NPV of \$14,303.

Table 4.3: 8% Discount Rate

	Current Values:	Price Effect	P2
	1	0.9	1.1
	8%	8%	8%
NPV	\$14,303.00	(\$9,420.18)	\$38,026.18
IRR	11.27%	5.70%	16.28%

The foregoing shows that growing hops in Nebraska is feasible under the base scenario conditions presented. We also find that the project is economically feasible at the original base price and higher but not economically feasible with a 10% decline in the base prices. This would suggest that price is more critical to the economic feasibility of the project and must, therefore, be explored lot more completely. For example, the farmer must focus on getting some of the price risks eliminated by entering long-term supply agreement with a buyer early in the project. Managing this risk would enhance the potential for the project to achieve its desired objective.

CHAPTER V: SUMMARY & CONCLUSION

The summary and conclusions from the research are presented in this chapter. The chapter is organized into three sections. The first provides the summary of the study and the second provides the conclusions emanating from the analyses. The final section looks at alternative uses for hops and provides an opportunity for the producer to consider entrenching the farms' risk management and revenue enhancing strategies.

5.1 Summary

The purpose of the exploratory study was to determine if it was in fact profitable to begin a hops production operation in Nebraska. This includes both the costs to establish and operate a hop yard as well as whether there are enough local brewers to buy the hops.

Assuming prices remain steady and hops plants remain healthy, then growing hops is an economically viable investment. The base scenario of a 5% discount rate produced an NPV of over \$31,000. This indicates that this venture is profitable and worth investing in. Higher discount rates do complicate matters and lower profitability. In that case, it is imperative that the plants must remain healthy and able to produce at 100%.

Another objective for this study was determine to what effect Nebraska's volatile weather would have on hops plants. The study assumed that weather would have a great impact on the viability of hops and thus deter any prospective producer. The results proved that while weather events such as hail, wind and tornados do pose a threat to all Nebraska crops however, it is not as detrimental as previously thought.

Based on historical data, tornados pose the least threat to a hops yard. This model indicated that out of ten years the threat of a tornado was minimal. In addition, there is absolutely no way to guard against a tornado. However, wind and hail have a higher probability of occurring and thus are a valid concern.

Hail is the most prevalent weather event, but impossible to guard against. This model proved that hail also had the most detrimental effect on yield production. That said, the probability and effect of hail on yield never completely decimated our yield production. Fortunately hops have proven to be able to continue growing and produce hops if the hail storm occurs early enough in the season. (Wertlieb & Bodette, 2014)

Wind is the only weather risk that a hops producer can take measures to minimize. This model measured wind speeds of 60 mph or greater. With winds at those speeds, the effects of on yield were minimal. Proper placement of the hops yard can decrease the amount sustained wind and potential damage that Nebraska summer wind can cause.

5.2 Conclusion

This study did not explore buying land for the purpose of a hops yard. Therefore, further study could be done to see how the costs of buying land affect a prospective hops yard. The study also assumed the land owner already paid the necessary taxes and insurance. Therefore, adding hops were part of the acreage or farming operation. Similar to land acquisition, taxes and insurance could be another further study to examine profitability.

Assuming a prospective producer owns the land, hops are relatively easy to get started. Three acres to begin with is quite ambitious, but can be done if you have time and capital. Cost to operate a hops yard can fluctuate and can be decreased by effective management of labor costs.

The market for locally grown hops by breweries based in Nebraska is robust enough to support hops production as of 2017. Nebraska's trend in craft brewery mirrors the national trend and shows no signs of slowing down. Therefore, a potential grower can be confident that there is a market to sell their hops.

While weather is a concern for any Nebraska summer time activity, it should not be a deterrent to a potential hops grower. The threat of severe weather happens regularly, however the detrimental effects do not. Proper placement of the hops yard to protect the plants is the best guard against Nebraska weather.

5.3 Beyond Beer

This study focused the hops yard in favor of craft brew beer. Which makes sense since hops are primarily used for beer brewing in the United States. However, for centuries prior they were infused into tea as an herbal medicine remedy. Researchers are now finding additional uses for hops beyond herbal tea in the areas of animal feed and sugar processing.

It has been found that feeding cattle with feed infused with low alpha varieties of hops have lower incidences of microbial or fungal diseases. Some poultry producers have also experienced positive results from using hops in their feed in place of antibiotics. In the area of sugar processing, the beta acids from hops can be serve as an antimicrobial preservative. (USDA, 2008)

According to John Henning, a Forest Seed and Cereal Research Unit (FSCRU) geneticist, “Brewery interest in tea maker and similar cultivars has been low but interest from the animal-feed and sugar processing industries could significantly expand the hops market.”

Colony collapse disorder (CCD) is responsible for killing thousands of honey bees per year. One cause of CCD is the varroa mite. Researchers from the Carl Hayden Bee Research Center in Tucson, Arizona, along with the USDA Ag Research Service have begun testing the pesticidal properties of hop beta acids (HBA) against varroa mites with the help of BetaTec Hop Products. The results so far show that HBA could be lethal to mites, but caused no harm to the honeybee (Leighton, 2013). Further research needs to be

done to see how effective and for how long hops beta acids can be used against the mites to fight colony collapse disorder.

This study serves as an exploration of how viable a hops operation could be in Nebraska. The official recommendation is that a hops yard is a profitable investment in Nebraska for the committed producer. The industry in Nebraska is very young and therefore opening the door for a producer to become a local industry expert. In the event that consumer's thirst for craft beer begins to wane, it is reassuring for a producer to know (Watson, 2016) that research is being done to explore the additional benefits of hops beyond beer. Even though they are a specialty or niche crop, hops have proved their importance by remaining relevant for centuries.

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