Inter-Generational Transition Strategy Assessment: The Case of Rosburg Farms

by

BRITNEY ROSBURG

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Dr. Terry Griffin

Major Professor

ABSTRACT

Rosburg Farms is a crop farm in Northwest Iowa that specializes in corn and soybean production. The oldest farm operator, Richard was looking ahead to retirement while the next generation, Brian has been working to identify an entry strategy into the operation as a beginning farmer. The purpose of this research was to identify and evaluate candidate alternatives that Brian could bring to Rosburg Farms and to understand if the operation was at a point where Brian was needed as full time labor. Three candidate scenarios including renting additional crop acreage, building a hog facility, and building a poultry layer house were evaluated via SWOT analyses. The SWOT analysis results indicated that renting additional crop acres was the best candidate alternative for the farming operation. To understand how adding the additional acreage to crop production affects the timeliness of the operation and to identify binding resources a whole-farm linear programming planning model was parameterized. Parameters included available labor, machinery, days suitable for field work, crop rotations and available acreage. Production enterprise budgets for corn and soybean production and a projected cash flow were developed to understand if this acreage expansion would be profitable for the multi-family farming operation. The results of the planning model indicated that the field work operations would be completed with the available labor, machinery, and days suitable for fieldwork. The production budgets and cash flow results indicated that Rosburg Farms would remain profitable once farm size was expanded with additional rented acreage. Considering Brian employed off the farm, it was not necessary for him to quit his job to farm full time at this point. Future analysis should be used to understand at what farm size

are needed to justify Brian leaving his off-farm employment to farm full time. These results are applicable beyond the Rosburg farm and are of interest to beginning farmers, farms anticipating transition to next generation, and professional specializing in succession planning.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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CHAPTER I: INTRODUCTION

1.1 Background

Rosburg Family Farms was a multi-generation crop farm specializing in corn and soybean production in Northwest Iowa. Decisions need to be made soon to determine the future of the farm. A family member was transitioning into retirement while the next generation was trying to identify what they can add to the operation to be successful as a full-time farmer. Altogether, the family farm operation was comprised of Brian (26), Keith (52), and Richard (73) with Keith and Richard being the current main farm operators. All three are the farm decision makers.

The past two years Richard has been stepping back and slowing down with what he can do and has been talking about moving from the farm to town. Keith has been trying to make more of the decisions as Richard has been fulfilling the leadership role. Brian was self-employed as a seed salesman through Channel and worked on the farm operation during nights and weekends with harvest and planting after he takes care of his clients. Brian and Keith both rent land for their own crop production. Because Brian does not own any equipment, he pays Keith and Richard for custom hire for machinery use and labor to conduct field operations. Keith and Richard pay Brian for his labor put into their crops. Major farm decisions are made by all three, Richard, Keith and Brian. The farm operation was at a point where Brian was needed to help full time when Richard has transitioned out of being active in the operation. Crop farming is seasonal, and Brian needs to identify opportunities to replace his current income to farm full time.

1.2 Research Problem

The overall goal of this research was to determine how to optimize Brian's role in Rosburg Family Farms. The objectives are defined as:

1. Identify additional enterprises such as livestock and renting land for crop production to see how they could generate additional income to replace the current income made by Brian's seed sales.
2. After choosing the best candidate alternative, learn how this scenario affects the whole farm resources such as machinery, labor, and time constraints.

This thesis is presented in two independent essays. The first essay qualitatively evaluates three candidate alternatives being considered for farm expansion using SWOT analysis. The second essay qualitatively evaluates the best alternative from the qualitative assessment of candidate options. Chapter 4 summarizes the results of the qualitative (Chapter 2) and quantitative (Chapter 3) portions of this thesis and offers suggestions for future research.

CHAPTER II: ASSESSMENT OF CANDIDATE ALTERNATIVES FOR FARM EXPANSION

This chapter discusses the three candidate alternatives for farm expansion being considered by Rosburg Farms. The candidate alternatives were considered by Brian and his wife Britney then presented to the other farm decision makers. Initially, there were seven candidate alternatives after in a brainstorming discussion with all the farm decision makers, only three candidates were selected for further evaluation. The candidate alternatives are evaluated using SWOT analysis. This chapter features the literature review on SWOT, SWOT analyses, and ranking of the three candidate alternatives.

2.1 SWOT Literature Review

The Strengths, Weakness, Opportunities and Threats analysis (SWOT) was developed by Andrews in the 1970's and continues to be used as a strategic management tool used for planning and strategic positioning. In a SWOT analysis, strengths are the capabilities and resources that allow a company to engage in activities that generate an economic value or gain a competitive advantage (Hill, 2012). Weaknesses are internal limitations, lack of resources, or capabilities that prevent economic activities from happening. Opportunities can be anticipated or unexpected events that allow an organization to improve its competitive advantage. Threats are defined as outside factors that may reduce the company's performance. This may be from new products or services in the market, government regulation or specific demands from consumers. For a company to have a strong strategy, all four areas of the SWOT analyses should be taken into consideration. To capture the relevant strengths, weaknesses, opportunities, and threats, companies with multiple products or services, may need multiple SWOT analysis to fully capture what may exist across the operations (Hill, 2012).

In a review of academic research, Helms and Nixon (2010) found over the past ten years, SWOT research has primarily dealt with analyzing organizations for recommended strategic options. Those SWOT analyses were not only used by companies but also by industries, teachers, consultants, and trainers. It was also found that SWOT was used in multiple industries. Limitations included the need to use SWOT analysis with additional strategic methodologies to build on theories. There has been a lack of quantifiable findings on the success of SWOT analyses (Helms and Nixon n.d.).

A SWOT analysis was used as a tool by Hauger in *Net Income, Risk and Business Plan for Hauger Farm (2014).* Hauger used the SWOT analysis as a tool to create a farm strategy and business plan. By identifying weaknesses and threats, Hauger was able to identify ways to overcome possible obstacles to create a strong business plan.

A major limitation of SWOT was that it does not address how a company can identify the elements within itself (Hill, 2012). The SWOT framework does not provide guidance for how a company can identify the elements within itself. An example is when a strength that has been identified, may not truly be a strength. Weaknesses can be easier to determine but are generally not identified until it was too late to create a strategy to overcome it.

The first step in this project was to identify possible enterprises to evaluate how candidate alternatives could generate additional income to replace the current income made by Brian’s seed sales. A SWOT analysis was completed on each candidate alternative that was being considered. Currently, the farm operation has been focused on corn and soybean production. Margins have been tight for crop farmers in 2016 (Hart, 2017). Although prices are not expected to increase significantly, crop margins are expected to improve as the cost of production continues to slowly decrease (Hart and Schulz, 2016). During site visits with established and beginning farmers in the study area, a few farms expressed that they are continuing to rent land at a projected loss. Because they have a good relationship with their banks and various safety nets in place, they have been able to stay in operation. Safety nets include crop insurance and diversified enterprises on their farm such as crop and livestock enterprises. Beginning farmers have unique challenges as they are less likely to have sufficient capital or equity to become established crop producers. Many beginning and younger farmers in the study area were able to farm full time because they inherited land or have been able to find entry strategies that allow them to add value to an existing farm operation. Those entry strategies have brought value to the whole farm operation. Beginning farmers may bring agronomic or farm management expertise or have identified a way to diversify the farm through livestock, specialty crops, or custom farming.

Rosburg Farms considered expanding the operation by adding livestock production, specifically a hog confinement or a poultry layer house or by renting additional 375 crop acres. A SWOT analysis was conducted on each option that were considered. The result of the SWOT analyses are presented in Figures 2.1, 2.2 and 2.3.

Figure 2.1 SWOT Analysis of Renting Additional Land for Crop Production

Strengths

Land available for rent was close in location to grain storage and equipment

Ability to secure credit to support this financially until the grain was produced and sold

Equipment to put in and harvest the crop was accessible

Brian has worked as an agronomist and seed salesmen and has knowledge of crop production practices and techniques

Rent can be negotiated annually so tenants are not locked into a specific price long term

Weakness

Margins are tight in crop production

Crop market fluctuations impact profitability

The busy times for crop production is the same as Brian's off-farm job

If Brian would leave his off-farm job, this would not fully replace his income

If another tenant signs a lease, this opportunity to rent this land may not present itself again

Opportunities

Increased income from crops

Iowa's Beginning Farmer tax credits would benefit the landlord

Opportunity to spread fixed expenses over more acres

Opportunity exists to add a livestock enterprise in the future

Threats

Another farmer could offer higher rent

Volatile market swings and high input costs impacts profitability of crop production

Weeds, insects, and weather have potential to damage crops, affecting yield

Tenants would be establishing a relationship with an elderly landlord. After he passes, the heirs could sell the land or make management changes to the lease agreement or change tenants

Figure 2.2 SWOT Analysis of Chicken Layer House

Strengths

Positive cash flow

There are no other chicken houses near the location that was being considered which is needed for biosecurity to prevent disease spreading

Building site would be the closest facility to the hatchery in Spencer, Iowa or Jackson, Minnesota.

Hy-Line has been in operation for an number of years and has proven production records

This would diversify income and farm operations

Poultry litter can be used as fertilizer for crop production on farm operation or sold for income

Weakness

Intermittent and intensive labor throughout the day

There may be a need to hire outside help during crop harvest and spring planting

Egg handling equipment can be hazardous if not used properly or if operator was not paying attention

$1.6 million investment to establish facility

Opportunities

Incentives to exceed production goals

Meet the goal of replacing Brian's off-farm income

Labor and education requirements to raise and care for layer are minimal

Fifteen year contract ensures stability

Opportunity for a cage free chicken production if producers ever got out of the contract or would choose not to resign the contract expires

Threats

Disease outbreak.

Chicken litter from other poultry facilities cannot be spread within a two mile radius of the building site

In the event something would happen to either owner, it could put the operation at risk

A line of credit would be needed and could risk approval of future credit

Figure 2.3 SWOT Analysis of Swine Facility

Strengths	**Weakness**
Both Brian and wife Britney raised hogs while growing up have basic knowledge of production practices	Loading and unloading hogs could happen at any time of the day or night
The bank loan officer encouraged young farmers to look at this as an option and has agreed to give credit for a facility	Hogs damage hard on buildings and structure repairs would happen every few years
Manure could be used as fertilizer for crop production	Consumers perception of livestock grown in confinement may cause changes to the industry and production policies
Most chores could be done by one person	Additional labor would be needed to load and unload hogs
This would diversify income and farm operations	

Opportunities	**Threats**
Growing world population will continue to demand protein products	Disease outbreak could affect production and income
There are pork companies in the area looking to put up more building unit	Concern of neighbor relations due to odor or proximity of the building.
Demand for pork products continues to be strong and Iowa continues to be a top hog producing state	There are multiple hog facilities within a few mile radius of the possible site location causing a concern for biosecurity
A contract would ensure income stability.	Required a line of credit which could risk approval of future credit

2.2 SWOT Discussion

A SWOT analysis was completed on the candidate alternatives that the farm, decision makers were considering. Two livestock facilities were considered including swine and poultry that would allow for further diversification. The third analysis evaluated renting additional acreage for crop production. Table 2.1 shows a comparison of all candidate alternatives being considered including the size of operations, investment and projected net return. The investment for the poultry layer house and swine facility is for building the facility. The investment for the poultry layer house is $1.6 million and the swine facility investment is $732,000. The investment for crop production includes the rent and expected cost of production to raise corn and soybeans which totals $212,000. The projected net return for the poultry layer house and swine facility are based on average production in established facilitates and does not include any incentives. The net return for crop production was based on 187.5 acres of corn and 187.5 acres of soybeans.

Table 2.1: Candidate Alternative Comparison

Candidate alternatives	**Size of operation**	**Investment**	**Projected net return**
Poultry Layer House	35,000 head	$1,600,000 for facility	$62,000
Swine Facility	24,000 head	$732,000 for facility	$25,000
Acres for crop production	375 acres	$212,000 for rent and inputs	$33,000

2.1.1 SWOT Discussion: Renting Additional Land for Crop Production

When analyzing the alternative to rent additional land for crop production, a number of strengths were identified. The additional land was close to where the harvested grain would be stored. The land was also very close to where the equipment was located. This was a benefit because it minimizes the time that equipment spends in transit and maximizes proportion of time devoted to field work. Brian's education and career experience has been in crop production and agronomy. That will allow him to make sound crop production decisions. A relationship with a local banker has already been established and Brian knows he can secure credit for an operating loan to purchase inputs needed to produce a crop on those additional acres. The loan would then be paid once the grain has been harvested and sold. Brian also has a good relationship with the landlord. Since Brian was considered a 'beginning farmer', the landlord was able to utilize tax credit benefits. The landlord was willing to work with Brian to establish a fair cash rent price they are both comfortable with and by signing a two-year contract, both have the option to revisit the lease agreement. This also creates a threat as another famer could offer the landlord a higher cash rent. The farm decision makers worked hard to create a positive relationship with the landlord and plan to do their part to see the positive relationship continue. Renting additional land for crop production allows risk to be spread out over more acres and there will still be an opportunity to pursue a livestock enterprise in the future which was attractive to the decision makers.

Although renting additional land for crop production would result in positive net returns, this was dependent on the commodity market which has recently exhibited volatile swings and fluctuations. The cost of inputs needed to raise corn and soybeans also affect profitability. Based on the projected production costs and income, this option would not fully replace Brian's income from his off-farm employment. The decision makers realize that Brian would need to balance his off-farm seed sales with fieldwork and crop management. Uncontrollable factors such as insects, weeds, disease, and weather impact crop yield. Lower yields result in less grain to sell which affects profitability.

2.1.2 SWOT Discussion: Chicken Layer House

The chicken layer house alternative that was analyzed would consist of taking care of hens that lay eggs. The eggs would then be taken to a hatchery where they would go as broilers or meat poultry.

A major benefit of the chicken layer house option was that the objective of replacing Brian's off farm income would be sufficient such that he would be able to farm full time. The site location that was considered would be the closest layer site to the hatchery in Spencer, Iowa or Jackson, Minnesota. This facility would be built by the farm decision makers and a contract with a company would be signed. The contract would be for 15 years and the agreement would be that the farm decision makers would provide the facility and labor. The company would provide the birds, feed, and veterinarian services. The company has been in production for several years and was expected to remain in production. In the event that the terms of the contract were not met, the farm decision makers could go into cage-free poultry production with the facility as a contingency plan. The fifteen year contract allows for income stability and any production that exceeds the goals set by the company results in an incentive bonus. The labor requirements would be intermittent throughout the day. The barn would need to be walked through in the morning to inspect the herd's health. Labor activities would consist of sorting and packaging the eggs to be put into a cooler room until they are picked up and taken to the hatchery. If Brian were to leave his full time off-farm job to be the main source of labor for the chicken layer house, there would be need to hire an additional individual to help in the fall and spring when Brian would be helping with planting and harvesting crops. Providing care for poultry would be relatively easy and support would be provided by the company and a network of established producers. As with any livestock, risk of disease was a concern. As part of the contact, the company expects no other chicken litter from other sites to be spread within a two-mile radius of the building site. This was a major concern for the farm decision makers as there were several fields farmed by neighbors who use chicken litter as fertilizer within a two-mile radius. This facility would require considerable line of credit to get established which could risk future approval of credit. If anything would happen to either owner before the house would be paid off, it could put the operation at risk. Life insurance would be one way to overcome that possible threat. Brian and his wife Britney pursued the poultry layer house. Credit for the $1.6 million facility was secured and a contact was signed. One week prior to starting construction, Brian and Britney received notice that the facility could not be built because a neighbor refused to honor the two mile radius range and was going to continue using chicken litter from other facilities as fertilizer. This was a biosecurity risk the company was not willing to take.

2.1.3 SWOT Discussion: Swine Facility

A swine facility would be a logical option as the farm decision makers all have experience with hogs and basic knowledge of production practices. By having an existing relationship with the bank loan officer who encouraged the decision makers to consider this option, they know credit would be available to financially support this alternative. Income could be generated by the hogs themselves and from their manure. This would meet the goal of diversifying income and signing a contract would ensure stability. Several swine companies were looking to expand and build facilities in the study area. With hog production, producers need to consider that the larger animals and may be hard on buildings. This option would require a $732,000 investment to build the facilities. Major repairs would need to happen frequently to provide a safe facility for the hogs and caretakers. Care could be done primarily by one person but more labor would be needed when loading and unloading hogs from the facility to the truck which could happen at any time of day or night. Disease outbreak and biosecurity would be a concern as there are several swine facilities in close proximity to the considered building site. Neighbor relations could be strained from the odor and perception of livestock grown in confinements.

2.3 Results and Decision from SWOT Analysis results

During fall harvest all family members eat supper together. One evening Britney shared the results and a discussion was had each candidate alternative. At supper the following evening, the candidate alternatives were ranked. The final ranking of alternatives based on the SWOT analyses results were: 1) rent an additional 375 acres of crop land, 2) addition of a livestock operation, either a hog facility or poultry layer house. A number of factors were considered when ranking these options. Identifying land for rent can be challenging. A neighbor chose Brian and Keith over other neighboring farmers by asking if they were interested in renting his land for crop production. As this option was discussed, the decision makers felt like this opportunity does not present itself very often and if declined, there may never be a second chance to cash rent this land for crop production. A major weakness of this option was that it did not fully meet the objective of replacing Brian's income.

A leading reason why a livestock enterprise was not attractive was because of the possibility of Brian purchasing acreage that would necessitate taking out a loan. The farm decision makers felt that taking out a substantially large loan to establish a livestock operation would increase their risk of obtaining credit in the future. Brian also did not want to build a facility until he knew if he was moving so he could build the facility somewhat near his permanent living location. Richard was considering moving off the acreage where the machinery storage and gain bin site are located. If Richard moves, Brian would then move to that location.

Based on the results of the SWOT analysis and choosing to pursue renting additional crop acres, the remainder of this thesis focuses on the remaining objectives:

1. Understand how adding additional rented land would affect crop mix and machinery resource requirements.
2. Understand if it would be feasible to change Brian's employment from off-farm to on-farm and how that decision will affect household income and joint utility.

CHAPTER III: WHOLE FARM IMPACT OF ACREAGE EXPANSION

After completing the SWOT analysis and ranking the candidate alternatives for farm expansion, it was determined that adding acreage for crop production to the existing farm were the best option for Rosburg Farms. The farm decision makers desired to know how whole-farm timeliness would be impacted by the addition of 375 acres with the same equipment. Decision makers also desired to understand how overall cash flow were changed and if that income were sufficient for Brian to leave his full time off-farm employment.

Linear programing (LP) methodology were chosen to evaluate how expanding farm acreage impacts whole farm timeliness and profitability. Cash flow financial statements were chosen to evaluate if Brian could feasibility leave his off-farm job.

To understand how adding more acres impacts the whole farm, existing farm equipment were inventoried and information on crop rotation, tillage systems, labor resources, timeframe of equipment use, and current farm size was collected. A list of proposed changes that may occur to the crop operation as a comparison to the current situation was identified. These parameters were inputted into the Purdue PC-LP Farm Plan program (Dobbins et al., 2006).

The farm operation income and production budgets were compared to the possible changes that could happen with additional acreage. Production budgets and cash flow tools were used for the financial analysis. Budget generating forms from Iowa State University's Ag Decision Maker Crop Production Costs Budgets for Corn following Soybeans and Herbicide Tolerant Soybeans following Corn (herbicide tolerant) (Johanns, 2017) and Estimated Costs of Crop Production in Iowa- 2017 (Plastina, 2017) were utilized. The cash flow statement was created using Iowa State University Ag Decision Maker's Cash Flow Budget (Leibold and Hofstrand, 2016).

3.1 Literature Review

Linear programming is a method to estimate an optimal solution to maximize an objective function (Dantzig, 1949).

Agricultural systems are vastly diverse. Schoemaker (1982) identified four purposes of systems model include: 1) description, 2) prediction, 3) post-diction, and 4) prescription. Models that characterize the system and allow users to evaluate performance are descriptive models. Predictive models are used for forecasting future behaviors of a system. Postdictive models use logical constraints to explain after the occurrence what system constraints or phenomena caused a specific result. A prescriptive model tells what a system should do to meet a goal. Models used for agricultural purposes can serve more than one of these four purposes (Schoemaker, 1982).

In the *Modeling of Agricultural Systems* paper, Swinton and Black (2009) identify various applications of modeling within an agriculture setting. Advances in computing allowed modelers to gain from the strengths of the models. The major strengths of mathematical models include 1) mimic system complexity and dynamics through detailed equations, 2) Mimic random processes, and 3) models can conduct these with precision and replicability. It was stated in the paper that farm managers who utilize good predictions of future outcomes that are likely to occur are able to make sound decisions. Modeling was a way to forecast future outcomes to analyze the results.

In the 2014 paper titled *Estimating whole farm costs of conducting on-farm research on Midwestern US corn and soybean farms: A linear programming approach*, Griffin et al. (2014) used a linear programming framework to estimate whole-farm costs of conducting field-scale on-farm trials. In their study, the objective function was to maximize whole-farm contribution margin or returns to land, machinery, and unpaid labor. While the article demonstrated how linear programming could be used to compare different scenarios, limitations of the model were also noted. Limitations included not considering any stochastic properties such as risk and that input parameters utilized exact values. This means that model results were only as good as the data utilized (Griffin et al., 2014).

Thomas Tice developed a LP and tested it for Northeast Kansas to select the most profitable size of machinery and combination of crops and tillage practices with land, labor available and fieldwork days as the constraints. Crops in his model included corn, grain sorghum, wheat, and soybeans. The results of his LP found that one man with a four bottom plow and average number of field workdays could farm approximately 700 acres. This was compared to using three bottom plow equipment and average number of field workdays which resulted in one farmer being able to farm 625 acres (Tice, 1973).

3.2 Methods and Data for Whole Farm Impact of Acreage Expansion

The methods used to analyze farm efficiency and timeliness of the operation are described in this section. Linear programing (LP) was utilized as a method to optimize an objective function. LP utilizes mathematics to solve an objective function. The objective function maximizes returns to fixed costs based on the constraints defined which includes unpaid labor, land and capital (Dantzig, 1949). LP was used to determine the optimal usage of crop acres, labor, machinery, and resources. A baseline LP model was created for the current farm operation then additional scenarios were evaluated against the baseline.

The key methods used when establishing the LP model included determining parameters, gathering data, identifying any constraints, creating the baseline then determining what changes need to be made for the additional scenarios.

Production budgets and a cash flow statement were used to determine if this expansion was profitable. The production budgets and cash flow statement were calculated for the 2017 crop year. The production budgets include expected costs and projected income from crop sales. These budgets allowed the farm decision makers to calculate projected income or loss to determine if it was financially feasible to rent the additional crop acres. The cash flow statement identifies time periods for cash inflow and outflow for the whole farm. Results of the cash flow statement determine if there was adequate working capital in the operation or if credit is needed to cover expenses until the crop would be sold (Leibold and Hofstrand, 2016).

3.3 LP Base Model for Whole Farm

The linear program model can be written using standard summation notation as written in Boehlje and Eidman (1982, p. 404-405) as:

Equation $(1) Max \prod \quad = \sum_{j=1}^{n} C_j X_j$

Subject to:

Equation (2) $\sum_{j=1}^{n} a_{ij} X_j \leq b_{i\ for\ i=1\ldots m}$

Equation (3)$X_j \geq 0\ for\ j = 1 \ldots n$

where:

X_i= the level of the jth production process or activity,

C_j= the per unit return to the unpaid resources (bj's) for the jth activity,

a_{ji} = the amount of the ith resource required per unit of the jth activity,

b_i = the amount of the ith resource available

The objective function (equation 1) maximizes the per unit net returns (c_j) from all activities (X_i). The second equation defines the constraints on the units of each activity in the optimal solution. The *j* activities include production of the crops grown. The *i* resources include: (1) labor available as expressed in combination of number of individuals, hours per day, and number of days suitable for fieldwork per period, (2) land available for crop production and (3) availability of machinery including the inventory of types of machinery, hours per day the machine available, and working rates expressed in acres per hour for each crop production task. The remaining variables are the production process, activity resource requirements, and resource availability constraints. The crop growing season was divided into 20 time periods constraints with the most active planting and harvesting time being in one week periods and other periods were longer. Labor constraints were divided into unpaid and hourly wage earners. Equation 3 prevents negative results. (Griffin and Lowenberg-DeBoer n.d.).

3.4 Constraints for Baseline LP Model

The baseline LP model was defined with information collected from the current farm operation. Days suitable for fieldwork (DSFW) are useful for farmers in many ways. The leading farm management implication of DSFW includes making decisions related to how many acres can be planted and/or harvested given the machinery resources available. Likewise, DSFW are also used when choosing machinery and making acreage allocation decisions. In order to optimize yields, producers desire to conduct fieldwork in a timely manner while being efficient with machinery and labor resources (Griffin and Barnes, 2017).

To ensure likelihood of completing fieldwork in a timely manner, larger machinery could be necessary during planting or harvest times being affected by adverse weather. Not finishing fieldwork in a timely manner could lead to decreased yield production, i.e. yield penalties. Equipment sizing decisions must consider DSFW and labor availability. (Williams and Llewelyn, 2013). Mensing analyzed DSFW in *Farm Management Implications of Uncertanity in Days Suitable for Fieldwork* (2017). Mensing noted that farm management implications were evaluated in relations to DSFW espically machinery utilization. Producers wanting to maxamize profits must manage machinery resources so they are not over-equipt buy have adequate capacity to plant and harvest all acres within available DSFW.

Days suitable for fieldwork was collected from Iowa State University based on USDA NASS data gathered by ISU retired economist William Edwards. Days suitable for fieldwork used are listed in Table 3.1. Using the Purdue PC-LP Farm Plan as a guideline, good fieldwork days per period were calculated at the 30th percentile (Doster et al, 2006). The number of workdays that laborers were available per week ranged from 6 to 7. During the busy fieldwork times, unpaid laborers worked 7 days per week compared to the 6 days per week that they worked during non-bottlenecked time periods which allows a day of rest.

Table 3.1: Days Suitable for Fieldwork in Northwest Iowa

Time period	Period length (weeks)	Good field days per period	Labor days per week
December 6-April 21	19 ½	9.3	7
April 22- April 25	½	1.3	7
April 26-May 2	1	3.1	7
May 3-May 9	1	3.2	7
May 10-May 16	1	3.3	7
May 17-May 23	1	3.9	7
May 24-May 30	1	3.8	7
May 31-June 6	1	3.6	7
June 7-June 13	1	4.3	7
June 14-June 20	1	4.5	6
June 21-June 27	1	4.4	6
June 28-July 4	1	4.5	6
July 5-July 11	1	4.7	6
July 12-August 29	7	30.5	6
August 30-September 19	3	14.6	6
Sept. 20- Sept. 26	1	4.4	7
September 27-October10	2	89.3	7
October 11- October 31	3	14.1	7
November 1-November 14	2	8.1	6
November 15- Dec. 5	3	9.9	6

Labor resources for the 1,243 cropping acres include two individuals at permanent status who can work 12 hour days (Table 3.2). There were no temporary or paid employees in the baseline model. Drying and storing resources include a dryer that can be ran for 20 hours per day and can remove 750 points of moisture per hour. The bushel capacity for corn and soybeans was 81,500 for on-farm storage.

Table 3.2: Land and Labor Resource Constraints

Constraints	Model 1: Baseline
Land constraints	
Cropland (acres)	1,243
Labor Resources	
Permanent labor (people)	2
Hours per day worked	12
Drying Resources	
Hours the dryer runs per day	20
Dryer capacity in points removed from 250 bushels	750
Bushel capacity of storage	81,500

Machinery resources include two big tractors and one small tractor. All three tractors were available to operate up to 10 hours per day (Table 3.3).

Table 3.3: Machinery Resources: Tractor Sizes, Numbers, and Time Available

Tractor name	No. of tractors	Horsepower	Total hours per day
Big Tractors	2	285-425	10
Small Tractors	1	125	10

The machinery operation requires 1 labor hour per 1 machine hour with the exception of the sprayer and harvesting equipment (Table 3.4). The sprayer requires one person to operate the tractor and sprayer in the field and one additional person to haul water to the sprayer. During harvest, labor was needed to operate the combine, the tractor with the grain cart, and tractor trailer to transport the grain. Therefore, for each hour of combine operation, two more labor hours are needed to operate the grain cart and tractor trailer resulting in 3 labor hours per combine machine hour.

Table 3.4: Machinery Resources: Machinery and Labor Hours

Machinery Name	No. of machines	Total hours per day	Tractor required	Tractor hrs. per machine per hour	Labor hrs. per machine per hour
Chisel	2	10	Big Tractor	1	1
Disc	1	10	Big Tractor	1	1
Field Cultivator	1	10	Big Tractor	1	1
Sprayer	1	10	Small Tractor	1	1.2
Cultivator	1	10	Small Tractor	1	1
Combine	1	10	Big Tractor	1	3

The two crop rotations were corn preceded by soybean with the minimum acres set at 621.5 and a three-year rotation of corn preceded by soybean, corn preceded by corn, and soybean preceded by corn with the minimum acres of corn preceded by corn set at 16.7. All soybeans were "planter soybeans" meaning that they were planted using the row crop planter (30 inch row spacing) rather than a grain drill.

The farm decision makers identified machinery operations for land preparation, planting, post-planting and harvesting phases of production. For all phases of production, machinery utilization was identified, the working rate in acres per hour for each type of machinery was calculated, and the number of persons needed to operate each machine were specified. For post-planting activities, the number of weeks after planting was assigned. For example, spraying occurs three weeks after planting. Beginning and ending time periods were also defined for each field operation. For example, land preparation with the field cultivator was defined to begin in the December 6-April 21 time frame and end in the time period May 3- May 9. Corn could not be planted until each land preparation activity was completed. Field operations with machinery are listed for each production phase in tables 3.5, 3.6 and 3.7 for each crop rotation used in the farm operation.

Table 3.5 Corn Following Corn Field Operations

Production phase	Machinery type	Beginning period	Ending period	Working rate: acres per hour	Labor required
Land Preparation	Field Cultivator	Dec. 6-April 21	May 3-May 9	30	1
Planting	Planter	April 22-April 25	May 31-June 6	12	1
Post-Plant	Sprayer	3 weeks after planting	1 week to complete	50	1.2
Harvest	Combine	Sept. 20-Sept. 26	Nov. 15- Dec. 5	10	3

Table 3.6: Corn Preceded by Soybeans Field Operations

Production phase	Machinery type	Beginning period	Ending period	Working rate: acres per hour	Labor required
Land Preparation	Field Cultivator	Dec. 6- April 21	May 3- May 9	30	1
Planting	Planter	April 22-April 25	May 31- June 6	12	1
Post-Plant	Sprayer	3 weeks after planting	1 week to complete	50	1.2
Harvest	Combine	Sept 20- Sept. 26	Nov. 15- Dec. 5	12	3

Table 3.7: Soybeans preceded by corn, planted with the corn planter field operations

Production phase	Machinery type	Beginning period	Ending period	Working rate: acres per hour	Labor required
Land Preparation	Chisel	Oct. 11- Oct. 31	Nov. 15- Dec. 5	8	1
Land Preparation	Field Cultivator	May 3- May 9	May 31-June 6	30	1
Planting	Planter	April 26-May 2	June 7- June 13	12	1
Post-Plant	Sprayer	3 weeks after planting	1 week to complete	50	1.2
Harvest	Combine	Sept 20- Sept. 26	Nov. 15- Dec. 5	12	3

Expected yields when planted and harvested in the best time period were assigned based on the five year yield average. For the acres planted in the soybeans preceded by corn rotation, the best yield was set at 55 bushels per acre. The expected yield for corn following soybeans were assigned a per bushel yield of 200. The best yield for the continuous corn acreage was set at 180 bushels per acre. This yield takes into consideration a yield penalty that can be expected for a second-year corn crop which was a 10% reduction from the expected 200 bushel per acre yield.

3.5 Baseline Farm Operation Results-LP

Utilizing Purdue Crop/Livestock Linear Programming (PCLP) the base farm was defined. Constraints included land acres amiable for crop production, machinery resources, labor resources, and days suitable for fieldwork.

Based on the constraints defined, the total contribution margin in the baseline LP model was $504,211 which does not factor in the opportunity cost of land, unpaid labor or management, or machinery expenses. To optimize crop production, the acreage allocation from optimal solution matched the expected crop acreage. Land as a resource was completely utilized and a shadow value of $396.14 per acre was calculated. This means that if the farm could obtain one more acre of land, revenue would increase by the shadow value of $396.14. The machinery resources that were identified by the model as limited were the planter and dryer. The planter had a shadow value of $117.61 per hour in the April 26-May 2 time period and $6.22 per hour in the May 10-May 16 time period. The dryer had a $.01 ($/point) marginal value in the September 27-October 10 time periods and a $.02 marginal value during October 11- October 31. Even though these resources were fully utilized and have a shadow value, they is still capacity remaining. The shadow values were not enough to result in recommending updating the equipment or investing in additional drying facilities. If a shadow price was above the market price, the operation could afford to pay for the land or machinery. In the case that the shadow price was lower than the market value, the decision maker would want to count the number of time periods with a non-zero shadow value. Three or four time periods with a shadow value indicates that the farm was not timely with respect to the specific field operation. Given the estimated shadow values, the baseline operation was considered timely with crops being planted and harvested during acceptable time periods based on the chosen days suitable for fieldwork parameters. As seen in Appendix G, there are multiple time periods with excess hours. Based on the results, there are some time periods when machinery resources were not fully utilized.

3.6 LP Modifications and Results

To understand the effects of adding additional crop acres a second LP model was run with additional rental acres. All other constraints were kept the same as the baseline, the only change was increasing land for crop production from 1,243 to 1,618 acres.

The results of this modified LP with additional rented land indicated that land was able to be fully utilized and has a shadow value of $387.59. This was an $8.55 decrease from the baseline value of $396.14.This shadow value was the price amount at which the revenue would increase for each additional acre added. The planter was the limiting machinery resource identified. In the April 26-May 2 time period, the planter had an increased shadow value of $322.67 per hour which was an increase of $205.06 from the baseline value. The LP calculated a $205.06 per hour in shadow value the May 3-May 9 time period which was an increase from no shadow value in the baseline. The May 10-May 16 shadow value of $6.22 was constant in the baseline and modified scenario. Although the planter was a limiting resource, the LP results do not justify a larger or additional planter for the expanded farm acreage. The dryer was again identified as a limiting resource as well but had the same results as the baseline which was a shadow cost of $.01 in the Sept 27- Oct. 10 time period and $.02 shadow cost in the Oct. 11- Oct 31 time period.

Comparing the baseline LP labor results to the modified LP labor results, the major differences was that full-time labor was utilized earlier in the spring and required more hours to conduct all field operations needed to produce the crops. Machinery resources are listed in the Appendix. Available hours for each machine were calculated based on field activities that occur in the specified time period, labor availability, and days suitable for fieldwork.

Crop activities by period calculated fieldwork activities in a given time period based on the equipment constraints defined. It was suggested to start fieldwork on the acres that have the highest yield potential.

Table 3.8: Crop Activities by Period: Calendar of Events

Time Period	Available hours	Used hours	Remaining hours
December 6-April 21	93	0	93
April 22- April 25	13	0	13
April 26-May 2	31	0	31
May 3-May 9	32	0	32
May 10-May 16	33	0	33
May 17-May 23	39	7	32
May 24-May 30	38	5	33
May 31-June 6	36	8	28
June 7-June 13	43	4	38.66
June 14-June 20	39	0	39
June 21-June 27	38	0	38
June 28-July 4	39	0	39
July 5-July 11	40	0	40
July 12-August 29	261	0	261
August 30-September 19	125	0	125
Sept. 20- Sept. 26	4	0	44
September 27-October10	93	0	93
October 11- October 31	141	0	141
November 1-November 14	69	0	69
November 15- Dec. 5	85	0	85

The farm operation was considered timely and efficient with the baseline constraints of labor, machinery, crop rotation, and land for crop production that was defined. In the modified LP scenario with additional land for crop production, the results indicated that all land was planted and harvested with the same labor and machinery resources defined in the baseline model. If labor or machinery ever decreased, this would impact the timeliness, yield, and income from the crop production.

3.7 Crop Production Costs

An enterprise budget was created for soybean and corn production based on Iowa State University's Ag Decision Maker Crop Production Cost Budgets (Plastina 2017). To determine machinery costs, custom rates from Iowa State University's Ag Decision Maker, Custom Rate Survey was used to determine the opportunity cost. An opportunity cost is a benefit that could have been received but was given up to take another course of action (Hofstrand, 2008). For example, the machinery could be used for custom farming but was used for field work on Rosburg Farms. These budgets are reflective of estimates for the 2017 planting year and differ from the results of the LP which were 5- year projected average.

The Herbicide Tolerant Soybean following Corn Cost Production budget was generated on 613 acres with an anticipated yield of 55 bushels per acre and compared to the scenario of additional 801 crop acres allocated to soybean production. The planter expense included additional costs for variable rate seeding. At Rosburg Farms, operators do one application of herbicide using the sprayer and a local cooperative applied the second application. Interest was calculated at 4.8% for 12 months on the operating note. The operating note was used to purchase inputs and was paid in the fall after harvest was completed and the crop was sold. The combine cost was calculated based on the complete custom rate per acre which included the machinery, labor and fuel cost for the combine, grain cart and hauling to farm storage, plus an additional cost for GPS mapping. Handling refers to the auger being used to move the grain into the dryer or storage bins. The total cost for modified acres represents the LP scenario of adding additional rented acres for crop production which was 801 acres of soybeans.

Table 3.9: Production Cost of Soybeans following Corn

	Cost per acre	Total cost for Baseline 613 acres	Total cost for Modified Scenario 801 acres
Tillage and Planting Machinery			
Tillage	$17.80	$10,911.40	$14,258
Field Cultivate	$14.05	$8,612.65	$11,254
Planter	$21.25	$13,026.25	$17,021
Spray	$6.00	$3,678.00	$4,806
Custom Application: Fertilizer	$6.00	$3,678.00	$4,806
Total Machinery Cost	$65.10	$39,906.30	$52,145.10
Seed, Chemicals, etc.			
Seed	$53.00	$32,489	$42,453
Phosphate	$8.80	$5,394	$7,049
Potash	$10.50	$6,437	$8,411
Herbicide	$32.20	$19,739	$25,792
Crop Insurance	$8.00	$4,904	$6,408
Miscellaneous	$10.00	$6,130	$8,010
Interest	$9.00	$5,517	$7,209
Total input cost	$131.50	$80,609.50	$105,331.50
Harvest Machinery			
Combine	$48.85	$29,945	$39,128.85
Handling grain by auger price per bushel	$3.36	$2,732	$3,568.00
Total Harvest Machinery Cost	$52.21	$32,677.05	$42,696.85
Land			
Cash rent equivalent	$225	$137,970	$180,225
Total All Costs	**$473.81**	**$291,162.85**	**$380,398.45**

The total cost per acre to produce soybean was $473.81. The cash rent equivalent of $225 was used based on the average from the 2016 Iowa State University Extension's Cash Rent survey for the study area's county (Plastina et al., 2016).

The corn cost of production budget was generated on 613 acres with an anticipated yield of 200 bushels per acre. The results were compared to the scenario of 817 acres allocated to corn production from the additional crop land rental. When the machinery cost was calculated, an additional cost for variable rate seeding was included with the planter cost. Similar to the soybean budget, the sprayer was used for one application of fertilizer and the local cooperative was hired to apply the second application. Interest was 4.8% for a 12-month operating note. The combine cost was calculated based on the complete custom rate per acre which included the machinery, labor and fuel cost for the combine, grain cart and hauling to farm storage, plus an additional cost for GPS yield mapping. The cost for the auger was included in the handling expense. The total cost for modified acres represents the LP scenario of adding additional acres for crop production. This resulted in 817 acres being planted for corn production.

Table 3.10: Production Cost Budget Corn following Soybeans

	Cost per acre	Total cost for Baseline 630 acres	Total cost Modified Scenario 817 acres
Tillage and Planting Machinery			
Field Cultivate	$14.05	$8,852	$11,479
Planter	$24.40	$15,372	$19,935
Spray	$6.00	$3,780	$4,902
Custom Application: Fertilizer	$6.00	$3,780	$4,902
Total Machinery Cost	$50.45	$31,783	$41,218
Seed, Chemicals, etc.			
Seed	$106.42	$67,045	$86,945
Nitrogen	$60.00	$37,800	$49,020
Phosphate	$38.50	$24,255	$31,455
Potash	$21.00	$13,230	$17,157
Herbicide	$38.10	$24,003	$31,128
Crop Insurance	$12.20	$7,686	$9,967
Miscellaneous	$10.00	$6,300	$8,170
Interest	$16.16	$10,181	$13,203
Total input cost	$302.38	$190,499	$247,044
Harvest Machinery			
Combine	$37.20	$23,436	$30,392
Drying price per bushel	$36.40	$22,932	$29,738
Handling grain by auger price per bushel	$6.78	$4,271	$5,539
Total Harvest Machinery Cost	$80.38	$50,639	$65,669
Land			
Cash rent equivalent	$225	$137,970	$183,825
Total All Costs	**$658.21**	**$410,891**	**$537,756**

The cost per acre for corn production was $658.21. This was calculated using custom hire rates for the machinery which includes labor, maintenance and fuel.

Table 3.11: Projected Net Returns for Corn and Soybean Production

	Corn	Soybean
Baseline		
Acres	630	613
Expected Selling Price/ Bushel	$ 3.64	$ 9.80
Baseline Model		
Total Returns	$458,640	$ 330,515.00
Total Costs	$410,891.90	$ 291,162.85
Baseline Model Net Returns	**$ 47,748.10**	**$ 39,352.15**
Acres	817	801
Modified Scenario		
Total Returns	$ 594,776.00	$ 431,739.00
Total Costs	$537,756.51	$ 380,398.45
Modified Scenario Net Returns	**$ 57,019.49**	**$ 51,340.55**

Net returns for corn production were calculated based on the fall 2017 price at the study area's local cooperative's price of $3.64 and 200 bushel per acre yield. This resulted in a $47,748 return at the baseline acres of 630 and a $57,019.49 return in the modified scenario of additional rented acres for crop production.

The soybean net returns were calculated based on a 55 bushel per acre yield and a $9.80 Fall 2017 price at the same cooperative. Returns for the soybean crop was $39,352.15 for the baseline 613 acres. In the modified scenario of acres planted for soybean production there was a return of $51,340.55.

3.8 Projected Cash Flow Statement

A cash flow statement lists the flow of cash coming into an operation as income and cash leaving the operation as expenses. A cash flow not only shows the amount of the cash flowing but also the timing as it was constructed with multiple time periods. An example would be showing a monthly listing of cash inflows and outflows over a year. This projects the cash balance remaining at the end of a year and the monthly cash balance (Leibold and Hofstrand, 2016). Working capital was an important component of the cash flow analysis. Working capital is defined as the amount of money needed to operate business transactions. Creating a cash flow allows the farm decision maker to project sources of income and cash deficit time periods. By knowing cash deficit time periods, operators can alter the time when transactions are made or borrow money if needed. If there was a need to borrow money, a cash flow statement can help determine the amount.

An estimated cash flow was created for the farm scenario with additional crop acres rented. Income for the farm comes from sales of corn and soybeans that were produced the previous fall. Insurance payments and farm payments were not included in the cash flow as that varies year to year and was not guaranteed. Income was based on the projected net incomes that was calculated based on 200 bushels per acre yield on corn and 55 bushel per acre yield on soybeans. Machinery expenses were calculated from the ISU Custom Rates. Rent payments vary between contracts and different landlords; however, the average of $225 per acre was used for the purpose of this project. Family living expenses also need to be considered. Based on a family size of 4, the estimated annual living expenses was $135,653 (Kraph et al., 2016). This was the family living expense considered for Brian and his family that includes Britney and two children, Briley and Brice. The farm income was based on the high third of families surveyed and includes medical expenses, insurance, and expendables. Family living expenses were also taken out for Keith and his wife Nancy and Richard and his wife, Betty. For a family of two, the estimated annual living expense $84,779 was assumed (Kraph et al, 2016). Storage costs for the grain was calculated by taking the storage capacity available per bushel minus the amount of grain produced. This was the amount of grain that would need to be sold in the fall or stored off farm. An average of 4 cents per bushel per month was used for the off-farm storage rate. One-third of storage expenses were paid up front in November and the remainder was calculated out and expensed in the months the crops were sold. An expense for on-farm storage and drying costs were calculated and included in the cash flow. This expense reflected fuel and utilities needed to dry grain that was stored on the farm. Crop insurance was figured as an expense of $2.86 per acre for corn and $3.59 per acre for soybeans. These rates were based on a quote from a crop insurance agent in the study area. A simple breakeven analyses was conducted to determine what price corn would need to be at to justify Brian leaving his off farm employment. Based on the breakeven analyses, corn would need to be $4.12 to create a breakeven justifying Brian leaving his off-farm employment. The farm decision makers understand this price is a goal to reach but there are many other factors that would need to be considered, such as input prices changed and that the decision cannot be made based solely on the price of corn.

Even though there were some time periods with negative net cash flow, the cumulative net cash flow shows adequate income related to expenses for the farm operation. The author makes the conclusion that this farm was profitable. Carryover from previous time periods were not considered and would show more cash available throughout the year. The cumulative net cash flow was positive in all time periods meaning there was adequate income in the year to cover the projected expenses.

3.9 Full Farm Employment and Off-farm Income

Making the decision to leave off-farm employment to farm full time was not an easy or simple decision for beginning farmers. Many factors must be considered when making this decision. Factors include household composition and the participation patterns of other family members. Time and money costs that are imposed by different household members can affect the household consumption.

In the *Demographic Composition of Farm Households and Its Effect on Time Allocation,* Kimhi (1996) estimated a joint labor participation model of farm operators and spouse, where participant's decisions are conditioned on household consumption. Kimhi hypothesized that time costs imposed on the household by small children are larger than the monetary costs. They estimated a multivariate probit model with fixed effects using quasi maximum likelihood methods. In their study, dependents such as small children and elderly generally impose a cost on the household in terms of consumption goods and in the amount of time used for house work. They found that time allocation of the primary farmer and spouse was affected by other members of the household. In this case study, Britney, Brian's wife was employed full time as the Program Director for ISU Extension and Outreach in the county they reside in. Together, Brian and Britney have children, Briley (3 years old) and Brice (6 months old). In Kimhi's study, results indicate in a family with children up to three years of age, one spouse tends to focus on housework and the other tends to work more off the farm and less on the farm. This allowed one spouse to specialize in home production and the other to engage in income-generating activities. Families with older children see their home time decreasing so the spouse that previously focused on housework can now be utilized on the farm and the other can work outside the household. Older children who contribute farm labor are seen as a complement to the couple's farm work (Kimhi, 1996).

Considerations need to be made on quality-of-life changes that may occur as a result of working off the farm versus on the farm (McCoy and Filson, 1996). Off farm work was a way to provide a “safety net” or was used as a “survival mechanism’ for some farm families. Quality of life can be defined as satisfaction and happiness (Wilkening, 1981). The influence of farm work on the quality of life varies based on the lifestyle but its burdens are perceived to fall heaviest on female farmers, especially those with young children. A large segment of the farm population has added farming to an existing career rather than supplementing farming with off-farm income (Bartlett, 1986). Coughler (1992) found that majority of farmers in Ontario, Canada and New York use off farm income to supplement the family farm income or to increase their household income. Farmers who work off the farm have less satisfaction in their quality of time spent with spouse, children and other family and friends. After working off the farm and on the farm, they have less time available. This results in the perception of their quality of life being negatively affected. There was also a feeling of independence for farmers as they are their own boss. This sense of control was another factor that affects a farmer’s quality of life (McCoy and Filson 1996). These labor versus leisure considerations need to be included when making the decision if Brian should leave his off-farm employment to farm full time.

CHAPTER IV: CONCLUSION

Qualitative and quantitative analysis were conducted to ascertain the feasibility of adding a family member as a full-time farmer. The SWOT analysis allowed for a ranking of candidate alternatives being considered for Rosburg Farms. The farm decision makers chose to rent additional land for crop production as the most attractive candidate option. This option was evaluated by a whole farm LP model. The results of the modified LP indicated that the operation could be able to accommodate additional acres with the labor, machinery, and days suitable for field work as defined in the constraints of the LP. Three time periods were identified where the planter was a limited resource in the spring and the dryer was a limiting resource in the fall. If the crop operation would add more acres in the future, improving planting capacity may be necessary to ensure all acres are planted in a timely manner to ensure a crop was produced and allowed time to reach its potential yield. The drying system was also identified as having a shadow value in three time periods. Operators may consider taking crops to a local cooperative or elevator to be dried off the farm. Doing this comes at a cost which needs to be considered when making this decision. Considering the cost of production, it was important to the farm decision makers to have a marketing plan to ensure that adequate income was received to cover the expenses of producing the crops. Even though the cash flow statement identified time periods with negative net cash flow, the cumulative cash flow was positive. This indicates there was adequate income to offset operational expenses, living expenses and cash carried over into the next time periods to be reinvested in the farm operations. The ending cumulative net cash flow was $21,000 which could be sensitive to crop yield and sales price. Yield and prices used in this project may be considered high so this number could vary and the argument could be made that that carryover was needed to reinvest in the operation. Based on a breakeven calculation, Brian could justify leaving his off-farm employment if corn reaches $4.12 per bushel.

When considering if it would be reasonable for Brian to leave his full-time job, the conclusion made by the author was that it was not yet feasible. If the farm operation continued to add additional land, machinery upgrades will need to be made. By keeping his full-time job, additional income could then be allocated toward a new planter. As Richard continues to consider retirement and moving, there may be an opportunity for Brian to purchase his acreage which was hub of the farm operation and was the location for the grain bins and machinery storage. Future studies could identify how many more acres of land would be needed in order to justify Brian leaving his off-farm job.

REFERENCES

Bartlett, P.E. 1986. "Part time farming: Saving the farm or saving the life-style." *Rural Sociology* 51 (3): 289-313.

Boehlje, M. D., and V.R. Eidman. 1984. "Farm Management." New York: Wiley.

Dantzig, G.B. n.d. "Programming interdependent activities, II mathematical model." *Econometrica* 17:200-211.

Dantzig, G.B. 1949. "Programming interdependent activities, II, mathematical model." *Econometrica* 200-211.

Dobbins, C.L., D.H. Doster, G.F. Patrick, W.A. Miller, and P.V. Preckel. 2006. *Purdue PC-LP Farm Plan B-21 Crop Input Form.* Purdue University.

Griffin, and Barnes. 2017. "Available Time to Plant and Harvest Cotton across the Cotton Belt." *Journal of Cotton Science.*

Griffin, T. W., C. L. Dobbins, J. M. Lowenberg-Deboer, and T B. Mark. 2014. "Estimating whoe farm costs of conducting on-farm research on midwetern US corn and soybean farms: A linear programming approach." *International Journal of Agricultural Management* 21-27.

Griffin, T., and Lowenberg-DeBoer. n.d. "Impact of Automated Guidance for Mechanical Control of Herbicide Resistant Weeds in Corn."

Hart, C. 2017. "2017 Presentation." *Iowa State University Extension and Outreach.* Iowa State University. February. Accessed February 4, 2017. http://www2.econ.iastate.edu/faculty/hart/presentations2017.html.

Hart, C., and L. Schulz. 2016. "Iowa Farm Outlook." *Iowa State University Extension and Outreach.* Iowa State University. December. Accessed February 4, 2017. http://www2.econ.iastate.edu/ifo/files/ifo2016/ifo120116.pdf.

Hauger, M. 2014. "Net Income, Risk and Business Plan for Hauger Farm." Master of Agricultural Business Thesis. Accessed January 2017.

Helms, M. M., and J. Nixon. n.d. "Exploring SWOT analysis-where are we now? A review of academic research from the last decade." *Journal of Strategy and Management Vol. 3* 215-251.

Hill, S. D. 2012. "SWOT Analysis." *Encyclopedia of Management* 977-980.

Hofstrand, D. 2008. *Iowa State Univeristy Extension and Outreach Ag Decision Maker.* Iowa State University. May. Accessed February 13, 2017. https://www.extension.iastate.edu/agdm/wholefarm/html/c5-210.html.

Johanns, A. 2017. "Ag Decision Maker Crop Decision Tools." *Iowa State University Extensio and Outreach.* Iowa State University. Accessed February 4, 2017. https://www.extension.iastate.edu/agdm/decisionaidscd.html.

Kimhi, A. 1996. "Demographic Composition of Farm Households and its Effect on Time Allocation." *Journal of Population Economics* 9 (4): 429-439. Accessed January 2017. https://link.springer.com/article/10.1007/BF00573074.

Kraph, B. M., D. Raab, and B. L. Zwilling. 2016. "Farm and Family Living Income and Expenditures." *FarmDoc.* Department of Agriculture and Consumer Economics. October 2016. Accessed February 19, 2017. http://www.farmdoc.illinois.edu/manage/enterprise_cost/FBM-0190familyliving.pdf.

Leibold, K., and D. Hofstrand. 2016. "Understanding Cash Flow." *Iowa State University Ag Decision Maker.* Iowa State University. November. Accessed February 20, 2017. https://www.extension.iastate.edu/agdm/wholefarm/html/c3-14.html.

McCoy, M., and G. Filson. 1996. "Working off the Farm: Impacts on Quality of Life." *Social Indicators Research Vol. 37 No 2* 37 (2): 149-163. Accessed February 20, 2017. https://link.springer.com/article/10.1007/BF00315526.

Mensing, M. 2017. "Farm Management Implications of Uncertanity in Days Suitable for Fieldwork." Master of Agricultural Business Thesis. Accessed February 2017.

Plastina, A. 2017. "Estimated Cost of Crop Production in Iowa." Department of Economics, Iowa State University. Accessed February 11, 2017. https://www.extension.iastate.edu/agdm/crops/html/a1-20.html.

Plastina, A., A. Johnanns, and C. Welter. 2016. "Cash Rental Rates for Iowa 2016." Survey, Department of Economics, Iowa State University. Accessed February 11, 2017. http://www.extension.iastate.edu/agdm/wholefarm/pdf/c2-10.pdf.

Schoemaker, P.J.H. 1982. "The Expected Utility Model: Its Varians, Purposes, Evidence and Limitations." *Journal of Economic Literature* 20 (2): 529-563. Accessed January http://www.econ.yale.edu/~nordhaus/homepage/documents/Schoemaker_EU_JEL.pdf, 2017.

Swinton, S. M., and J. R. Black. 2000. *Modeling of Agricultural Systems.* Staff Paper, Department of Agricultural Economics, East Lansing: Michigan State University . Accessed 2017.

Tice, T. F. 1973. "Farm Machinery Selection: A Linear Programming Model." Masters of Agricultural Business Thesis, Kansas State University. Accessed 2017.

Wilkening, E.A. 1981. "Farm Families and Family Farming." In *The Family in Rural Society*, by R. T. Coward and W. M. Smith, Jr., 27-37. Accessed 2017 January.

Williams, J., and R. Llewelyn. 2013. "Days Suitable for Field Work in Kansas by Crop Reporting Regions." Department of Agricultural Economics, Kansas State Research and Extension. Accessed 2016. https://www.agmanager.info/sites/default/files/FieldWorkdays_Kansas.pdf.

APPENDIX A

Time Period	Available hours	Baseline LP Used hours	Baseline LP Remaining hours	Modified LP Used hours	Modified LP Remaining hours	Difference in hours used (Modified-Baseline)	Difference in hours remaining (Modified-Baseline)
Dec. 6-Apr. 21	93	0	93	0	93	0	0
Apr. 22- Apr. 25	13	0	13	0	13	0	0
Apr. 26-May 2	31	0	31	0	31	0	0
May 3-May 9	32	0	32	0	32	0	0
May 10-May 16	33	0	33	1	32	1	-1
May 17-May 23	39	7	32	7	32	0	0
May 24-May 30	38	5	33	8	30	3	-3
May 31-June 6	36	8	28	8	28	0	0
June 7-June 13	43	4	38.66	8	35	4	-3.66
June 14-June 20	39	0	39	0	39	0	0
June 21-June 27	38	0	38	0	37	0	-1
June 28-July 4	39	0	39	0	39	0	0
July 5-July 11	40	0	40	0	40	0	0
July 12-Aug. 29	261	0	261	0	261	0	0
Aug. 30-Sept. 19	125	0	125	0	125	0	0
Sept. 20- Sept. 26	44	0	44	0	44	0	0
Sept. 27-Oct.10	93	0	93	0	93	0	0
Oct. 11- Oct. 31	141	0	141	0	141	0	0
Nov. 1-Nov. 14	69	0	69	0	69	0	0
Nov.15- Dec. 5	85	0	85	0	85	0	0

APPENDIX B

Small Tractor Time Availability and Utilization

Time Period	Available hours	Baseline LP Used hours	Baseline LP Remaining hours	Modified LP Used hours	Modified LP Remaining hours	Difference in hours used (Modified-Baseline)	Difference in hours remaining (Modified-Baseline)
Dec. 6-Apr. 21	93	0	93	0	93	0	0
Apr. 22- Apr. 25	13	0	13	0	13	0	0
Apr. 26-May 2	31	0	31	0	31	0	0
May 3-May 9	32	0	32	0	32	0	0
May 10-May 16	33	0	33	1	32	1	-1
May 17-May 23	39	7	32	7	32	0	0
May 24-May 30	38	5	33	8	30	3	-3
May 31-June 6	36	8	28	8	28	0	0
June 7-June 13	43	4	38.66	8	35	4	-3.66
June 14-June 20	39	0	39	0	39	0	0
June 21-June 27	38	0	38	0	37	0	-1
June 28-July 4	39	0	39	0	39	0	0
July 5-July 11	40	0	40	0	40	0	0
July 12-Aug. 29	261	0	261	0	261	0	0
Aug. 30-Sept. 19	125	0	125	0	125	0	0
Sept. 20- Sept. 26	44	0	44	0	44	0	0
Sept. 27-Oct.10	93	0	93	0	93	0	0
Oct. 11- Oct. 31	141	0	141	0	141	0	0
Nov. 1-Nov. 14	69	0	69	0	69	0	0
Nov.15- Dec. 5	85	0	85	0	85	0	0

APPENDIX C

Processor Capacity and Utilization: Dryer

Time Period	Available hours	Baseline LP Used hours	Baseline LP Remaining hours	Modified LP Used hours	Modified LP Remaining Hours	Difference in hours used (Modified-Baseline)	Difference in hours remaining (Modified-Baseline)
Sept. 20- Sept. 26	1050	0	1050	0	1050	0	0
Sept. 27-Oct.10	2100	2100	0	2100	0	0	0
Oct. 11- Oct. 31	3150	3150	0	3150	0	0	0
Nov. 1-Nov. 14	1800	1800	0	1800	0	0	0
Nov. 15- Dec. 5	2700	0	2700	0	2700	0	0

APPENDIX D

Cash Flow Statement with Additional Acres for Crop Production

CASH INFLOWS	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total All Periods**
Cash from Corn sold	$99,129		$99,129	$99,129						$148,694	$148,694		$594,776
Farm Payments													$0
Crop Insurance Payments			.										$0
Cash from Soybeans Sold	$107,935		$107,936							$215,870			$431,740
Total Cash Inflows	**$207,064**	**$0**	**$207,065**	**$99,129**	**$0**	**$0**	**$0**	**$0**	**$0**	**$364,564**	**$148,694**	**$0**	$1,026,516
CASH OUTFLOWS													
Machinery Hire and Fuel												$87,700	$87,700
Cash Rent			$130,515								$130,515		$261,030
Crop Insurance						$52,121							$52,121
Interest	$1,701	$1,701	$1,701	$1,701	$1,701	$1,701	$1,701	$1,701	$1,701	$1,701	$1,701	$1,701	$20,412
On farm drying cost											$4,412		$4,412
Off farm drying cost											$2,145		$2,145
Fertilizer	$67,420												$67,420
Seed												$100,944	$100,944
Chemicals												$84,574	$84,574
Soil Sampling											$3,225		$3,225
Fertilizer Recommendations											$2,020		$2,020
Family Living Expense family of 4) Brian	$11,305	$11,305	$11,305	$11,305	$11,305	$11,305	$11,305	$11,305	$11,305	$11,305	$11,305	$11,305	$135,654
On farm grain storage expense	$2,160	$2,160	$2,160	$2,160							$2,160	$2,160	$12,959
Off-farm grain storage expense	$148		$148	$148							$296		$741
Family Living Expense (family of 2) Keith	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$84,779
Family Living Expense (family of 2) Richard	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$7,065	$84,779
Total Cash Outflows	**$96,864**	**$29,295**	**$159,958**	**$29,443**	**$27,135**	**$79,257**	**$27,135**	**$27,135**	**$27,135**	**$27,135**	**$171,908**	**$302,513**	$1,004,914
Net Cash Flow	**$110,200**	**-$29,295**	**$47,107**	**$69,686**	**-$27,135**	**-$79,257**	**-$27,135**	**-$27,135**	**-$27,135**	**$337,428**	**-$23,214**	**-$302,513**	**$21,602**
Cumulative Net Cash Flow	**$110,200**	**$80,905**	**$128,012**	**$197,698**	**$170,563**	**$91,306**	**$64,171**	**$37,036**	**$9,900**	**$347,328**	**$324,115**	**$21,602**	**$21,602**

APPENDIX E

Cash Flow Statement: Hog Facility

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Yardage Payment	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000
Manure Revenue	$ 10,225	$ 10,328	$ 10,431	$ 10,535	$ 10,641	$ 10,747	$ 10,855	$ 10,963	$ 11,073	$ 11,183	$ 11,295	$ 11,408	$ 11,522	$ 11,638	$ 11,754
Total Revenue	**$112,225**	**$112,328**	**$ 112,431**	**$112,535**	**$ 112,641**	**$112,747**	**$112,855**	**$112,963**	**$113,073**	**$ 113,183**	**$ 113,295**	**$ 113,408**	**$113,522**	**$113,638**	**$113,754**
Loan Payments	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142	$ 65,142			
Electricity	$ 7,200	$ 7,389	$ 7,584	$ 7,783	$ 7,988	$ 8,198	$ 8,414	$ 8,635	$ 8,862	$ 9,095	$ 9,334	$ 9,580	$ 9,832	$ 10,090	$ 10,356
LP	$ 6,000	$ 6,158	$ 6,320	$ 6,486	$ 6,657	$ 6,832	$ 7,011	$ 7,196	$ 7,385	$ 7,579	$ 7,778	$ 7,983	$ 8,193	$ 8,408	$ 8,630
Property Taxes	$ 1,920	$ 1,930	$ 1,939	$ 1,949	$ 1,959	$ 1,968	$ 1,978	$ 1,988	$ 1,988	$ 2,008	$ 2,018	$ 2,028	$ 2,038	$ 2,049	$ 2,059
Insurance	$ 3,120	$ 3,202	$ 3,286	$ 3,373	$ 3,461	$ 3,552	$ 3,646	$ 3,742	$ 3,840	$ 3,941	$ 4,045	$ 4,151	$ 4,260	$ 4,372	$ 4,487
Misc.	$ 2,400	$ 2,463	$ 2,528	$ 2,594	$ 2,663	$ 2,733	$ 2,805	$ 2,878	$ 2,954	$ 3,032	$ 3,111	$ 3,193	$ 3,277	$ 3,363	$ 3,452
Repairs and Maintenance	$ 2,400	$ 3,168	$ 3,936	$ 4,704	$ 5,472	$ 6,240	$ 7,008	$ 7,776	$ 8,544	$ 9,312	$ 9,557	$ 9,808	$ 10,066	$ 10,331	$ 10,603
Office/Barn Supplies	$ 1,920	$ 1,970	$ 2,022	$ 2,076	$ 2,130	$ 2,186	$ 2,244	$ 2,303	$ 2,363	$ 2,425	$ 2,489	$ 2,555	$ 2,622	$ 2,691	$ 2,761
Total Operating Expenses	**$ 90,102**	**$ 91,422**	**$ 92,757**	**$ 94,107**	**$ 95,472**	**$ 96,851**	**$ 98,248**	**$ 99,660**	**$101,078**	**$102,534**	**$103,474**	**$104,440**	**$ 40,288**	**$ 41,304**	**$ 42,348**
Net Cash Flow	**$ 22,123**	**$ 20,906**	**$ 19,674**	**$ 18,428**	**$ 17,169**	**$ 15,896**	**$ 14,607**	**$ 13,303**	**$ 11,995**	**$ 10,649**	**$ 9,821**	**$ 8,968**	**$ 73,234**	**$ 72,334**	**$ 71,406**

Capital Structure of Hog Facility and Additional Assumptions

Percentage of debt	80%
Percentage of equity	20%
Equity contribution	146,400
Loan Amount	$585,000
Interest Rate	4.75%
Term	12 years
Depreciable Life	10 years
Marginal Tax Rate	25%
Property Tax Inflation Rate	0.5%
Operating Expense Inflation Rate	2.63%
Manure N/P/K Inflation Rate	1%
15 Year Total Return	20%

APPENDIX F

Cash Flow for Chicken Layer House

Total Eggs		240		245		250		255		260
Hatched Eggs (dozen)		20		20.42		20.83		21.25		21.67
Cracked Eggs (dozen)		2.8		2.8		2.8		2.8		2.8
Hatched Eggs (HE)	$	5.20	$	5.31	$	5.42	$	5.53	$	5.63
Cracked Eggs (CE)	$	0.50	$	0.50	$	0.50	$	0.50	$	0.50
Bird Care (BC)	$	0.20	$	0.20	$	0.20	$	0.20	$	0.20
Total	**$**	**5.90**	**$**	**6.01**	**$**	**6.12**	**$**	**6.23**	**$**	**6.33**
Flock Size		35000								
	$	206,500	$	210,350	$	214,200	$	218,050	$	221,550
Principle and Interest	$	135,000	$	135,000	$	135,000	$	135,000	$	135,000
Expenses	$	33,000	$	33,000	$	33,000	$	33,000	$	33,000
Net Income	**$**	**38,500**	**$**	**42,350**	**$**	**46,200**	**$**	**50,050**	**$**	**53,550**
Flock Size	$	35,500								
	$	209,450	$	213,355	$	217,260	$	221,165	$	224,715
Principle and Interest	$	135,000	$	135,000	$	135,000	$	135,000	$	135,000
Expenses	$	33,000	$	33,000	$	33,000	$	33,000	$	33,000
Net Income	**$**	**41,450**	**$**	**45,355**	**$**	**49,260**	**$**	**53,165**	**$**	**56,715**
Flock Size	$	36,000								
	$	212,400	$	216,360	$	220,320	$	224,280	$	227,880
Principle and Interest	$	135,000	$	135,000	$	135,000	$	135,000	$	135,000
Expenses	$	33,000	$	33,000	$	33,000	$	33,000	$	33,000
Net Income	**$**	**44,400**	**$**	**48,360**	**$**	**52,320**	**$**	**56,280**	**$**	**59,880**
Flock Size	$	36,500								
	$	215,350	$	219,365	$	223,380	$	227,395	$	231,045
Principle and Interest	$	135,000	$	135,000	$	135,000	$	135,000	$	135,000
Expenses	$	33,000	$	33,000	$	33,000	$	33,000	$	33,000
Net Income	**$**	**47,350**	**$**	**51,365**	**$**	**55,380**	**$**	**59,395**	**$**	**63,045**

Not included: Compliance incentive and manure value

APPENDIX G

Labor Resources

Time Period	Available hours	Baseline LP Used hours	Baseline LP Remaining hours	Modified LP Used hours	Modified LP Remaining hours	Difference in hours used (Modified-Baseline)	Difference in hours remaining (Modified-Baseline)
Dec. 6-Apr. 21	3288	0	3288	0	3288	0	0
Apr. 22- Apr. 25	96	0	96	7.15	88.5	7.15	-7.5
Apr. 26-May 2	168	43.4	124.6	43.4	124.6	0	0
May 3-May 9	168	30.08	137.92	44.8	123.2	14.72	-14.72
May 10-May 16	168	53.44	114.56	61.16	106.84	7.72	-7.72
May 17-May 23	168	27.02	140.98	42.65	125.35	15.63	-15.63
May 24-May 30	168	6.19	161.81	9.22	158.78	3.03	-3.03
May 31-June 6	168	9.5	158.5	9.5	158.5	0	0
June 7-June 13	168	5.21	162.79	9.71	158.29	4.5	-4.5
June 14-June 20	144	0	144	0	144	0	0
June 21-June 27	144	0	144	0	144	0	0
June 28-July 4	144	0	144	0	144	0	0
July 5-July 11	144	0	144	0	144	0	0
July 12-Aug. 29	1008	0	1008	0	1008	0	0
Aug. 30-Sept. 19	432	0	432	0	432	0	0
Sept. 20- Sept. 26	168	0	168	0	168	0	0
Sept. 27-Oct.10	336	58.1	277.9	74.89	261.11	16.79	-16.79
Oct. 11- Oct. 31	504	43.85	460.15	61.6	442.4	17.75	-17.75
Nov. 1-Nov. 14	288	12.13	275.87	11.97	276.03	-0.16	0.16
Nov.15- Dec. 5	432	12.1	275.87	100.8	331.92	88.7	56.05