Ostmeyer Family Farms: Economic feasibility of replacing summer fallow with field peas in Northwest Kansas

by

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ABSTRACT

This thesis was completed to study the economic feasibility of replacing summer fallow with field peas in Northwest Kansas and more particularly on Ostmeyer Family Farms. Ostmeyer Family Farms consists of dryland and irrigated farm ground in Thomas and Sheridan County, Kansas. The farm has been in no-till production for the past 20 plus years. To help combat the chemical resistant weeds and improve overall profit per acre, Ostmeyer Family Farms needs to look at alternative management approaches. This thesis outlines one alternative approach to summer fallow.

Research was completed regarding the ability to grow field peas and market them in northwest Kansas. This research showed that the climate was particularly suited to grow field peas in northwest Kansas. The field pea market is also available in southern Nebraska, which is feasible to ship by truck.

Analysis was completed on each of the following enterprises: i) wheat after fallow, ii) wheat after field peas, iii) chemical fallow, iv) corn, and v) field peas. Each enterprise budget was used to establish a rotational budget of fallow-wheat-corn and field peas-wheat-corn. The fallow-wheat-corn rotational budget resulted in a net loss of ($26.43) per acre, while the field peas-wheat-corn rotational budget resulted in a net loss of ($23.62).

For the field pea-wheat-corn rotation to equal the fallow-wheat-corn rotation, field pea price would need to decrease by $0.34 per bushel, yield would need to decrease by 1.24 bushel per acre, or a combination of the two. A worst case scenario was also completed to show what each rotation would be with a totally failed crop. This results in fallow-wheat-corn rotation net loss per acre of ($87.76) and field peas-wheat-corn rotation net income

loss per acre of ($115.63). This worst case scenario would favor the fallow-wheat-corn rotation by $27.87/acre.

The researcher found that the field pea-wheat-corn rotation would be riskier, but overall more profitable than the fallow-wheat-corn rotation. Based on this research, a field pea-wheat-corn rotation is more economical than a fallow-wheat-corn rotation. The researcher recommends Ostmeyer Family Farms switch from a fallow-wheat-corn rotation to a field peas-wheat-corn with an economic gain currently $2.81 per acre better than the current fallow-wheat-corn rotation. However, it would be beneficial for Ostmeyer Family Farms to experiment with the field pea-wheat-corn rotation on a small acreage, since the difference between each rotation is very minimal. This would allow for them to observe what the actual yield of field peas is on their farm and yield penalty on the follow wheat crop. Doing this on a small acreage would limit the loss if the worst case scenario were to happen.

With a slim economical difference between the two rotations, Ostmeyer Family Farms should continue to reassess this with the decision tool provided with this research as prices and inputs change.

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CHAPTER I: INTRODUCTION

1.1 Introduction

Ostmeyer Family Farms is a small farm in northwest Kansas or more specifically Thomas and Sheridan County Kansas. The farm consists of irrigated and dry land farm ground. Ostmeyer Family Farms has 3 major decision makers Chase Ostmeyer, Jay Ostmeyer, and Chris Ostmeyer. The brothers have been operating the farm, since 2008. Each individual decision maker has a specific skill that is utilized to operate the farm. Jay, a fertilizer district manager by trade, provides crop nutritional and agronomic advice. Chris, a farm manager, manages the day-to-day operations. While Chase, an agricultural banker, focuses on the financials and capital purchases. All three brothers share equally in the labor requirements. Ostmeyer Family Farms operates to maximize profit per acre. They have been in no-till crop farming for the past 20 years. Being no-till farming operators, chemical fallow has become a vital part of the dry land farming operation. Over the past 5 years, the brothers have noticed an increase in chemical resistant weeds. In order to combat chemical resistant weeds, multiple chemicals with different modes of action are used. This has increased the cost of chemical fallow.

1.2 Research Problem and Objectives

Ostmeyer Family Farms would like an analysis completed on the feasibility of replacing summer fallow with field peas. Adding field peas to the rotation should improve overall profit per acre and provided ground cover reducing the need for costly chemicals.

The researcher will complete an economical analysis on the common rotations of fallow-wheat-corn and combine it to incorporate field peas. The analysis will use crop enterprise budgeting to show the net profit per acre for fallow-wheat-corn and field pea-wheat-corn. Crop budgets will be completed for each enterprise including chemical fallow, wheat after fallow, wheat after field peas, corn, and field peas. These budgets will then be combined to show the net profit per acre for each rotation.

Field peas were selected as an alternative to fallow for many economical and agronomical perceived benefits. Field peas are planted in late March and harvested in July. This would allow a shorter fallow period prior to wheat drilling in September but add additional income from selling field peas. Since field peas are planted in March, they should provide ground cover to help prevent chemical tolerant weeds. Field peas are a broadleaf legume. This would allow for biodiversity in an all grass rotation (wheat and corn). Being a legume, field peas provide nitrogen fixation. This nitrogen fixation provides added nitrogen to the rotation that should lessen nitrogen fertilizer application for the following wheat crop. A disadvantage to adding field peas to the rotation would be the use of soil moisture that should result in a low yield for the following wheat crop.

The researcher will investigate agronomic practices for fallow, wheat, corn, and field peas regarding the overall planting, fertilizing, harvesting, and marketing. Wheat and corn are more commonly used in the area, but field peas would be a new enterprise for Ostmeyer Family Farms and other farmers in the area.

In order to complete the enterprise budgets, the researcher gathered yield data for corn, wheat, and field peas for the area. Local markets were identified to establish the price received for the crops and delivery locations. Cost variables were researched regarding fertilizers cost, chemical cost, storage cost, equipment cost, and land cost.

The cost information for wheat and corn were derived from local input suppliers and grain elevators in the immediate area. Field pea production required additional research to establish the market and procure inputs; particularly seed. The researcher is currently aware of two separate markets in the area including the Farm Business Network and Gavilon Grain. Contracts for field peas were procured to get an accurate market value for them.

This project will provide a written thesis, oral defense, enterprise budgets, and decision tool to annually analyze the profitability of substituting field peas in place of fallow in the rotation. Ostmeyer Family Farms will use this data to analyze and possibly plant a test field to field peas this coming Spring.

CHAPTER II: LITERATURE REVIEW

Continuous cropping and the use of cover crops to improve soil quality may not be feasible in the semiarid environment of the high plains (Stepanovic, Werle and Peterson, et al. 2016). Over the past 30 years, farmers including Ostmeyer Family Farms have used no-till summer fallow as an important water conservation practice. A typical rotation in this area would include wheat-corn-fallow and wheat-fallow. The use of summer fallow in a no-till system requires the use of herbicide. However, in the past 20 years herbicide resistant weeds have prevented farmers from controlling the weeds during this fallow period. This lack of control has serious consequences for the following crop due to excessive soil water extraction from herbicide resistant weeds.

The loss of soil moisture and overall costly no-till summer fallow is the primary reason Ostmeyer Family Farms has requested an analysis on introducing field peas into the rotation.

2.1 Field Pea Agronomics

Field peas or Pisum Sativum L. are very similar to garden peas. It is a climbing annual legume with vines reaching lengths of 4 to 5 feet. Typically, field peas grow to be 1.5 to 2 feet tall. They have a well nodulated shallow root system. The resulting seed is large and round with approximately 4,000 seeds/lbs. It comes in many colors with the most common being yellow, white, gray, green, or brown. Seed germination occurs at 40 degrees Fahrenheit, while rapid growth occurs between 50-70 degrees Fahrenheit. The preferred growing conditions included well drained, cool, and moist soil. Soil PH is ideal at 7.0 but can tolerate PH between 4.2-8.3 (Sattell, et al. 1998). Ostmeyer Family Farm's farm ground has been grid soil tested for the past 5 years with a consistent PH between 6.5 and 7.5. This would be ideal for field pea production.

From planting to harvest, field peas typically take 80 to 100 days to reach full maturity. Field peas are very sensitive to heat stress at flowering. If field peas flower during intolerable heat, they will reduce pod count and overall yield. Field pea roots can extend to 4 feet below the surface; however, 75% of the root mass is within 2 feet of the surface. Depending on the variety, flowering is typically 40 to 50 days after planting and last for two to four weeks. Ideally field peas should be drilled in Mid-March with an air seeder that is capable of handling large seeds without cracking. Row spacing should be between 6 and 12 inches and drilled 2 inches deep with at least ½ inch of moisture above the seed. Plant density should be between 300,000 to 350,000 plants per acre. Field peas are a legume and as a legume it is important to inoculate the seed prior to planting with a Rhizobium bacteria. Being a legume allows the plant to obtain its nitrogen from a symbiotic relationship with Rhizobium bacteria in the soil. This process occurs when nodules form on the roots, which results in nitrogen fixation. Field peas are very efficient at obtaining up to 80% of their nitrogen needs due to nitrogen fixation. Nitrogen fixation along with nitrogen already in the soil will satisfy nitrogen requirements in a typical growing season. Phosphorus fertilizer is the primary concern relating to field pea nutrient needs, assuming proper nitrogen fixation. Weed control is very import in field pea production. In a Canadian trial, two wild mustard plants per square foot reduced field pea yield as much as 35 percent. Applying a pre-emerge herbicide before planting field peas is encouraged (North Dakota State University Extension Service 2016).

In order to get an idea on planting population, a researcher completed a study on how yield was affected due to seeding rates and depth. The study showed that yield topped out at a plant population of 310,000 plants per acre. An overall yield goal was set at 30 bushel per acre. The study further analyzed the economically optimal population with field pea seed stock costing $15 per bushel and field peas selling at $7 per bushel. Using these values for the calculation, the economically optimal population was 220,000 plants per acre. Seed depth study was also completed with the results showing seeding depth should be between 1 inch to 2.5 inches with optimal moisture. Seeding depth deeper than 2.5 inches showed up to 8.5% yield loss compared to shallower planting (Stepanovic and Werle, Field Pea Production 2017).

2.2 Field Pea Market

Field peas are a spring planted, cool-season crop that can be grown as an alternative to summer fallow. The agronomic and rotational benefits have been seen by farmers across the mid-west; however, a lack of market opportunities has presented a unique challenge in the past. In 2016, there was approximately 35,000 acres of field peas planted across southwest Nebraska, northwest Kansas, and northeast Colorado (Nebraska Farmer 2016). This increase in field pea production is partially attributed to new markets available to sell field peas. Gavilon Goodlife Grains is one of these new markets available. Gavilon has invested approximately $9 million in a new storage and processing facilities in the region. They are offering new contracts to local producers and have receiving points located in 5 locations in Nebraska including Benkelman, Imperial, Cozad, Kearney, and Hastings.

Field peas are primarily used for livestock feed and human consumption. Since they are comprised of 21-25 percent protein of which is 86-87 percent digestible, field peas are well suited for this purpose. Research has shown field peas to be a great protein supplement for swine, cattle, poultry, and dairy rations (North Dakota State University Extension Service 2016). Another popular use of field peas is in cat and dog food. Human consumption has been increased due to the increase in vegetarian protein drinks and gluten-free properties of field peas. Approximately, 40 million people in the United States alone suffer from Celiac Disease or a gluten intolerance. In fact, gluten-free sales are projected to increase 20-30% through 2019.

2.3 Crop Rotational Effects

Substituting a short-season crop, spring-planted for summer fallow when soil moisture is adequate might reduce soil degradation without significantly increasing the risk of failure to the following crop (Felter 2006).

With this in mind, field peas might be a viable option to replace summer fallow. This may reduce herbicide applications, provide rotational benefits including nitrogen fixation, and provide additional profit. A rotational study was completed to compare the impact of field peas vs no-till summer fallow (Stepanovic, Werle and Peterson, et al. 2016). The study looked into 6 different areas including soil health, beneficial insects, water use, field pea yield, yield of succeeding wheat crop, and profitability. It was completed over 2 years (2015 and 2016) at multiple locations in western Nebraska with side by side strip tests. Soil health was shown using soil samples at different depths. The study concluded that organic matter and concentration of actual soil nutrients did not differ between field peas and summer fallow; however, soil microbial activity was higher in areas that field peas had been grown. The study also concluded that it took 10.9 inches of water to produces 36 bushel of field peas or 3.3 bushel per acre inch. At the end of the growing season, the fallow showed a total water available of 9.8 inches, while field peas had 6.9 inches. Water use was figured by rain plus soil water at beginning minus soil water at end minus runoff minus deep percolation. An important factor to consider is that the fallow remained at full water holding capacity and didn't have the ability to store additional rains of 5.3 inches, while field pea ground utilized additional rain fall to produce grain. A profitability analysis was completed to show the differences between field pea test and fallow.

A consideration in whether to add field peas to the rotation is how field peas will perform in different rotations and how water efficiencies change. A study in the northern great plains evaluated field pea growth, yield, water use, crop rotation, and weed management. This was examined using three different crop rotations including W-P (spring wheat – pea), W-B-P (spring wheat-forage barley-pea), and W-B-C-P (spring wheat-forage barley-corn-pea). Weed management was differentiated between traditional (early plant, conventional seeding rates, broadcast N fertilization, and reduced stubble height) and improved (variable seeding rates, late plant, banded N fertilization, and increased stubble height). The research data was compiled between 2004 and 2010. The data was then run through a regression analysis to determine statistical significance. The researchers found that the use of improved weed management practices improved pea plant height, pod number, grain yield, and water use efficiency by 4 to 23 percent over traditional weed management practices. Furthermore, the research showed that an extended crop rotation improved pea yield, height, preplant and post-harvest soil water content. In fact, the W-B-P rotation and W-B-C-P rotation were 2 to 51 percent greater on these metrics over W-P rotation. Dryland pea yield can be improved by using extended diversified crop rotations and by using improved weed management (Lenssen, et al. 2018).

Research was conducted on field peas as a potential fallow alternative in northwest Kansas (Haag 2016). This was conducted in Thomas County Kansas by drilling field peas in 5 feet by 40 feet plots and was repeated 5 times. Control plots were implemented. The researcher drilled on 7.5 in row spacing with a target live seed rate of 350,000 into row crop residue. The result of the study showed field peas use 3.52 inches more water than fallow. Wheat yields after peas averaged 8 bushel per acre less than wheat after fallow. Trials resulted in a three-year average (2014-2016) yield of 29.33 bushel per acre for field peas in Colby, KS. This research is very valuable to Ostmeyer Family Farms, since it was completed in the same county as most of their farm ground.

In North Platte, Nebraska, research was completed on insect communities in field peas vs. fallow. This research was completed by installing pitfall traps to collect arthropods that are active on the ground and sweep nets to collect arthropods that are flying or in vegetation. This was done on fallow and field pea acreage. The resulting data showed a much larger population of both beneficial and detrimental insects in the field peas when compared to the fallow. The following wheat crop only had one insect group that showed a difference. Aphids were twenty times more prevalent when the previous year was fallow instead of field peas. The conclusion of the research showed that an increase in natural predators were present when a field pea rotation was utilized (Peterson 2016). This study provides valuable insight on the insect communities in field peas and shows the possibility of improved aphid control in wheat crop, after field peas are added to the rotation.

Ostmeyer Family Farms believes crop rotation is very important, but will adding field peas to the rotation improve or reduce wheat yield? Research was completed to investigate the effect of winter wheat production after the introduction of field peas into the crop rotation in the Slovak Republic. Data was collected from 2013-2015 and used regression analysis to establish if adding field peas to the rotation significantly improved wheat productivity. The research concluded that including field peas as the preceding crop in a crop rotation high in cereal grains would statistically significantly increase winter wheat yield by 0.99t/ha (Babulicova 2016). This research is in direct conflict of what was found in Thomas County by other researchers including Haag. However, it should be noted that the research completed in Slovak Republic was after winter barley and not fallow.

One of the main perceived benefits to adding field peas to a no-till rotation is the residual nitrogen fertilizer that would limit the amount needed to be applied. Research was completed to show the overall nitrogen residual effect of adding field peas to an annual cropping rotation (Beckie and Brandt 1996). This study was in Saskatchewan, Canada. Crops in the study included polish canola, spring wheat, and field peas. Nitrogen fertilizer was applied equally to plots from 0 to 100 kg/ha. The researcher used check plots to eliminated perceived non-nitrogen benefits. The researcher used 2 years of data and regression analysis to show overall nitrogen residual was statistically significantly higher when field peas were introduced into the system. The conclusion to the research showed that nitrogen benefit from adding field peas into the cropping system was between 10 lbs. and 24 lbs. of nitrogen per acre.

2.4 Conclusion

The literature review in this chapter gave a firm foundation on the production methods to growing field peas, field pea yields, water use, and benefits associated with adding field peas to a rotation. This knowledge will be used to make an accurate enterprise budget for field peas in northwest Kansas. The economic benefits to adding field peas to the rotation can then be analyzed.

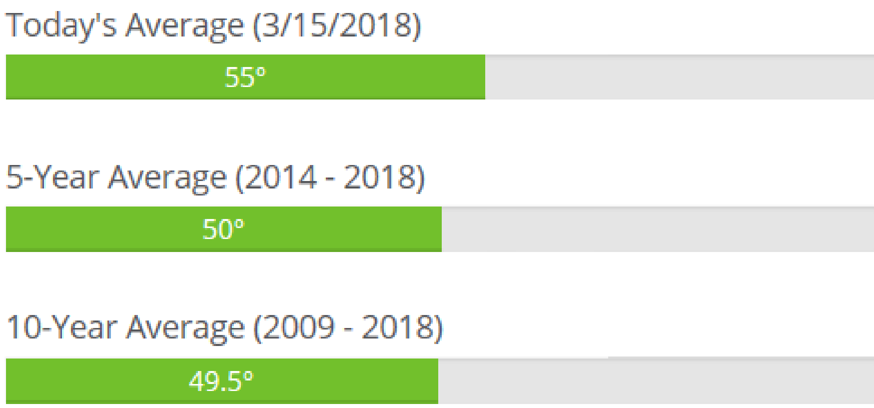
CHAPTER III: METHODS AND CONCEPTUAL MODEL

In order to analyze the economic feasibility of replacing fallow with field peas in northwest Kansas several methods are utilized including agronomic analysis of field peas, enterprise budgets, and the use of multi-year cash flow projections. The analysis will focus between two different rotation choices including fallow-wheat-corn and field peas-wheat-corn. Enterprise budgets will be completed on a per acre basis for each cropping enterprise including fallow, field peas, wheat after peas, wheat after fallow, and corn. The cropping enterprises will then be averaged for the respective rotation. Although the enterprise budgets will give a snapshot of each cropping enterprise, the researcher focuses on each rotation as a single unit. Furthermore, each rotation will be averaged based on the enterprise budgets to derive a net income per acre. For example, if in a fallow-wheat-corn rotation the net income is -$50:$50:$60 respectively, then the net income per acre would be the average of $20 per acre. This information will help the researcher decide, which rotation maximizes profit per acre.

3.1 Agronomic Analysis of Field Peas

Agronomic analysis was performed by researching field peas from an agronomic standpoint for the suitability for growth in northwest Kansas. Field peas are typically planted in mid-March and require the soil temperature to be 40 degrees to germinate (Sattell, et al. 1998). As seen below in Figure 3.1, the soil temperature at 2 inches is well above the required 40 degrees to achieve germination on March 15 in Colby, KS.

Figure 3.1: Average Soil Temperature on March 15 in Colby, KS



Source: http://www.greencastonline.com/tools/soil-temperature

One of the most important times for field peas is during flowering. Heat stress will cause the plant to abort pods decreasing yield. Field peas flower between 40 and 50 days from germination and prefer a temperature range between 50 and 70 degrees Fahrenheit (Sattell, et al. 1998). Assuming a March 15th plant date, flowering would occur in late April to early May. As shown in the below Table 3.1, the average temperature during this time would be between 64 and 74 degrees. This is almost the ideal temperature for flowering.

Table 3.1: Average Monthly Temperature For Colby, KS in Degrees Fahrenheit

	February	March	April	May	June
Average High	45	54	64	74	85
Average Low	18	26	35	47	57

Source: https://www.usclimatedata.com/climate/colby/kansas/united-states/usks0120

As previously mentioned in the Literature Review, field pea acres continue to increase across Colorado, Nebraska, and Kansas. This increase along with the above mentioned data would indicate that the area is suitable for cultivating field peas.

3.2 Enterprise Budgets

A farm operation is made up of many different enterprises including crops and livestock. An enterprise budget narrows down the income and expenses specific to each enterprise. This type of budgeting allows the researcher to have a better understanding of each enterprise and how each variable effects the bottom line of net income per unit. As a result, the researcher can understand break-even analysis and how yield, price, and cost affect net income. Enterprise budgets can be very useful when deciding on which crops to plant. The enterprise budgets were created for Ostmeyer Family Farms on a per acre basis and include the following expense assumptions.

Figure 3.2: 2018 Custom Application Rates for Northwest Kansas

Fertilizing	
Anhydrous Application	$ 14.20
Liquid Application	$ 5.38
Planting /Drilling with Fertilizer Application	
Wheat	$ 16.17
Corn	$ 17.69
Peas (Soybeans)	$ 18.00
Herbicide/Insecticide Application	
Ground Rig	$ 5.49
Aerial	$ 7.13
Grain Harvesting (flat rate charge)	
Wheat	$ 24.50
Corn	$ 30.29
Peas (Soybeans)	$ 35.25
Grain Hauling (Per bushel to nearest elevator/farm)	
Wheat	$ 0.21
Corn	$ 0.19
Peas (Soybeans)	$ 0.17
Crop Consulting	
Dryland	$ 6.50

Source: http://www.agmanager.info/machinery/papers/2016-rates-paid-kansas-farmers-custom-work

Figure 3.3: 2018 Fertilizer Prices for Northwest Kansas

Product	$/Ton	$/Actual lb
82-0-0	$ 515.00	$ 0.31
32-0-0	$ 275.00	$ 0.43
10-34-0	$ 425.00	$ 0.63

Source: Frontier Ag, Inc.

Figure 3.4: Nutrient Requirements Per Bushel Produced

Commodity	N/Bu.	P/Bu.
Wheat	1.49	0.57
Corn	0.67	0.35
Field Peas	0	0.73

Source: http://www.agphd.com/resources/nutrient-removal-charts/

Figure 3.5: 2018 Chemical Prices

Chemical	Cost/Gallon	Oz.
2-4D Ester	$ 17.11	$ 0.13
Ally	Dry	$ 2.09
Atrazine	$ 11.75	$ 0.09
Authority MTZ	Dry	$ 1.11
Balance Flex	$ 340.00	$ 2.66
Capreno	$ 545.00	$ 4.26
Dicamba	$ 43.61	$ 0.34
Dual II Magnum	$ 36.39	$ 0.28
Huskie	$ 83.55	$ 0.65
LumaxEZ	$ 43.00	$ 0.34
Paraquat	$ 21.50	$ 0.17
Prowl	$ 38.83	$ 0.30
Rave	Dry	$ 1.58
Resicore	$ 42.00	$ 0.33
Roundup 4 lb.	$ 14.50	$ 0.11
Scoparia	$ 768.00	$ 6.00
Spartan Elite	$ 87.00	$ 0.68
Status	Dry	$ 3.19
SureStart	$ 43.00	$ 0.34

Source: Farmers Business Network

Using the above chemical prices (Figure 3.5), three separate chemical plans were created with input from Ostmeyer Family Farm members and their agronomist. The cheapest herbicide plan for each crop was used in each enterprise budget.

Figure 3.6: Corn Herbicide Plans

Spraying	Herbicide Plan 1	Oz	Cost	Herbicide Plan 2	Oz	Cost	Herbicide Plan 3	Oz	Cost
1	Balance Flex	5	$ 13.28	Roundup	32	$ 3.63	SureStart	32	$ 10.75
	Atrazine	16	$ 1.47	Dicamba	12	$ 4.09	Dicamba	12	$ 4.09
	Dicamba	12	$ 4.09	Atrazine	16	$ 1.47	Atrazine	16	$ 1.47
	Roundup	32	$ 3.63				Roundup	32	$ 3.63
2	Capreno	3	$ 12.77	Lumax EZ	43	$ 14.45	Dicamba	16	$ 5.45
	Atrazine	16	$ 1.47	Roundup	32	$ 3.63	Resicore	80	$ 26.25
	Dicamba	12	$ 4.09				Atrazine	16	$ 1.47
	Roundup	32	$ 3.63						
3	Roundup	32	$ 3.63	Lumax EZ	43	$ 14.45	Roundup	32	$ 3.63
	Status	6	$ 19.14	Roundup	32	$ 3.63	Status	6	$ 19.14
Total Cost/Acre			**$ 67.18**			**$ 45.32**			**$ 75.87**

Source: Ostmeyer Family Farms Agronomist

Figure 3.7: Wheat Herbicide Plans

Spraying	Herbicide Plan 1	Oz	Cost	Herbicide Plan 2	Oz	Cost	Herbicide Plan 3	Oz	Cost
1	Ally	0.2	$ 0.42	Rave	4	$ 6.32	Huskie	16	$ 10.44
	Dicamba	4	$ 1.36						
2	Paraquat	32	$ 5.38	Paraquat	32	$ 5.38	Paraquat	32	$ 5.38
	2-4D	16	$ 2.14	2-4D	16	$ 2.14	2-4D	16	$ 2.14
3	Roundup	32	$ 3.63	Roundup	32	$ 3.63	Roundup	32	$ 3.63
	Atrazine	16	$ 1.47	Atrazine	16	$ 1.47	Atrazine	16	$ 1.47
Total Cost/Acre			**$ 14.39**			**$ 18.93**			**$ 23.05**

Source: Ostmeyer Family Farms Agronomist

Figure 3.8: Field Pea Herbicide Plans

Spraying	Herbicide Plan 1	Oz	Cost	Herbicide Plan 2	Oz		Herbicide Plan 3	Oz	
1	Spartan	21	$ 14.27	Spartan	21	$ 14.27	Spartan	21	$ 14.27
				Dual II Magnum	16	$ 4.55	Dual II Magnum	16	$ 4.55
				Prowl	32	$ 9.71			
2	Paraquat	32	$ 5.38	Paraquat	32	$ 5.38	Paraquat	32	$ 5.38
	2-4D	16	$ 2.14	2-4D	16	$ 2.14	2-4D	16	$ 2.14
3	Paraquat	32	$ 5.38	Paraquat	32	$ 5.38	Paraquat	32	$ 5.38
	2-4D	16	$ 2.14	2-4D	16	$ 2.14	2-4D	16	$ 2.14
Total Cost/Acre			**$ 29.30**			**$ 43.56**			**$ 33.85**

Source: Ostmeyer Family Farms Agronomist

Figure 3.9: Chemical Fallow Herbicide Plans

Spraying	Herbicide Plan 1	Oz	Cost	Herbicide Plan 2	Oz	Cost	Herbicide Plan 3	Oz	Cost
1	Authority MTZ	16	$ 17.76	Roundup	32	$ 3.63	Scoparia	3	$ 18.00
	Paraquat	32	$ 5.38	Dicamba	12	$ 4.09			
				2-4D	16	$ 2.14			
2	Paraquat	32	$ 5.38	Paraquat	32	$ 5.38	Roundup	32	$ 3.63
	2-4D	16	$ 2.14	2-4D	16	$ 2.14	Dicamba	12	$ 4.09
							2-4D	16	$ 2.14
3	Paraquat	32	$ 5.38	Roundup	32	$ 3.63	Paraquat	32	$ 5.38
	2-4D	16	$ 2.14	Dicamba	12	$ 4.09	2-4D	16	$ 2.14
				2-4D	16	$ 2.14			
4	Paraquat	32	$ 5.38	Roundup	32	$ 3.63	Paraquat	32	$ 5.38
	2-4D	16	$ 2.14	Dicamba	12	$ 4.09	2-4D	16	$ 2.14
				2-4D	16	$ 2.14			
Total Cost/Acre			**$ 45.68**			**$ 37.07**			**$ 42.88**

Source: Ostmeyer Family Farms Agronomist

3.2.1 Corn Enterprise Budget

The corn enterprise budget is calculated according to the following equation.

Corn Enterprise Budget Model:

$$C_{EB} = (C_P * C_Y) - (C_{FE} + C_{WCE} + C_{SE} + C_{CIE} + C_{LE} + C_{CFOE} + C_{IE} + CRE)$$

C_{EB} = Corn Enterprise Profit/Loss

C_P = Corn Price

C_Y = Corn Yield

C_{FE} = Corn Fertilizer Expense

C_{WCE} = Corn Weed Control Expense

C_{SE} = Corn Seed Expense

C_{CIE} = Corn Crop Insurance Expense

C_{LE} = Corn Labor Expense

C_{CFOE} = Corn Custom Field Operation Expense

C_{IE} = Corn Operating Interest Expense

CRE = Cash Rent Expense

Table 3.2: Dryland Corn Yield For Ostmeyer Family Farms

	N	Mean	Std Dev	Minimum	Maximum
Yield	10	100.75	30.28	55.50	139.00

Production for the corn enterprise budget is based on Ostmeyer Family Farms' average dryland corn yield since 2008, which is shown above in Table 3.2. Average corn yield of 101 bushels/acre was multiplied by the USDA's long-term projection model for corn price of $3.90 resulting in a revenue per acre of $393.90.

Expenses were divided into 8 different categories including fertilizer, weed control, seed, crop insurance, labor, custom field operations, interest on operating capital, and cash rent. The fertilizer expense is based on AgPHD's estimated nutrients per bushel of corn or 0.67 actual lbs. of nitrogen and 0.35 actual lbs. of phosphorus (Figure 3.4) (AgPHD n.d.). Each recommended rate is multiplied by the current cost of an actual lbs. of 82-0-0 (%N-P2O5-K2O) and 10-34-0 fertilizers (Figure 3.3). Weed control was discussed in depth with Ostmeyer Family Farms' agronomist. Three separate chemical plans were completed with the cheapest plan being used in this enterprise budget (Figure 3.6). Seed cost is for the 2019 actual average seed cost per bag of corn or $223/bag. Corn is projected to be planted at 16,500 seeds per acre recommended by agronomist. Crop insurance expense is based on 2018 actual cost per acre for 70% RP (Revenue Protection) insurance coverage. Labor cost is for crop consulting fees per acre of dryland farm ground charged to Ostmeyer Family Farms for the 2019 crop year. Miscellaneous labor is derived from Kansas State University (KSU) enterprise budgets. Custom field operations are based off the 2018 custom rates survey completed by KSU (Figure 3.2). Interest on operating capital is figured as 50 percent of the expenses times the operating rate currently being charged to Ostmeyer Family Farms, which is 6%. 50 percent is assuming the funds will be borrowed for half of the year from planting to harvest. Cash rent was equal to NASS survey for cash rent in Thomas County, Kansas or $55.50 per acre. This is in line with Ostmeyer Family Farms cash rent between $45 and $65 per acre depending on quality. The dry land corn enterprise budget estimates a per acre net income of $71.54 (Figure 3.10).

Figure 3.10: Ostmeyer Family Farms Corn Enterprise Budget

		Unit	Price	Quantity	Amount	Sub-total	Total
Income							
Corn- Ostmeyer Farms		bu	$ 3.90	101.00	$393.90	**$ 393.90**	
Total Income						$ 393.90	
Expenses							
Fertilizer							
Phosphorus (10-34-0)		lb	$ 0.63	35.35	$ 22.09		
Nitrogen (82-0-0)		lb	$ 0.31	67.67	$ 21.25	**$ 43.34**	
Weed Control							
Herbicide Plan 2							
	Herbicide						
Spray #1	Roundup	oz	$ 0.11	32.00	$ 3.63		
	Dicamba	oz	$ 0.34	12.00	$ 4.09		
	Atrazine	oz	$ 0.09	16.00	$ 1.47		
Spray #2	Lumax EZ	oz	$ 0.34	43.00	$ 14.45		
	Roundup	oz	$ 0.11	32.00	$ 3.63		
Spray #3	Lumax EZ	oz	$ 0.34	43.00	$ 14.45		
	Roundup	oz	$ 0.11	32.00	$ 3.63	**$ 45.32**	
Seed							
Corn-Roundup Ready BT		1k seeds	$ 2.79	16.50	$ 46.04	**$ 46.04**	
Crop Insurance							
Corn Dry land Ostmeyer Farms		acre	$ 12.75	1.00	$ 12.75	**$ 12.75**	
Labor							
Crop Consulting		acre	$ 6.50	1.00	$ 6.50		
Miscellaneous (beyond custom field operations)		hour	$ 15.00	0.50	$ 7.50	**$ 14.00**	
Customer Field Operations							
Fertilizer Application (NH3)		acre	$ 14.20	1.00	$ 14.20		
Plant-Corn		acre	$ 17.69	1.00	$ 17.69		
Spray-Ground Herbicide		acre	$ 5.49	3.00	$ 16.47		
Harvest- Corn		acre	$ 30.29	1.00	$ 30.29		
Haul- Corn		bu	$ 0.19	101.00	$ 18.99	**$ 97.64**	
Interest on Operating Capital			6.00%	$129.54	$ 7.77	**$ 7.77**	
Cash Rent		acre	$ 55.50	1.00	$ 55.50	**$ 55.50**	
Total Expenses						**$ 322.36**	
Net Income Per Acre							**$ 71.54**

3.2.2 Wheat After Fallow Enterprise Budget

The wheat after fallow enterprise budget is calculated according to the following equation.

Wheat After Fallow Enterprise Budget Model:

$$\mathbf{WF_{EB} = (W_P * W_Y) - (W_{FE} + W_{FCE} + W_{WCE} + W_{SE} + WF_{CIE} + W_{LE} + W_{CFOE} + W_{IE} + CRE)}$$

WF_{EB} =	Wheat After Fallow Enterprise Profit/Loss
W_P =	Wheat Price
W_Y =	Wheat Yield
W_{FE} =	Wheat Fertilizer Expense
W_{FCE} =	Wheat Fungicide Expense
W_{WCE} =	Wheat Weed Control Expense
W_{SE} =	Wheat Seed Expense
WF_{CIE} =	Wheat After Fallow Crop Insurance Expense
W_{LE} =	Wheat Labor Expense
W_{CFOE} =	Wheat Custom Field Operation Expense
W_{IE} =	Wheat Operating Interest Expense
CRE =	Cash Rent Expense

Table 3.3: Dryland Wheat After Fallow Yield For Ostmeyer Family Farms

	N	Mean	Std Dev	Minimum	Maximum
Yield	9	38.50	18.87	14.00	71.00

Production for the wheat after fallow enterprise budget is based on Ostmeyer Family Farms' average dryland wheat since 2008, which is shown above in Table 3.3.

Average rounded wheat yield of 39 bushel was multiplied by the USDA's long-term projection model for wheat price or $5.20 resulting in an income per acre of $202.80.

The fertilizer expense is based on AgPHD's estimated nutrients per bushel of wheat or 1.49 actual lbs. of nitrogen and 0.57 actual lbs. of phosphorus (Figure 3.4). Each recommended rate is multiplied by the current cost of an actual lbs. of 32-0-0 and 10-34-0 fertilizers (Figure 3.3). Weed control was discussed in depth with Ostmeyer Family Farms' agronomist. Three separate chemical plans were completed with the cheapest plan being used in this enterprise budget (Figure 3.7). Chemical prices were obtained from the local chemical dealer. Seed cost is for the 2018 actual average seed cost per acre for certified seed. Wheat is projected to be drilled at a rate of 1 bushel per acre as recommended by an agronomist. Crop insurance expense is based on 2018 actual cost per acre for 70% RP insurance coverage. Labor cost is for crop consulting fees per acre of dryland farm ground charged to Ostmeyer Family Farms for the 2019 crop year. Miscellaneous labor is derived from Kansas State University (KSU) enterprise budgets. Custom field operations are based off the 2018 custom rates survey completed by KSU (Figure 3.2). Interest on operating capital is figured as 50 percent of the expenses times the operating interest rate being charged to Ostmeyer Family Farms, which is 6%. Cash rent was equal to NASS survey for cash rent in Thomas County, Kansas. The dryland wheat after fallow enterprise budget estimates a per acre net loss of ($26.79). Refer to below Figure 3.11.

Figure 3.11: Ostmeyer Family Farms Wheat After Fallow Enterprise Budget

		Unit	Price	Quantity	Amount	Sub-total	Total
Income							
Wheat- Ostmeyer Farms		bu	$ 5.20	39.00	$202.80	**$ 202.80**	
Total Income						**$ 202.80**	
Expenses							
Fertilizer							
Phosphorus (10-34-0)		lb	$ 0.63	22.23	$ 13.89		
Nitrogen (32-0-0)		lb	$ 0.43	58.11	$ 24.97	**$ 38.86**	
Weed Control							
Herbicide Plan 1							
	Herbicide						
Spray #1	Ally	oz	$ 2.09	0.20	$ 0.42		
	Dicamba	oz	$ 0.34	4.00	$ 1.36		
Spray #2	Paraquat	oz	$ 0.17	32.00	$ 5.38		
	2-4D	oz	$ 0.13	16.00	$ 2.14		
Spray #3	Roundup	oz	$ 0.11	32.00	$ 3.63		
	Atrazine	oz	$ 0.09	16.00	$ 1.47	**$ 14.39**	
Fungicide							
Wheat-Fungicide	Quilt	oz	$ 0.59	10.00	$ 5.90	**$ 5.90**	
Seed							
Wheat-		bu	$ 14.00	1.00	$ 14.00	**$ 14.00**	
Crop Insurance							
Wheat Dry land Ostmeyer Farms		acre	$ 4.11	1.00	$ 4.11	**$ 4.11**	
Labor							
Crop Consulting		acre	$ 6.50	1.00	$ 6.50		
Miscellaneous (beyond custom field operations)		hour	$ 15.00	0.50	$ 7.50	**$ 14.00**	
Customer Field Operations							
Fertilizer Application (Liquid)		acre	$ 5.38	1.00	$ 5.38		
Drill-Wheat		acre	$ 16.17	1.00	$ 16.17		
Spray-Aerial Fungicide		acre	$ 7.13	1.00	$ 7.13		
Spray-Ground Herbicide		acre	$ 5.49	3.00	$ 16.47		
Harvest- Wheat		acre	$ 24.50	1.00	$ 24.50		
Haul- Wheat		bu	$ 0.21	39.00	$ 8.11	**$ 77.76**	
Interest on Operating Capital			6.00%	$ 84.51	$ 5.07	**$ 5.07**	
Cash Rent		acre	$ 55.50	1.00	$ 55.50	**$ 55.50**	
Total Expenses						**$ 229.59**	
Net Income Per Acre							**$ (26.79)**

3.2.3 Wheat After Field Peas Enterprise Budget

The wheat after field peas enterprise budget is calculated according to the following equation.

Wheat After Field Peas Enterprise Budget Model:

$$WP_{EB} = (W_P * (W_Y - FP_{YP})) - ((W_{FE} - FP_{NC}) + W_{FCE} + W_{WCE} + W_{SE} + WF_{CIE} + W_{LE} + W_{CFOE} + W_{IE} + CRE))$$

WP_{EB} = Wheat After Field Peas Enterprise Profit/Loss

W_P = Wheat Price

W_Y = Wheat Yield

FP_{YP} = Field Peas Yield Penalty

W_{PFE} = Wheat Fertilizer Expense

FP_{NC} = Field Peas Nitrogen Credit

W_{FCE} = Wheat Fungicide Expense

W_{WCE} = Wheat Weed Control Expense

W_{SE} = Wheat Seed Expense

WF_{CIE} = Wheat After Fallow Crop Insurance Expense

W_{LE} = Wheat Labor Expense

W_{CFOE} = Wheat Custom Field Operation Expense

W_{IE} = Wheat Operating Interest Expense

CRE = Cash Rent Expense

Production for the wheat after field peas enterprise budget is based on Ostmeyer Family Farms' average dryland wheat since 2008, which is shown above in Table 3.3. An adjustment was completed to decrease the projected yield by 8 bushel per acre. This yield penalty in wheat production following field peas is based on the research completed by Lucas Haag (Haag 2016). Average wheat yield of 39 minus 8 bushel yield penalty resulting in 31 bushels/acre was multiplied by the USDA's long-term projection model for wheat price or $5.20 resulting in an income per acre of $161.20.

Expenses are the same as the enterprise budget for wheat after fallow with two exception. The fertilizer expenses were adjusted for the lower yield projection and a credit of 20 actual lbs. of nitrogen was given based on the study completed showing field peas fixing between 14 actual lbs. and 24 actual lbs. of nitrogen (Beckie and Brandt 1996). Crop insurance expense was increased from $4.11/acre to $11.87/acre. This increase is attributed to field peas being added to the rotation requiring continuous wheat insurance rates instead of fallow rates. The dryland wheat after field peas enterprise budget estimates a per acre net loss of ($57.61). Refer to below Figure 3.12: Ostmeyer Family Farms Wheat After Field Peas Enterprise Budget.

Figure 3.12: Ostmeyer Family Farms Wheat After Field Peas Enterprise Budget

		Unit	Price	Quantity	Amount	Sub-total	Total
Income							
Wheat- Ostmeyer Farms		bu	$ 5.20	31.00	$161.20	**$ 161.20**	
Total Income						**$ 161.20**	
Expenses							
Fertilizer							
Phosphorus (10-34-0)		lb	$ 0.63	17.67	$ 11.04		
Nitrogen (32-0-0)		lb	$ 0.43	46.19	$ 19.85		
Nitrogen (credit after peas)		lb	$ 0.43	(20.00)	$ (8.59)	**$ 22.30**	
Weed Control							
Herbicide Plan 1							
	Herbicide						
Spray #1	Ally	oz	$ 2.09	0.20	$ 0.42		
	Dicamba	oz	$ 0.34	4.00	$ 1.36		
Spray #2	Paraquat	oz	$ 0.17	32.00	$ 5.38		
	2-4D	oz	$ 0.13	16.00	$ 2.14		
Spray #3	Roundup	oz	$ 0.11	32.00	$ 3.63		
	Atrazine	oz	$ 0.09	16.00	$ 1.47	**$ 14.39**	
Fungicide							
Wheat-Fungicide	Quilt	oz	$ 0.59	10.00	$ 5.90	**$ 5.90**	
Seed							
Wheat-		bu	$ 14.00	1.00	$ 14.00	**$ 14.00**	
Crop Insurance							
Wheat Dry land Ostmeyer Farms		acre	$ 11.87	1.00	$ 11.87	**$ 11.87**	
Labor							
Crop Consulting		acre	$ 6.50	1.00	$ 6.50		
Miscellaneous (beyond custom field operations)		hour	$ 15.00	0.50	$ 7.50	**$ 14.00**	
Customer Field Operations							
Fertilizer Application (Liquid)		acre	$ 5.38	1.00	$ 5.38		
Drill-Wheat		acre	$ 16.17	1.00	$ 16.17		
Spray-Aerial Fungicide		acre	$ 7.13	1.00	$ 7.13		
Spray-Ground Herbicide		acre	$ 5.49	3.00	$ 16.47		
Harvest- Wheat		acre	$ 24.50	1.00	$ 24.50		
Haul- Wheat		bu	$ 0.21	31.00	$ 6.45	**$ 76.10**	
Interest on Operating Capital			6.00%	$ 79.28	$ 4.76	**$ 4.76**	
Cash Rent		acre	$ 55.50	1.00	$ 55.50	**$ 55.50**	
Total Expenses						**$ 218.81**	
Net Income Per Acre							**$ (57.61)**

3.2.4 Field Pea Enterprise Budget

The field pea enterprise budget is calculated according to the following equation.

Field Pea Enterprise Budget Model:

$$FP_{EB} = ((FP_{P} * FP_{Y}) - (FP_{FE} + FP_{WCE} + FP_{SE} + FP_{CIE} + FP_{LE} + FP_{CFOE} + FP_{IE} + CRE))$$

FP_{EB} = Field Pea Enterprise Profit/Loss

FP_{P} = Field Pea Price

FP_{Y} = Field Pea Yield

FP_{FE} = Field Pea Fertilizer Expense

FP_{WCE} = Field Pea Weed Control Expense

FP_{SE} = Field Pea Seed Expense

FP_{CIE} = Field Pea Crop Insurance Expense

FP_{LE} = Field Pea Labor Expense

FP_{CFOE} = Field Pea Custom Field Operation Expense

FP_{IE} = Field Pea Operating Interest Expense

CRE = Cash Rent Expense

Table 3.4: Dryland Field Pea Production At K-State Extension Center Colby, KS

	N	Mean	Std Dev	Minimum	Maximum
Yield	7	25.14	15.74	8.00	56.00

Production for the field pea enterprise budget is based on research completed by the K-state extension center in Colby, KS over a 7 year period of growing field peas on plots, which is shown above in Table 3.4. Average rounded field pea yield of 25 bushel was multiplied by the $7.00 per bushel, which is the current contract price for Gavilon Grain in Hastings, Nebraska. This results in revenue of $175.00 per acre.

The fertilizer expense is based on AgPHD's estimated nutrients per bushel of soybeans or 0 actual lbs. of nitrogen and 0.73 actual lbs. of phosphorus (Figure 3.4). Soybean recommendations were used due to field peas recommendations not being readily available. Like soybeans, field peas are a legume and nutrient requirements will be comparable per bushel. Each recommended rate is multiplied by the current cost of an actual lbs. of 32-0-0 and 10-34-0 fertilizers (Figure 3.3). Weed control was discussed in depth with Ostmeyer Family Farms' agronomist. Three separate chemical plans were completed with the lowest cost plan being used in this enterprise budget (Figure 3.8). Chemical prices were derived from the local chemical dealer. Seed cost is from Gavilon Grain per bushel and planting 350,000 seeds per acre. A written agreement crop insurance policy was completed with for Field Peas with RCIS (Rural Community Insurance Services) resulting in crop insurance cost of $5.89/acre. Labor cost is for crop consulting fees per acre of dryland farm ground charged to Ostmeyer Family Farms for the 2019 crop year. Miscellaneous labor is derived from Kansas State University (KSU) enterprise budgets. Custom field operations are based off the 2018 custom rates survey completed by KSU (Figure 3.2). Interest on operating capital is figured as 50 percent of the expenses times the operating interest rate being charged to Ostmeyer Family Farms, which is 6%. 50 percent is assuming the funds will be borrowed for half of the year from planting to harvest. The field pea enterprise budget estimates a per acre net loss of ($84.79). Refer to below Figure 3.13: Ostmeyer Family Farms Field Pea Enterprise Budget.

Figure 3.13: Ostmeyer Family Farms Field Pea Enterprise Budget

		Unit	Price	Quantity	Amount	Sub-total	Total
Income							
Field Peas- Ostmeyer Farms		bu	$ 7.00	25.00	$175.00	**$ 175.00**	
Total Income						**$ 175.00**	
Expenses							
Fertilizer							
Phosphorus (10-34-0)		lb	$ 0.63	18.25	$ 11.41		
Nitrogen (82-0-0)		lb	$ 0.31	-	$ -	**$ 11.41**	
Weed Control							
Herbicide Plan 1							
	Herbicide						
Spray #1	Spartan	oz	$ 0.68	21.00	$ 14.27		
Spray #2	Paraquat	oz	$ 0.17	32.00	$ 5.38		
	2-4D	oz	$ 0.13	16.00	$ 2.14		
Spray #3	Paraquat	oz	$ 0.17	32.00	$ 5.38		
	2-4D	oz	$ 0.13	16.00	$ 2.14	**$ 29.30**	
Seed							
Field Pea		1k seeds	$ 0.12	350.00	$ 42.00		
Inoculant	Bradyrhizobiu	oz	$ 1.33	10.00	$ 13.30	**$ 55.30**	
Crop Insurance							
Field Peas Dry land Ostmeyer Farms		acre	$ 5.89	1.00	$ 5.89	**$ 5.89**	
Labor							
Crop Consulting		acre	$ 6.50	1.00	$ 6.50		
Miscellaneous (beyond custom field operations)		hour	$ 15.00	0.50	$ 7.50	**$ 14.00**	
Customer Field Operations							
Plant-Field Peas		acre	$ 18.00	1.00	$ 18.00		
Spray-Ground Herbicide		acre	$ 5.49	3.00	$ 16.47		
Harvest- Field Peas		acre	$ 35.25	1.00	$ 35.25		
Haul- Field Peas to Farm		bu	$ 0.17	25.00	$ 4.33		
Haul- Field Peas to Hastings		bu	$ 0.34	25.00	$ 8.40	**$ 82.44**	
Interest on Operating Capital			6.00%	$ 99.17	$ 5.95	**$ 5.95**	
Cash Rent		acre	$ 55.50	1.00	$ 55.50	**$ 55.50**	
Total Expenses						**$ 259.79**	
Net Income Per Acre							**$ (84.79)**

3.2.5 Chemical Fallow Enterprise Budget

The chemical fallow enterprise budget is calculated according to the following equation.

Chemical Fallow Enterprise Budget Model:

$$\mathbf{CF_{EB} = -(CF_{WCE} + FP_{LE} + FP_{CFOE} + FP_{IE} + CRE)}$$

CF_{EB} = Chemical Fallow Enterprise Loss

CF_{WCE} = Chemical Fallow Weed Control Expense

CF_{LE} = Chemical Fallow Labor Expense

CF_{CFOE} = Chemical Fallow Custom Field Operation Expense

CF_{IE} = Chemical Fallow Operating Interest Expense

CRE = Cash Rent Expense

Income for the chemical fallow enterprise budget is $0. There is no crop taken off the chemical fallow during the year.

Weed control was discussed in depth with Ostmeyer Family Farms' agronomist. Three separate chemical plans were completed with the cheapest plan being used in this enterprise budget (Figure 3.9). Chemical prices were derived from the local chemical dealer. Miscellaneous labor is derived from Kansas State University (KSU) enterprise budgets. Custom field operations are based off the 2018 custom rates survey completed by KSU (Figure 3.2). Interest on operating capital is figured by multiplying 50 percent of the expenses times the current operating interest rate being charged to Ostmeyer Family Farms, which is 6%. 50 percent is assuming the funds will be borrowed for half of the year. The chemical fallow enterprise budget estimates a per acre net loss of ($124.03). Refer to below Figure 3.14: Ostmeyer Family Farms Chemical Fallow Enterprise Budget.

Figure 3.14: Ostmeyer Family Farms Chemical Fallow Enterprise Budget

		Unit	Price	Quantity	Amount	Sub-total	Total
Income							
Total Income						$ -	
Expenses							
Weed Control							
Herbicide Plan 2							
	Herbicide						
Spray #1	Roundup	oz	$ 0.11	32.00	$ 3.63		
	Dicamba	oz	$ 0.34	12.00	$ 4.09		
	2-4D	oz	$ 0.13	16.00	$ 2.14		
Spray #2	Paraquat	oz		32.00	$ 5.38		
	2-4D	oz	$ 0.13	16.00	$ 2.14		
Spray #3	Roundup	oz	$ 0.11	32.00	$ 3.63		
	Dicamba	oz		12.00	$ 4.09		
	2-4D	oz	$ 0.13	16.00	$ 2.14		
Spray #4	Roundup	oz	$ 0.11	32.00	$ 3.63		
	Dicamba	oz	$ 0.34	12.00	$ 4.09		
	2-4D	oz	$ 0.13	16.00	$ 2.14	**$ 37.07**	
Labor							
Miscellaneous (beyond custom field operations)		hour	$ 15.00	0.50	$ 7.50	**$ 7.50**	
Customer Field Operations							
Spray-Ground Herbicide		acre	$ 5.49	4.00	$ 21.96	**$ 21.96**	
Interest on Operating Capital			6.00%	$ 33.27	$ 2.00	**$ 2.00**	
Cash Rent		acre	$ 55.50	1.00	$ 55.50	**$ 55.50**	
Total Expenses						**$ 124.03**	
Net Income Per Acre							**$ (124.03)**

3.3 Rotation Budgets

At first glance, the Field Pea Enterprise Budget shows net loss of ($84.79) per acre and the Chemical Fallow Enterprise Budget shows net loss of ($124.03). This would indicate that it is better to plant field peas instead of fallow with net savings of $39.24 per acre. Enterprise budgets are a good tool to help producers make decisions between various crops but can be a flawed approach. When one enterprise has a direct effect on the next, like wheat after peas, a full rotation budget should be utilized.

Rotation Budget Model:

$$\frac{\sum(EB)}{N}$$

EB= Enterprise Budget

N= Number of Enterprise Budgets

3.3.1 Fallow-Wheat-Corn Rotation Budget Model

The Fallow-Wheat-Corn Rotation Budget is calculated according to the following equation.

Net Income Per Acre= $$\frac{CF_{EB} + WF_{EB} + C_{EB}}{3}$$

CF_{EB} = Chemical Fallow Enterprise Loss

WF_{EB} = Wheat After Fallow Enterprise Profit/Loss

C_{EB} = Corn Enterprise Profit/Loss

3.3.2 Field Peas-Wheat-Corn Rotation Budget Model

The Field Peas-Wheat-Corn Rotation Budget is calculated according to the following equation.

Net Income Per Acre= $$\frac{FP_{EB} + WP_{EB} + C_{EB}}{3}$$

FP_{EB} = Field Peas Enterprise Profit/Loss

WP_{EB} = Wheat After Field Peas Enterprise Profit/Loss

C_{EB} = Corn Enterprise Profit/Loss

CHAPTER IV: RESULTS

Using the above Rotation Budget Models in conjunction with the individual Enterprise Budgets, a net income per rotation can be realized.

Fallow-Wheat-Corn Rotation Model results:

$$\frac{(\$124.03) + (\$26.79) + \$71.54}{3} = \text{Net Loss of } (\$26.43)$$

Field Peas-Wheat-Corn Rotation Model results:

$$\frac{(\$84.79) + (\$57.61) + \$71.54}{3} = \text{Net Loss of } (\$23.62)$$

The above Fallow-Wheat-Corn and Field Peas-Wheat-Corn rotation budgets are very similar in net loss per acre. With just a $2.81/acre loss difference, small changes in price and yield in wheat or field peas would change the results. Under the current scenario, gains made in adding field peas are more than losses in income per acre with wheat after field peas.

For the field pea-wheat-corn rotation to equal the fallow-wheat-corn rotation, field pea price would need to decrease by $0.34 per bushel, yield would need to decrease by 1.24 bushel per acre, or a combination of the two.

4.1 Decision Tool

The researcher created an excel spreadsheet to aid in future rotational analysis between fallow-wheat-corn rotation and field pea-wheat-corn rotation. Ostmeyer Family Farms can use this decision tool to adjust commodity prices, yield, and expenses to get an accurate net income per rotation. Refer to Figure 4.1: Ostmeyer Family Farms Excel Decision Tool.

Figure 4.1: Ostmeyer Family Farms Excel Decision Tool

Crop Enterprise	Yield Goal	Actual Yield	Projected Price/Bushel	Gross Income/Acre	Gross Expenses/Acre	Net Income/Acre
Corn	101	101.00	$ 3.90	$ 393.90	$ 322.36	$ 71.54
Wheat (after peas)	31	31.00	$ 5.20	$ 161.20	$ 218.81	$ (57.61)
Wheat (after fallow)	39	39.00	$ 5.20	$ 202.80	$ 229.59	$ (26.79)
Field Peas	25	25.00	$ 7.00	$ 175.00	$ 259.79	$ (84.79)
Fallow				$ -	$ 124.03	$ (124.03)
Total Acres				Insurance Gaurantee		

Comparison	
Rotation	Net/Acre
F-W-C	$ (26.43)
P-W-C	$ (23.62)

4.2 Sensitivity Analysis

Figure 4.2: Field Pea-Wheat-Corn Rotation Sensitivity (Net Income/Acre)

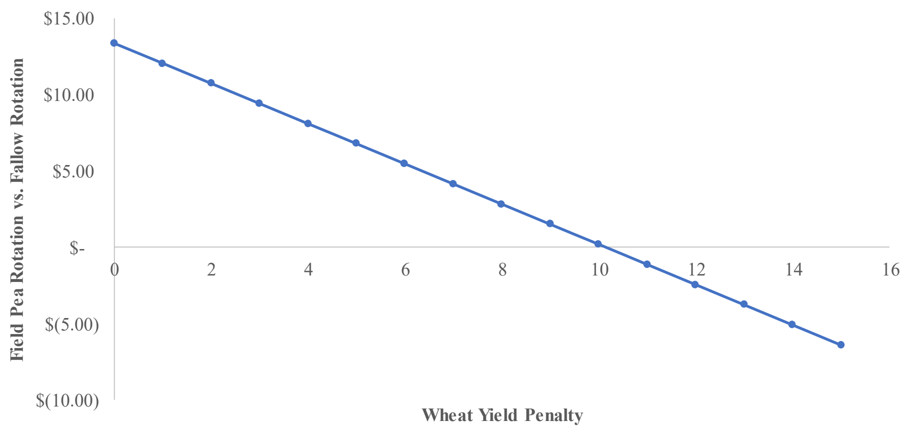
Field Pea Price

Field Pea Yield	$ 3.00	$ 4.00	$ 5.00	$ 6.00	$ 7.00	$ 8.00	$ 9.00	$ 10.00	$ 11.00	$ 12.00
0	$ (51.52)	$ (51.52)	$ (51.52)	$ (51.52)	$ (51.52)	$ (51.52)	$ (51.52)	$ (51.52)	$ (51.52)	$ (51.52)
5	$ (51.82)	$ (51.82)	$ (51.82)	$ (51.82)	$ (51.82)	$ (51.82)	$ (51.82)	$ (51.82)	$ (51.82)	$ (51.82)
10	$ (52.11)	$ (52.11)	$ (52.11)	$ (52.11)	$ (52.11)	$ (52.11)	$ (51.06)	$ (47.73)	$ (44.40)	$ (41.06)
15	$ (52.41)	$ (52.41)	$ (52.41)	$ (51.36)	$ (46.36)	$ (41.36)	$ (36.36)	$ (31.36)	$ (26.36)	$ (21.36)
20	$ (52.71)	$ (52.71)	$ (48.32)	$ (41.66)	$ (34.99)	$ (28.32)	$ (21.66)	$ (14.99)	$ (8.32)	$ (1.66)
25	$ (53.00)	$ (48.62)	$ (40.29)	$ (31.95)	$ (23.62)	$ (15.29)	$ (6.95)	$ 1.38	$ 9.71	$ 18.05
30	$ (52.25)	$ (42.25)	$ (32.25)	$ (22.25)	$ (12.25)	$ (2.25)	$ 7.75	$ 17.75	$ 27.75	$ 37.75
35	$ (47.55)	$ (35.88)	$ (24.22)	$ (12.55)	$ (0.88)	$ 10.78	$ 22.45	$ 34.12	$ 45.78	$ 57.45
40	$ (42.85)	$ (29.51)	$ (16.18)	$ (2.85)	$ 10.49	$ 23.82	$ 37.15	$ 50.49	$ 63.82	$ 77.15
45	$ (38.14)	$ (23.14)	$ (8.14)	$ 6.86	$ 21.86	$ 36.86	$ 51.86	$ 66.86	$ 81.86	$ 96.86
50	$ (33.44)	$ (16.77)	$ (0.11)	$ 16.56	$ 33.23	$ 49.89	$ 66.56	$ 83.23	$ 99.89	$ 116.56

Sensitivity analysis was completed using field pea price and field pea yield to show the result on net income for the field pea-wheat-corn rotation (Figure 4.2). Keeping everything else constant, a $1 increase in field pea price to $8 would increase the rotation's net income from a net income loss of ($23.62) to a net income loss of ($15.29). This scenario would increase the net income by $8.33 per acre. Conversely, a 5 bushel field pea yield decrease from 25 bushels to 20 bushels would decrease the rotation's net income from a net income loss of ($23.62) to a net income loss of ($34.99). This scenario would decrease the rotations net income by ($11.37).

Furthermore, an additional sensitivity analysis was completed on the wheat yield penalty after field peas. Figure 4.3 shows the variance between the field pea-wheat-corn rotation and fallow-wheat-corn rotation at different wheat yield penalties. A positive dollar amount results in higher net income per acre for the field pea rotation and a negative dollar amount is a higher net income per acre for the field pea rotation. Holding everything else constant, a wheat yield penalty greater than 10.13 bushel per acre would result in a higher net income per acre for the fallow-wheat-corn rotation.

Figure 4.3: Wheat After Peas Yield Penalty Sensitivity



4.3 Breakeven Analysis

A breakeven analysis was completed to show what field pea yield or field pea price would be needed to net the field pea-wheat-corn rotation a net income of $0. Using goal seek in excel with the decision tool created, the breakeven field pea price is $9.83 at the current assumed yield, while the breakeven field pea yield is 35.39 bushels per acre at the current assumed price. Refer to Figure 4.4 and Figure 4.5 below.

Figure 4.4: Ostmeyer Family Farms Field Pea Yield Breakeven

Crop Enterprise	Yield Goal	Actual Yield	Projected Price/Bushel	Gross Income/Acre	Gross Expenses/Acre	Net Income/Acre
Corn	101	101.00	$ 3.90	$ 393.90	$ 322.36	$ 71.54
Wheat (after peas)	31	31.00	$ 5.20	$ 161.20	$ 218.81	$ (57.61)
Wheat (after fallow)	39	39.00	$ 5.20	$ 202.80	$ 229.59	$ (26.79)
Field Peas	25	35.39	$ 7.00	$ 247.72	$ 261.64	$ (13.93)
Fallow				$ -	$ 124.03	$ (124.03)
Total Acres				Insurance Gaurantee		

Comparison	
Rotation	Net/Acre
F-W-C	$ (26.43)
P-W-C	$ 0.00

Figure 4.5: Ostmeyer Family Farms Field Pea Price Breakeven

Crop Enterprise	Yield Goal	Actual Yield	Projected Price/Bushel	Gross Income/Acre	Gross Expenses/Acre	Net Income/Acre
Corn	101	101.00	$ 3.90	$ 393.90	$ 322.36	$ 71.54
Wheat (after peas)	31	31.00	$ 5.20	$ 161.20	$ 218.81	$ (57.61)
Wheat (after fallow)	39	39.00	$ 5.20	$ 202.80	$ 229.59	$ (26.79)
Field Peas	25	25.00	$ 9.83	$ 245.86	$ 259.79	$ (13.93)
Fallow				$ -	$ 124.03	$ (124.03)
Total Acres				Insurance Gaurantee		

Comparison	
Rotation	Net/Acre
F-W-C	$ (26.43)
P-W-C	$ -

4.4 Worst Case Scenario

A worst case scenario was completed to see at what point the net income with each enterprise budget is at its lowest point. This happens when crop insurance guarantee is reached, and expenses are the highest per enterprise unit.

Revenue assurance crop insurance at the 70% insurance level is used by Ostmeyer Family Farms. This type of crop insurance uses a preset price and actual production history (APH) yield to determine insurance value.

Revenue Guarantee = APH X Price X Coverage %

This revenue guarantee provides a safety net for the enterprise budgets for corn, wheat after fallow, and continuous wheat. A written agreement was obtained for field peas; therefore, a safety net is also available. Refer to the below Figure 4.6: Crop Insurance Guarantee.

Figure 4.6: Crop Insurance Guarantee (Net Income/Acre)

Commodity	Corn	Wheat	Wheat	Peas
Practice	CNTCR	SUMFW	CNTCR	CNTCR
APH	89	39	27	18.8
Gaurantee Price	$ 3.96	$ 5.74	$ 5.74	$ 6.60
Coverage %	70%	70%	70%	70%
Cost	$ 12.75	$ 4.11	$ 11.87	$ 5.89
Revenue Gaurantee/acre	$ 246.71	$ 156.70	$ 108.49	$ 86.86

Figure 4.7: Worst Case Ostmeyer Family Farms Scenario

Crop Enterprise	Yield Goal	Actual Yield	Projected Price/Bushel	Gross Income/Acre	Gross Expenses/Acre	Net Income/Acre
Corn	101	63.00	$ 3.90	$ 246.71	$ 315.00	$ (68.30)
Wheat (after peas)	31	20.00	$ 5.20	$ 108.49	$ 216.45	$ (107.97)
Wheat (after fallow)	39	30.00	$ 5.20	$ 156.70	$ 227.67	$ (70.96)
Field Peas	25	12.00	$ 7.00	$ 86.86	$ 257.48	$ (170.62)
Fallow				$ -	$ 124.03	$ (124.03)
Total Acres				Insurance Gaurantee		

Comparison

Rotation	Net/Acre
F-W-C	$ (87.76)
P-W-C	$ (115.63)

The worst case scenario is reached when corn yield is 63 bushels per acre, wheat (after peas) is 20 bushels per acre, wheat (after fallow) is 30 bushels per acre, and field pea yield is 12 bushels per acre. This results in F-W-C rotation net income loss per acre of ($87.76) and P-W-C rotation net income loss per acre of ($115.63) (Figure 4.6). This worst case scenario would favor the F-W-C rotation by $27.87/acre. This difference is due to field peas having a worst case net loss of ($170.62) per acre compared to fallow net loss of ($124.03) per acre.

4.5 Actual Machinery Cost Scenario

The researcher used custom rates for field operations in order to illustrate a conservative value for these expenses. However, Ostmeyer Family Farms does have a full line of equipment. The addition of field peas to the rotation would add equipment savings due to economy of scale. Drilling and harvesting additional acres would allow Ostmeyer

Family Farms to spread the fixed equipment cost like insurance and cost of capital over additional acres. This would ultimately decrease the cost per acre of field operations. Using Iowa State University's "Machinery Cost Calculator", the researcher estimated the actual cost per acre of each field operation based on Ostmeyer Family Farms actual equipment values (Iowa State University Extension and Outreach 2019). This information was analyzed using the Ostmeyer Family Farms decision tool (Figure 4.1). The results are below in Figure 4.8.

Figure 4.8: Ostmeyer Family Farms Actual Machinery Cost Scenario

Crop Enterprise	Yield Goal	Actual Yield	Projected Price/Bushel	Gross Income/Acre	Gross Expenses/Acre	Net Income/Acre
Corn	101	101.00	$ 3.90	$ 393.90	$ 313.07	$ 80.83
Wheat (after peas)	31	31.00	$ 5.20	$ 161.20	$ 203.51	$ (42.31)
Wheat (after fallow)	39	39.00	$ 5.20	$ 202.80	$ 218.14	$ (15.34)
Field Peas	25	25.00	$ 7.00	$ 175.00	$ 231.52	$ (56.52)
Fallow				$ -	$ 109.94	$ (109.94)
Total Acres				Insurance Gaurantee		

Comparison	
Rotation	Net/Acre
F-W-C	$ (14.82)
P-W-C	$ (6.00)

Based on the actual equipment cost, the field pea-wheat-corn rotation has a lower net loss per acre of $8.82 over the fallow-wheat-corn rotation, which is greater than the custom rate approach of $2.81 per acre. Again, the researcher elected to use custom rates for field operations expense to show a more conservative value.

4.6 Current Market Price Scenario

USDA projected prices were used in the research to eliminate the day-to-day variances in wheat and corn price. The current market price scenario was used to show the difference between each rotation using current contract prices on April 13, 2019 for corn and wheat (Figure 4.9). Field Pea price remains unchanged with a contract price of $7.00 per bushel. Corn price at harvest delivery was changed to $3.51 per bushel, while wheat was changed to $3.92 per bushel. This resulted in a fallow-wheat-corn rotation net loss of

($54.92) and a field pea-wheat-corn rotation net loss of ($49.98). This scenario favors the field pea-wheat-corn rotation by $4.94 per acre. It is worth noting at this level wheat after fallow has hit it's crop insurance guarantee of $156.70 per acre.

Figure 4.9: Ostmeyer Family Farms Current Market Price Scenario

Crop Enterprise	Yield Goal	Actual Yield	Projected Price/Bushel	Gross Income/Acre	Gross Expenses/Acre	Net Income/Acre
Corn	101	101.00	$ 3.51	$ 354.51	$ 322.36	$ 32.15
Wheat (after peas)	31	31.00	$ 3.92	$ 121.52	$ 218.81	$ (97.29)
Wheat (after fallow)	39	39.00	$ 3.92	$ 156.70	$ 229.59	$ (72.89)
Field Peas	25	25.00	$ 7.00	$ 175.00	$ 259.79	$ (84.79)
Fallow				$ -	$ 124.03	$ (124.03)
Total Acres				Insurance Gaurantee		

Comparison

Rotation	Net/Acre
F-W-C	$ (54.92)
P-W-C	$ (49.98)

CHAPTER V: CONCLUSION

The thesis evaluates the economic feasibility of replacing summer fallow with field peas in northwest Kansas; moreover, on Ostmeyer Family Farms. The literature review examined field pea agronomics, field pea market, and crop rotational effects. This research showed that field peas would agronomically grow well on Ostmeyer Family Farms' ground and the market would be available to sell the grain.

Further analysis was completed to determine the economical effect of replacing fallow with field peas in a normal rotation. This was measured by completing individual rotation budgets to determine the net income per acre per rotation. The rotation budgets' results illustrate a fallow-wheat-corn rotation net income loss per acre of ($26.43), while a field pea-wheat-corn rotation net income loss per acre of ($23.62). This indicates that the field pea-wheat-corn rotation would outperform the fallow-wheat-corn rotation based on the assumptions in this research by $2.81 per acre.

In the worst case scenario, fallow-wheat-corn rotation net income loss per acre is ($87.76), while field peas-wheat-corn rotation net income loss per acre is ($115.63). This analysis shows that the field peas-wheat-corn rotation is riskier from a worst case scenario by $27.87 per acre.

The breakeven analysis showed what yield and price was needed to make the budget rotation net income $0; however, a better comparison would be to compare the field pea-wheat-corn rotation to equal the fallow-wheat-corn rotation. The researcher found that the field pea-wheat-corn rotation would be riskier, but overall more profitable than the fallow-wheat-corn rotation. Based on the above, the researcher would recommend

Ostmeyer Family Farms switch the farm from a fallow-wheat-corn rotation to a field peas-wheat-corn.

However, it would be beneficial for Ostmeyer Family Farms to experiment with the field pea-wheat-corn rotation on a small acreage, since the difference between each rotation is very minimal. This would allow for them to observe what the actual yield of field peas and yield penalty on the follow wheat crop with their soils and farming practices. Doing this on a small acreage would limit the loss if the worst case scenario were to happen.

The increase in weed resistance and overall cost of the fallow period is the underlying reason for this project. When chemicals like glyphosate were initially introduced in the early 90's, three sprayings with glyphosate would be the fallow period cost. Now with the introduction of chemical resistant weeds, four to five sprayings with multiple different chemicals is need for the fallow period. Without the introduction of new chemical chemistries, the fallow cost could continue to rise and make the field pea-wheat-corn rotation even more beneficial. Ostmeyer Family Farms should continue to reassess this with the decision tool provided with this research as grain and input prices change.

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