Economic implications of intensive early stocking on feeder cattle markets and land values in the Flint Hills

by

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B.S., Montana State University, 2018

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Agricultural Economics
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2021

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Abstract

Over the past 45 years, intensive early stocking (IES) has become the preferred grazing system of cattle producers in the Flint Hills region. Intensive early stocked steers gain more per day compared to their season-long (SLS) counterparts since they are stocked at twice the normal stocking density until mid-growing season (Smith and Owensby 1978). They reported that, compared the normal season-long grazing, overall daily gains and gains per acre were increased under IES. Because of that change, we speculated that there could be a direct effect on feeder cattle prices and land values. More specifically, under IES, steers at marketing time reached more desirable weights than those produced in the SLS system. Therefore, high-quality grazing land should become more desirable than before and feeder cattle prices and land values should increase. That question has not been addressed in the literature to date. This study estimates if, and to what magnitude, the impacts IES in the Flint Hills had on feeder cattle markets and land values in the form of feeder cattle prices and county-level land values. Results show on average an increase in feeder cattle prices of $0.27/cwt per 1% increase in adoption. The Flint Hills has land values that are statistically different than two of four regions of Kansas. In those two regions, IES increased the value of land. Additionally, a survey was conducted to determine whether a producer would opt to change from their current grazing practice to IES, or IES with late season grazing (IES+LSG). Producers surveyed preferred both IES and IES+LSG systems to neither system and with constraints of average daily gain and labor costs, only average daily gain was statistically significant in their decision.

Table of Contents

List of Figures

List of Tables

List of Equations

Acknowledgements

There are a few people I would like to thank for keeping me motivated and sane during my time at Kansas State University. First, I could not have done this without God's grace or strength and feel truly blessed to have had this opportunity. My family has truly been more supportive than I could have ever imagined. Mom and Dad, thank you for the many phone calls, meals during the pandemic, and being the best parents, a gal could ask for. Lindsay and Hannah, you are the best little sisters I have ever had. Thank you for calling to check in, asking to see my dog, and keeping me laughing. To Brycen, thank you for being supportive, loving and kind while I have been over a thousand miles away. Thank you for surprising me and making sure I always have a smile on my face.

There are many professors at K-State that made my experience superb. To Dr. Tonsor, thank you for being patient with multiple double emails, questions, and hairbrained ideas. Thank you to Dr. Clenton Owensby for giving me this Montana kid an opportunity to research a topic that is important to the future of cattle producers in the Flint Hills. Dr. Schroeder, thank you for putting up with my daily fun facts in class, and challenging my thinking to improve my research.

Without my friends here in MHK, I would not be finishing my degree. The "herd" made me feel at home in a place where I initially didn't know a soul. Our cohort is a special one, and those are memories I will treasure.

Last but not least, to the podcasters that kept me laughing, alone, while I worked, cooked, and cleaned. Bert Kriescher and Tom Segura, Kenyon, Lucy and Amanda, y'all are funny. Thank you.

Chapter 1 - Introduction and Literature Review

Grazing cattle in the Flint Hills has been an integral part of growing cattle in eastern Kansas for over a century. There is existing literature that addresses the benefits to both rangeland quality and stocker cattle gaining efficiency. However, there is no literature to date that addresses the impact grazing in the Flint Hills region has on land rental rates. Extensive literature has studied the impact of the Conservation Reserve Program, government grazing permit rates, and ecological impacts, for example. There is also research reported in some of these papers that can be important to understanding the relationship between a grazing system and land values.

In constructing a model that would accurately estimate land values, without any specificity for location or attributes, we sought out literature which addressed estimating the value land. We hypothesized that net farm income could be a determinant of farmland values. Land in Kansas adjusts to changes in net farm income slowly, but in periods like the 1970s and 1980s it is more difficult to estimate the impact of net farm income on land value because of the volatility in agricultural markets and interest rates (Featherstone, Taylor and Gibson 2017).

Ecologically, the Flint Hills is unique in its soil profile and plant biome. The soil was developed from a shale and limestone bedrock; the soil can be as shallow as one meter before hitting bedrock, and is ultimately classified as thin soils (National Parks Service n.d.). The ecological area is characterized by well-draining soil that is a gravelly silt loam in the top four inches followed by extremely gravelly horizons that hit bed rock at forty-four inches (USDA NRCS 2019). Intuitively, higher quality soil that are better for farming or grazing should be higher in value compared to poor quality soils.

Hanson (2013) used a parcel level analysis in Illinois to determine land values. They found a major connection between soil quality and sales price. While our model does not directly use soil quality as a variable, by including a Flint Hills dummy variable we may capture how this unique land type could impact overall value.

The Flint Hills can be considered rural in comparison to areas like Kansas City. Stewart and Libby (1998) studied the value of farmland in the Madison-Milwaukee-Chicago triangle to understand the impact of urbanization. Their findings suggest that land in Dekalb County, Illinois, is under pressure for conversion, but can be protected by zoning regulations. We hypothesize the best way to model urbanization in this study is to use population of a given county to control for differences in farmland conversion pressures.

Additionally, other literature reinforces that net farm income, population and land quality affect land values. In the Snake River valley of Idaho, farmland is impacted by wheat yield, population, credit availability, as well as interest rates and debt to asset ratios (Devadoss and Viswanadham 2007). That solidifies our reasoning for including net farm income, population, and interest rates in our models. While it would be helpful, on a multi-county level, it could be difficult to model credit availability without complex coding and analysis. While it could be important, we still use interest rate as a proxy for the cost of borrowing money and assume equal access to credit.

Stocker livestock is a unique segment of the beef cattle industry. This portion of a beef animal's life can be spent in a multitude of regimes. More broadly, the stocker segment is defined as the time between weaning a calf from the mother cow, to entering the feedlot for finishing (D. S. Peel 2006). The supply of stocker calves is not only sourced from domestic producers, but also from Canada and Mexico. Approximately one third of total beef imported from Canada and Mexico in the early 2000s were stocker or feeder cattle (Falconer and Anderson 2006). In the first quarter of 2020, the United States imported 731,535 head of cattle. Of the total, 539,668, or nearly 74% were stocker feeder type cattle.

Over the past 45 years, intensive early stocking (IES) has become the preferred grazing system of cattle producers in the Flint Hills region (C. E. Owensby, Professor 2019). Intensive early stocked steers gained more per day compared to their season-long counterparts, at twice stocking density for the first half of the grazing season followed by no grazing for the remainder of the season (Smith and Owensby 1987).

The Flint Hills of Kansas and Northern Oklahoma manage their tall grass prairie differently than producers might in the Northern Great Plains. Typically, producers will burn pastures in the late spring, removing surface litter. This burning does have a positive impact on forage quality and increases per head gains by 32 lb. per steer compared to unburned Flint Hills pastures (Anderson, Smith and Owensby 1970).

Owensby and colleagues have expanded the grazing research on intensive early stocking, season long stocking, and late season grazing. This new system, we will refer to as IES+LSG, using the intensive early stocking with the addition of grazing cattle after July through October. For example, if you have one-hundred cattle on a pasture that are stocked at twice the density you would for season long grazing, you would remove half, or 50, in July and leave the remaining 50 until October. This can increase pasture mean return per hectare by $5.98 compared to IES, and $8.52 compared to season long stocking (Owensby, et al. 2008). They found that, without the addition of supplemental feed using IES+LSG rotated with IES or SLS among years had a higher net return than using a continuous system year-on-year (Owensby and Auen 2018).

Because of this change in regimes, there could be a direct effect on feeder cattle prices and land values. More specifically, the marketing time of lighter calves is earlier than under the previous stocking method, and high-quality grazing land becomes more desirable. Feeder cattle prices and land values should increase. That question, being location-specific, has not been addressed in the literature to date.

That is not to say previous research has not addressed topics in the stocker-feeder space, because there is extensive literature on adjacent topics. Schroeder et al. (1988) states that prices are affected by the time of year in which the sale occurs. That difference can be seen in a $1 to $2 premium per hundredweight in the second and third quarters. This conclusion is important to the structural change in the market with IES. Previously, cattlemen were selling calves in the fall months after having grazed those calves fort the entire season on the tall-grass prairie. Under EIS, cattle are removed in July and sold at that time. After being sold and placed in a feedlot, compared to their non-IES counterparts, IES grazed cattle were 16% more efficient in the feedlot phase (Vermeire and Bidwell 2020).

The difference in cattle weights and prices is known as the price-weight slide. That differential can be explained simply as lower (higher) weight calves bring a higher (lower) price per hundredweight (Peel and Riley 2018). Producers that are utilizing IES and selling in July are capturing a higher price per hundredweight, even though calves are a lighter weight.

Cattle producer behavior has been studied since the 1950s. Griliches (1957) found that producers adopting technological innovation, like hybrid corn, found profitability to be the most influential factor in choosing to adopt.

Cow-calf producer behavior has also been studied when it comes to adopting a new practice. Kim et al. (2004) analyzed if a cow-calf producer would adopt Best Management

Practices (BMP), and rotational grazing. They found that farmers that are more diversified are more willing to adopt new practices. Additionally, a willingness to adopt a grazing rotation is directly correlated with the expectation of a producer receiving a higher bid for their cattle.

Other works have studied how producers would implement new technologies like management practices, implants, and stocking rates to name a few. Operation demographics were most significant, in this particular study, in whether or not a producer will adopt a new practice (Johnson, et al. 2010). Our survey instrument is different from the one used in Johnson et al. because it not only incorporates stocking rate, but the grazing horizon. That study can also identify the influence of operation size is influential in adopting a new grazing practice through the survey instrument.

One of the few studies that examines why a producer would not adopt a practice, is by Gillespie, Kim and Paudel (2006). They surveyed cattle producers to gather information about why a producer would or would not adopt one of the 16 best management practices. The two most cited reasons for not adopting a practice were unfamiliarity with the practice, and inapplicability to their operation. This could be true for our survey instrument, so we attempted to parse out inapplicable respondents by separating out producers that do not graze cattle at any point during the year.

There is vast other literature that evaluates the impact of IES on other segments of the cattle lifecycle. When feeding calves a uniform diet, then using IES, calves are more efficient and more rapidly gain weight in the feedlot phase (Brandt, Owensby and Milton 1995). Utilization of IES is not only beneficial to the cattle, but to the land. This short-term system allows for producers to double their stocking density for half the grazing season, without overgrazing their rangeland (Booysen and Tainton 1978). Stockers will go on to the feeder phase and will most likely start in the lot with a high forage diet with a transition to a high grain diet as the cattle reaches harvest weight.

This research focuses on the impact of IES on feeder cattle and land values in the Kansas Flint Hills as well as how producers might adopt a new grazing regime. In studying this topic, we were able to glean insights into producer behavior, decision making, and the impact of Dr. Clenton Owensby's work in studying grazing systems. Understanding the impact of IES on cattle prices can indicate a structural change in the market for feeder cattle. Similarly, if IES changes the grazing cycle of cattle, this could indicate a change in the demand for certain types of land. Lastly, a survey, while it is not a perfect predictor of producer decision making in the moment, can help us to gain insights into how a new system could in turn impact feeder cattle prices and land values in the Kansas Flint Hills region.

This thesis will address three main topics. The impact of IES on feeder cattle markets, the impact of regional differences in the impact of IES on land values and lastly a nationwide survey of the possible adoption of a new grazing system and a prediction of how production selection would change if we change variables like average daily gain and labor costs.

Chapter 2 - Cattle

This chapter focuses on the impacts of intensive early grazing on feeder cattle prices. Regression models were used to estimate the impact given three different estimations of adoption paths.

Data and Methods

Monthly Oklahoma City steer feeder cattle sales price data, in dollars per hundred weight, was obtained from the Livestock Marketing Information Center. The start year of the dataset is 1973 and culminates in 2011. Admittedly, early intensive stocking started to become a practice in the 1970s, however, this is the oldest dataset available which is why it is utilized here. Historical monthly corn prices, in dollars per bushel came from Macrotrends.

2-1 Cattle Model Summary Statistics

Variable	*Units*	*Mean*	*Min*	*Max*
Feeder Cattle Price	Monthly average dollars per hundredweight on feeder cattle sold	84.652	24.360	183.690
Weight	Pounds/head, in categorical variables	600.000	450.000	750.000
Adopt Simple	0, before 1975, 1 as a percentage	93.200	0	100.000
Adopt Smooth	0 in before 1975 and a linear trend to 95%, as a percentage	45.100	0	95.000
Adopt Kink	Dr. Owensby's opinion of adoption, as a percentage	59.700	0	95.000
Corn Price	Monthly average futures price in dollars/bushel	2.848	1.504	7.536
Fed Cattle Price	Monthly average fed cattle price in dollars/hundredweight	69.104	34.740	125.004
Number of Observations	1,872			

The cattle dataset contains 1,872 monthly observations. Summary statistics are displayed in Table 2-1. The feeder cattle price, in dollars per hundredweight is the average nominal price received for feeder calves in Oklahoma City on a monthly basis. This is stacked into four different weight classes. The average feeder cattle price in the dataset is $84.65/cwt. The minimum price observed is $24.36/cwt, and the maximum is $183.69/cwt. The only weights included in the dataset are from 450 to 750 pounds. For modeling purposes, weight classes are defined as 400-499 for the “450” category, 500-599 for “550”, 600-699 for “650” and 700-799 for “750.” These are middle weights in the cattle life cycle and made the best parallel to the weight of calves that are found on stocker operations. The mean weight is 600 pounds.

Adoption percentages in this study were determined using Dr. Clenton Owensby’s expert opinion of the practice, as well as two simpler models. Figure 2-1 displays the different levels. The *kinked adoption* is the outcome as hypothesized by Dr. Owensby. He stated that producers started utilizing IES in the early 1970s, and by 1980, fifty percent of producers were using IES until 1985 and producer adoption increase to 95% by 2010 (C. E. Owensby, Professor 2019). To connect the difference, a linear trend is drawn. The *simple adoption* is that before 1975, no producers used the practice a dummy variable equal to 0, and after 1975 a dummy variable equal to one, all used EIS. The *Smooth adoption* is a combination of the *simple* and *kinked* estimates. No producers used EIS prior to 1975 or 0, ninety-five percent adopted by 2010 or 0.95, and a linear trend is used between the two. While it is recognized that the practice was not adopted exactly in this manner, we hypothesize that this is a reasonable representation of the possible adoption path.

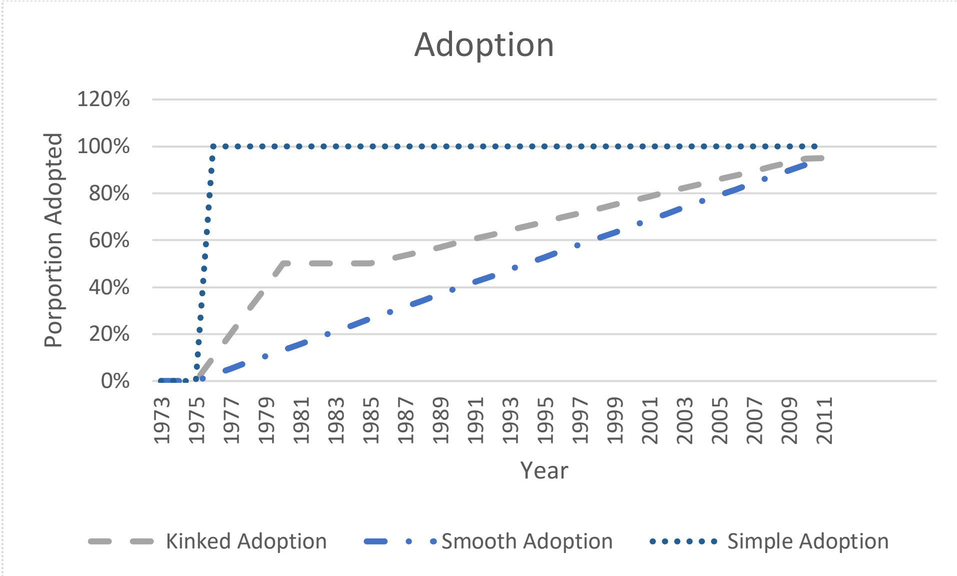


Figure 2-1 Estimated Adoption Trends

The time trend of feeder cattle prices, for all weight-classes can be seen in Figure 2-2. The trend in prices over time is the same between weight classes. This signaled that we needed to include a time trend dummy variable to control for seasonality and events that occurred that which otherwise would be impossible to exclude from our model. Throughout a given year, most cattle producers calve in the spring, and wean and ship feeder type cattle in the fall and winter months. This seasonality is unique to the cattle industry and is different from pork in that pork producers are able to sell multiple lots of feeder hogs when cattle producers are only able to place one. This also explains why we included a monthly dummy to control for uneven supply of feeder weight cattle throughout the year.

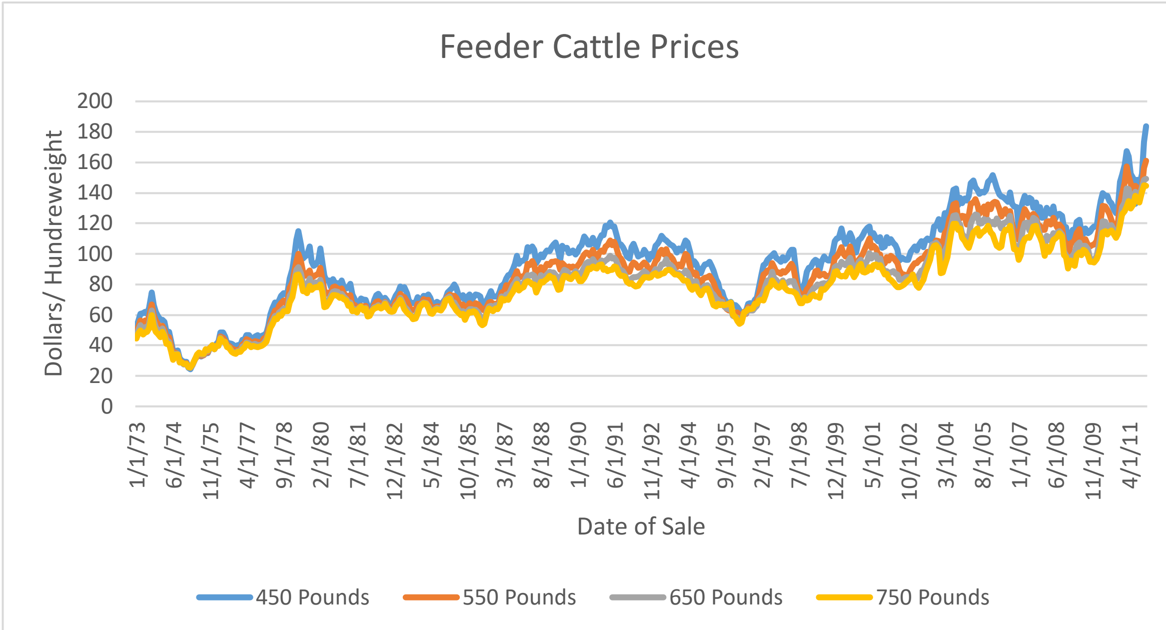


Figure 2-2 Feeder Cattle Prices

Additionally, Figure 2-2 shows that feeder cattle prices spiked in the late 1970s and then dip in 1995 necessitating a need to include a decade dummy. For example, the 1980-1989 dummy is equal to 1 for those years and 0 otherwise. We attempted to use individual year dummies, but because our adoption variable is 0 or 1 in a very specific group of years, the adoption variable would be excluded from the model in these circumstances because of multi-collinearity issues. By using the decade dummies, we were able to control for outside events and use our adoption variable in the model.

The corn price per bushel, from the futures market is in nominal terms for each year. The average corn price is $2.85/bushel and had a standard deviation of $1.00/bushel. The minimum corn price is $1.50/bushel, and the maximum is $7.63/bushel.

Monthly average fed cattle price is used as a proxy for the demand for beef from cattle. Feeder calves are an input to making fed cattle and this term holds demand constant across the entire time period. The demand for beef products can signal the demand for feeder cattle. The average price/hundredweight of a finished beef animal is \$69.10. The minimum price in the dataset for fed cattle is \$34.74/cwt and the maximum is \$125.00/cwt.

Equation 1 Feeder Cattle Price Estimation

$$Feeder\ Price = \alpha_0 + \beta_1 Weight + \beta_2 Adoption\% + \beta_3\ Corn\ Price + \beta_4 Weight * Adoption\% + \beta_5\ Fed\ Cattle\ Price + \beta_6 Monthly\ Fixed\ Effects + \beta_7\ Decade\ Fixed\ Effects + \varepsilon$$

Equation 1 shows a mathematical representation of the statistical model used to estimate the impact of IES on feeder cattle markets. The α_0 is the baseline feeder cattle price without considering any of the other variables, graphically, it is the intercept of the y-axis. Each of the β terms is the impact of the variable on the price of feeder cattle. Since this is an estimation and it does not explain all the variation in the data, ε is the difference between the estimated values and the actual values in the dataset.

To estimate if adoption of IES impacted feeder cattle prices in the Oklahoma City market region, Equation 1 is evaluated three ways considering the alternative adoption pathways. We estimate this simple OLS regression by using weight, adoption percentage, corn price, an interaction term with weight and adoption, as well as month and decade effects to control for seasonality and differences between years, as previously discussed. The adoption percentage is changed three times to analyze how different adoption scenarios could have impacted the feeder cattle price.

By including corn price we control for the impact of changes in feed price on feeder cattle prices. Corn is an essential input to the production of fed cattle and can be used as a barometer for feeder cattle prices. For example, if corn prices are high, feedlot operators may not be willing to pay as much for feeder cattle to maintain margins.

Producers that use IES typically use calves that are recently weaned from their mothers and are not yet ready for the feedlot. The interaction term between adoption and weight is essential to understanding the relationship between weight and adoption. If a producer is buying feeder cattle at certain weights, it could be more advantageous for using EIS over a different practice.

Controlling for seasonality between time periods is important because of the cyclical nature of the cattle industry. From the time a calf is born to being a fed animal going to the processing facility is over one year. For example, a cow can be bred in June 2019, calve in March of 2020, that calf is weaned in the fall of 2020, and is fed until the harvest of that calf in the late summer or fall of 2021. So, controlling for differences between months, as producers may be fall or spring calvers, is important to understand changes in prices only from EIS.

Results

In considering three alternative adoption paths, we have results that would reflect different adoption scenarios. All models use Equation 1, but the adoption variable is different for each. Model 1 uses the kinked estimate, Model 2 uses the smooth estimate, and Model 3 uses the simple estimate. The adoption variables as well as the adoption and weight interaction terms were statistically significant at the one percent level in all three models. The derivation for the marginal impact of weight and adoption on feeder cattle price is shown in Appendix A.

When evaluating the marginal impact of weight and adoption using the interaction term the variable of interest can change, but the other will be held constant. The calculations in Appendix A are specific to the marginal impact of 650-pound calves. This calculation can be re-done with any specific weight to find the marginal impact of weight. The same can be said about adoption. Weight was held constant when calculating the marginal impact. From that, we are able to calculate the impact of adoption with any level of adoption. In our estimation for the marginal impact of the weight and adoption variables, we used the mean for each of the adoption types.

Statistical significance when interpreting the OLS models uses three difference "alpha" values, or p-values. While it is common to use an alpha of 5% as a tolerance for research, we wanted to distinguish between variables that are more or less significant than one another. The alpha values used are 1%, 5% and 10%. When the p-value of a variable of a variable is below one of these alphas, we call it statistically significant. For example, the p-value for weight in Model 1 of Table 2-3 is 0.005. This means that there is a 0.5% chance that weight does not have an impact on feeder cattle price. Or, a 99.5% chance that weight does have an impact on feeder cattle price.

Table 2-3 contains the kinked adoption type, model 1 results. As a refresher, Model 1, denoted as Equation 1 earlier is displayed above the table. For a 100% increase in adoption, IES is estimated to have increased feeder cattle prices by $28.74/cwt. In other words, with each 1% increase in adoption, feeder cattle prices are estimated to increase by about $0.29/cwt. This model explains 92.45% of the variation in the data indicating we have reasonably captured the majority of feeder cattle price determinants.

The marginal impact of weight on feeder cattle price is a decrease in price of $0.05 per one-pound increase in weight. That is, we expect to see a $5 decrease per hundredweight for each 100-pound increase in calf weight. This is significant at the 1% level. On average, feeders are willing to pay a lower price/cwt for heavier feeders versus light feeders. That outcome is what we expected.

The corn price variable is significant at the 1% level. For a $1/bushel increase in corn prices, we find decrease in feeder cattle prices of $4.90/cwt. Feed price is one of the largest expenses incurred for the next stage of a stocker calf's life. If a feedlot is producing fed cattle, two important inputs are feeder cattle and corn, or other feedstuffs. If the price of corn increases, a feeder is willing to pay less for feeder cattle. Economically, this estimate of the variable's sign is logical.

By using the price of fed cattle as a proxy for demand for beef, a $1/cwt increase in fed cattle price increases the feeder price by $1.33 in this model. When demand for beef is high, we expect the price that feedlots are willing to pay for feeder cattle to increase.

$$Feeder\ Price = \alpha_0 + \beta_1 Weight + \beta_2 \boldsymbol{Kinked\ \ Adoption}\% + \beta_3\ Corn\ Price + \beta_4 Weight * Adoption\% + \beta_5\ Fed\ Cattle\ Price + \beta_6 Monthly\ Fixed\ Effects + \beta_7\ Decade\ Fixed\ Effects + \varepsilon$$

Table 2-2 Equation 1 Model 1 Results

Cattle Model 1	*Coefficient*	*Standard Error*	*p-value*	*95% Confidence Interval*

*Adoption- Kink****	70.138	4.3366	0.000	61.633	78.644
*Weight****	-0.011	0.004	0.005	-0.018	-0.003
*Corn Price****	-4.902	0.236	0.000	-5.365	-4.439
*Weight x Adopt****	-0.069	0.006	0.000	-0.081	-0.057
*Fed Cattle Price****	1.333	0.042	0.000	1.286	1.381
January	-0.831	0.845	0.325	-2.488	0.825
February	0.495	0.844	0.557	-1.160	2.151
March	0.093	0.844	0.912	-1.561	1.748
April	-0.397	0.844	0.638	-2.053	1.259
May	-0.750	0.844	0.374	-2.405	0.905
June	1.113	0.844	0.188	-0.543	2.769
*July***	1.714	0.844	0.042	0.059	3.370
August	1.777	0.844	0.035	0.122	3.432
September	0.571	0.844	0.499	-1.085	2.226
October	-1.469	0.844	0.082	-3.124	0.186
*November**	-1.430	0.844	0.090	-3.085	0.225
*1980-1989****	-10.652	1.020	0.000	-12.653	-8.651
*1990-1999****	-9.872	1.336	0.000	-12.492	-7.251
2000-2009	-6.747	1.727	0.000	-10.135	-3.359
2010-2011	-4.384	2.143	0.041	-8.588	-0.180
Constant	3.012	2.628	0.252	-2.143	8.167
R^2	0.923				
N	1,872				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Model 2 uses the smooth estimate of adoption with Equation 1. This estimation yields similar results to model 1. All variables that are not time control dummy variables are significant at the one percent level. This model explains 92.5% of the variation in the data. Regression results can be found in Table 2-3, and the model can be seen just above the table.

The marginal effect of adoption in this model results in a $24.72 increase in price of feeder cattle for the 100% increase in adoption, or $0.25/cwt increase in price for a 1% increase in adoption. The derivation of this value, and the marginal impact of weight can be found in Appendix A.

The weight variable results in a similar marginal effect as the first model. For a 1-pound increase in calf weight, we found a $0.052 decrease in the price of that calf. In other words, a 100-pound increase decreased the price per hundredweight by $5.20.

The last two variables, corn price and fed cattle price are similar to the outcomes in model 1. The corn price variable was negative; we observe a decrease in price by $5.20 for a $1 increase in corn price per bushel. If there was a $1 increase in the price of fed cattle, the model states there is an increase of $1.40 in feeder cattle price.

$$\begin{aligned} Feeder\ Price = {} & \alpha_0 + \beta_1 Weight + \beta_2\ \boldsymbol{Smooth\ Adoption}\% + \beta_3\ Corn\ Price + \beta_4 Weight * Adoption\% \\ & + \beta_5\ Fed\ Cattle\ Price + \beta_6 Monthly\ Fixed\ Effects + \beta_7\ Decade\ Fixed\ Effects + \varepsilon \end{aligned}$$

Table 2-3 Equation 2 Model 2 Results

Cattle Model 2	*Coefficient*	*Standard Error*	*p-value*	*95% Confidence Interval*	
*Adoption- Smooth****	61.31	4.120	0.000	53.237	69.396
*Weight****	-0.025	0.003	0.000	-0.030	-0.019

*Corn Price****	-5.200	0.241	0.000	-5.672	-4.728
*Weight x Adopt****	-0.061	0.005	0.000	-0.072	-0.051
Fed Cattle Price	1.402	0.23	0.000	1.357	1.447
January	-0.734	0.854	0.390	-2.409	0.941
February	0.554	0.853	0.516	-1.119	2.228
March	0.063	0.853	0.941	-1.610	1.763
April	-0.489	0.854	0.567	-2.163	1.185
May	-0.800	0.8533	0.348	-2.474	0.873
June	1.192	0.854	0.163	-0.482	2.866
July	1.803	0.854	0.035	0.129	3.477
August	1.832	0.853	0.032	0.159	3.506
September	0.620	0.853	0.468	-1.053	2.293
October	-1.454	0.853	0.089	-3.127	0.219
November	-1.466	0.853	0.086	-3.139	0.208
1980-1989	-6.79	0.823	0.000	-7.892	-4.665
1990-1999	-7.925	1.374	0.000	-10.619	-5.230
2000-2009	-6.888	2.024	0.001	-10.858	-2.917
2010-2011	-6.363	2.562	0.013	-11.387	-1.338
Constant	11.855	2.142	0.000	7.653	16.057
R^2	0.925				
N	1,872				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Model 3 explains 91.8% of the variation in the data and results are shown in Table 2-4. It should be noted that this simple adoption type would mean that after 1975, all producers would be using IES. Again, all non-time variables are significant at the one percent level. It should be said that this is likely not how adoption occurred, but it is worth the time to examine what would have happened if it did.

The marginal effect of adoption in model 3 was a $5.92 increase in price for a 100% increase in adoption, or an increase of about $0.06/cwt per 1% increase in adoption. Compared to model 1 and model 2, producers are worse off if they were able to adopt essentially overnight. They would flood the market and dampen the benefit by increase the supply of fed cattle in the market. Feed yards are not able to change the bunk space overnight, and this adoption estimate would not yield as much benefit as the other adoption types.

Weight, in this model, will decrease price by $0.052/pound, or $5.20/cwt. This is exactly the same result as the first two estimates. If corn prices increase by $1, we can expect a $4.71 decrease in the price of feeder cattle. Similar to our other models, if fed cattle price increase by $1, we expect a $1.41 increase in feeder cattle price.

$$Feeder\ Price = \alpha_0 + \beta_1 Weight + \beta_2\ \boldsymbol{Simple\ Adoption}\% + \beta_3\ Corn\ Price + \beta_4 Weight * Adoption\% + \beta_5\ Fed\ Cattle\ Price + \beta_6 Monthly\ Fixed\ Effects + \beta_7\ Decade\ Fixed\ Effects + \varepsilon$$

Table 2-4 Equation 1 Model 3 Results

Cattle Model 3	*Coefficient*	*Standard Error*	*p-value*	*95% Confidence Interval*

*Adoption- Simple****	28.723	3.730	0.000	21.407	6.038
*Weight****	-0.0173	0.006	0.003	-0.029	-0.006
*Corn Price****	-4.713	0.249	0.000	-5.201	-4.225
*Weight x Adopt****	-0.038	0.006	0.000	-0.050	-0.026
*Fed Cattle Price****	1.406	0.024	0.000	1.360	1.453
January	-0.687	0.883	0.437	-2.418	1.044
February	0.587	0.882	0.506	-1.143	2.317
March	0.055	0.882	0.950	-1.675	1.785
April	-0.515	0.883	0.560	-2.246	1.216
May	-0.841	0.882	0.341	-2.571	0.890
June	1.149	0.883	0.193	-0.582	2.879
July	1.825	0.883	0.039	0.094	3.556
August	1.867	0.882	0.035	0.136	3.597
September	0.651	0.882	0.461	-1.080	2.381
October	-1.415	0.882	0.109	-3.145	0.315
November	-1.436	0.882	0.104	-3.166	0.294
1980-1989	-3.777	0.747	0.000	-5.242	-2.312
1990-1999	1.071	0.804	0.183	-0.505	2.646
2000-2009	8.385	0.991	0.000	6.440	10.329
2010-2011	11.395	1.613	0.000	8.232	14.558
Constant	3.467	3.744	0.354	-3.875	10.810
R^2	0.918				
N	1,872				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Discussion and Implications

Over the period from 1973 to 2011, early intensive stocking had a positive impact on feeder cattle prices through an increase of, on average, $20.66 per hundredweight. Our assessment suggested this increase in feeder cattle prices ranged from $0.05/cwt to $0.29/cwt with each one percent increase in adoption. While these estimates are not perfect, largely reflecting how adoption rate is not actually observable, it does give statistically significant evidence of this which indicates that early intensive grazing increased feeder cattle prices. It is logical to assume that adoption did not happen overnight, so the true value of the increase in prices is likely closer the $0.28/cwt to $0.29/cwt per one percent increase in adoption. This estimate would be between the models based on smooth and expert opinion adoption trends.

Future research has space to improve upon this study by expanding the dataset. If heifers were also included in the data, it could affect the overall impact. Heifers, on average have a lower price per hundredweight of $10 to $15 as compared to steers (Peel and Riley, Feeder Cattle Price Fundamentals 2018).

The only available data from the Oklahoma City market goes back to 1973. Finding a greater range of historical data for the area could provide a more accurate estimation of the pre-period effects. Currently, the pre-period is only three years, and the simple adoption estimate shows a very different impact on price than the smooth or kinked estimates. This difference is, on average approximately $0.23/cwt per one percent increase in adoption.

Chapter 3 - Land

Chapter three discusses the impact of intensive early stocking on land values in the state of Kansas. We isolate Flint Hills counties from other to isolate the impact of grazing in the Flint Hills' unique ecosystem.

Data

Kansas historical county level average dollar value of farmland and improvements, in dollars per acre, came from the USDA census data that was used in Tsoodle and Wilson (2001). One benefit of this analysis compared to the preceding feeder cattle market assessment is use of data clearly capturing many years of pre-early intensive grazing to perhaps increase confidence in our findings. This dataset is for the years 1870-1997. Since 1997 is the last census year in the dataset, we went back 25 years to have a balanced pre and post period from initial adoption.

Farm profit data is from USDA Economic Research Service. Annual total data for Kansas is used, in nominal dollars. In this case, we are using this net cash income figure from the dataset to model if farming was or was not profitable in a given year. For ease of use, it is in millions of dollars.

Annual interest rate data was sourced from the World Bank. Adding interest rates in the model can indicate if borrowing money was "cheap" or "expensive." A higher interest rate will raise payments on land and ultimately cost more over the term of the loan.

Kansas County level population data came from the Kansas State Library. This figure is included to control for differences in rural and urban areas. For example, Overland Park, near Kansas City, has a drastically different population in contrast to Plains. Overland Park, KS has nearly 20 times as many residents as Plains, KS.

The Kansas Geological Society created a map of counties that are in the Flint Hills Region. This map was used to determine which counties were assigned to a given region. Regions were also used to determine regional differences in land values. USDA ARS regions were used to separate Kansas into 4 regions separate from the Flint Hills. A map of these regions can be found in Figure 3-1.

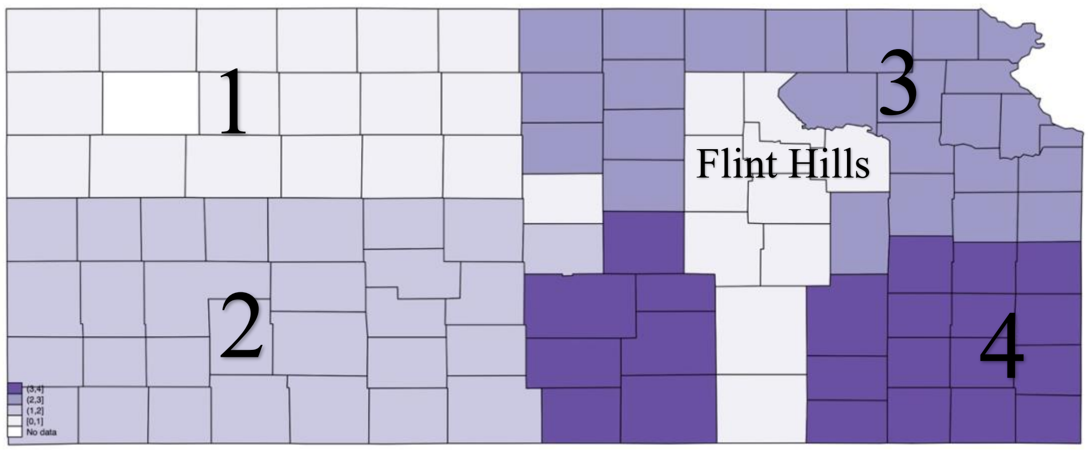


Figure 3-1 Regions

This dataset consists of 840 observations ranging from 1964 to 1997. A full list of summary statistics is in Table 3-1. Since the USDA census is only conducted every five years, the years 1964, 1969, 1974, 1978, 1982, 1987, 1992 and 1997 are used. Average land price in dollars per acre ranges from $73/acre to $2,349/acre reflecting both temporal and regional variation. The average value per acre is $419.95/acre.

The total net cash farm income for the state of Kansas, labeled as farm profit, is $1,258.816 million. The minimum of $444.2 million and a maximum of $1,991.353 million. This is the most granular estimate of net farm income available for the time period of data available from the USDA census data.

Population has a mean of 22,040.25 residents per county with a minimum population of 1,774 residents and a maximum of 403,662.

Adoption percentages of IES reflect the estimates provided by Dr. Owensby. Recall from the previous chapter that he estimated 95 percent adoption by 2010, and these data go only to 1997. Therefore, the maximum adoption for kink, smooth and simple are 72%, 50% and 100% respectively. The simple estimation is 0% before 1975 and 100% after 1975. The average adoption for the kinked estimate is 27%, for smooth it is 14% and for simple it is 60%. Intuitively, there are a greater number of observations after 1975, so the average for the simple estimate should be greater than 50%.

The interest rate has an average of 6.24%, the minimum is 1.01% and the maximum is 12.24%.

In the third model we analyze, Equation 4, the difference between Flint Hills county land values and those outside the Flint Hills. This type of model is used to analyze land values over time and if they are changing and the direction of the change relative to one another. We hypothesize that if a region has a greater average value per acre than the Flint Hills, and if demand for Flint Hills grazing land increases, land values in the Flint Hills will increase differentially from other regions.

The pairings for the difference model can be found in Table 3-1. The average Flint Hills land value is $326.43/acre, and the average land value for non-Flint Hills counties is $277.39/acre. The non-Flint Hills counties have a larger range in values from $38/acre to $872/acre. The Flint Hills counties have a minimum value of $62/acre to a maximum of $872/acre. When the difference is observed, Flint Hills values minus non-Flint Hills values, the average is $49.04/acre. The difference has a minimum of -$232 and a maximum of $396.

Table 3-1 Land Model Summary Statistics

Variable	**Description**	**Mean**	**Min**	**Max**

Year		1980.375	1964	1997
Land Price	Value from USDA ag census, in dollars per acre	419.95	73	2349
Farm Profit	Kansas annual total net farm income, in millions	1258.816	444.2	1991.353
Population	County level population data	22070.25	1774	403662
Adopt Kink	Dr. Owensby's opinion of adoption, in proportions	0.27	0	0.72
Adopt Smooth	0 in before 1975 and a linear trend to .95, in proportions	0.14	0	0.50
Adopt Simple	0, before 1975, 1 after, proportion of adoption	0.6	0	1
Interest Rate	Average monthly interest rate, in percent	6.24	1.01	12.24
Difference Model				
Land Price Non	$/acre for Non-Flint Hills Counties from USDA census	277.393	38	872
Land Price FH	$/acre for Flint Hills Counties from USDA census	326.429	62	730
Difference	FH- (Non-FH)	49.036	-232	396

Methods

To estimate the impacts of IES on the land markets, first we examined factors that could impact land values. The variables used to estimate land values included farm income, region, interest rate, and dummy variables to control for differences over time. This can be seen in Equation 2. Using a farm income variable explains whether farming is profitable. If farming is not profitable, farmland will not be worth as much. The region dummy controls for differences in regions. Land values near Kansas City are very different than in Colby, Kansas, for example because of the urban influence. The interest rate variable controlled for differences in borrowing behaviors across time. For example, interest rates in the 1980s and in the 1960s are drastically different. A graph of interest rates over time is displayed in Figure 3-2.

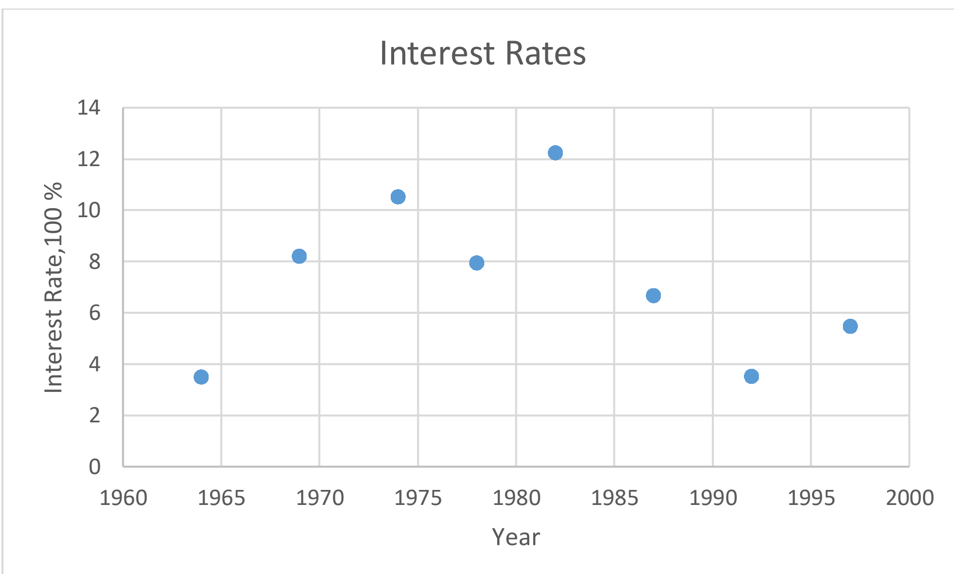


Figure 3-2 Interest Rate Over Time

Equation 2, Land Model 1 Land Value Estimation

$$Land\ Value^{County\ X} = \alpha_0 + \beta_1 FarmIncome + \beta_2 \text{Region} + \gamma_1 InterestRate + \beta_3 Time + \varepsilon$$

Next, we ran a model to identify if Flint Hills counties were statistically different in land value than those that were not in the Flint Hills region as demonstrated mathematically in Equation 3. Flint Hills Counties were identified by the Kansas Geological Survey and are shown in Figure 3-3. A 0, 1 dummy variable denotes whether a county is in the Flint Hills Region. Counties include Clay, Riley, Dickinson, Geary, Morris, Chase, Marion, Butler, Cowley, and Wabaunsee.

Equation 3, Land Model 2 Land Price Estimation with Flint Hills Specification

$$Land\ Value^{County\ X} = \alpha_0 + \beta_1 Flint\ Hills + \beta_2 Time + FarmProf + \gamma_1 InterestRate + \gamma_2 Population + \varepsilon$$

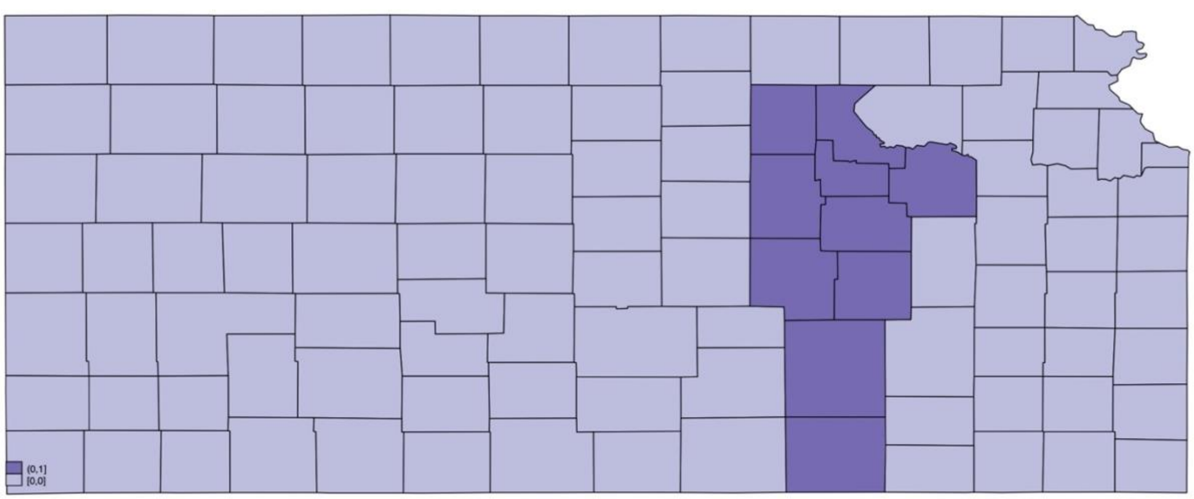


Figure 3-3 Flint Hills Map

Once we determined if land values in counties of the Flint Hills were statistically different than those outside of the Flint Hills region, a difference model was used to determine, based on the three types of adoption, the impact, if any, of intensive early stocking on land values. That is shown in Equation 4.

To determine how to pair counties, a random number generation in Microsoft Excel was used. By generating a number between 0 and 1 for each non-Flint Hills county, and ordering them from largest to smallest, we get a random pairing. The pairings are for each of the 4 other regions outside of the Flint Hills. A map of the regions can be seen in Figure 3-1. Table 3-2 displays the pairings for each region used in the third model.

Table 3-2: Flint Hills and Non-Flint Hills Difference Model Matches

Flint Hills County	Region 1	Region 2	Region 3	Region 4
Butler	Ellsworth	Edwards	Republic	Woodson
Chase	Rooks	Kearny	Osage	Cherokee
Clay	Ellis	Pawnee	Jewell	Elk
Cowley	Sherman	Stanton	Ottawa	Coffey
Dickinson	Decatur	Greeley	Washington	Wilson
Geary	Wallace	Pratt	Marshall	Sedgwick
Marion	Phillips	Rice	Doniphan	Neosho
Morris	Sheridan	Ness	Cloud	Harper
Riley	Osborne	Meade	Douglas	Labette
Wabaunsee	Norton	Gray	Franklin	McPherson

Equation 4, Land Model 3 Difference Model

$$LandPrice^{Flint\ Hills} - LandPrice^{Non-Flint\ Hills} = \alpha_0 + \beta_1 Adoption\% + \beta_2 Time + \varepsilon$$

Results

Model 1 results can be found in table 3-3. This model is used to explain the impact, if any, farm income, interest rate, region and time have on land values. That model was used for all counties in Kansas.

When Kansas total net farm income increases by \$1 million, we expect farmland values to increase by \$0.29 per acre. Farm income and interest rate variables are significant at the one percent level, with a p-value of 0.000 for each. This model suggests when interest rate increases by one percent, land values will increase \$33.15/acre in this model. Intuitively, higher interest rates make borrowing money more expensive, and thus land becomes more expensive to purchase. The interest rate could have an inverse effect on demand for land. When interest rates are low, people are more willing to borrow money which could increase demand for land, and thus the sign for the interest rate variable could be incorrect. A more granular dataset should demonstrate this phenomenon.

When evaluating the regional differences, the Flint Hills is used as the alternative. This model tells us that regions one and three are statistically different from the Flint Hills, while region two and region four are not statistically different from the Flint Hills. Region one has land values that are, on average, \$86.61 lower, and region three has land values that are, on average, \$191.05 higher than the Flint Hills. These are both significant at the one percent level and have a p-value of 0.001 and 0.000 respectively. Regions two and four have a p-value above our threshold, 0.464, and 0.122, and therefore are statistically insignificant in this model at our highest tolerance of 0.10. Land model 1 explained 56.9 percent of variation in the data.

$$LandPrice^{County\ X} = \alpha_0 + \beta_1 FarmIncome + \beta_2 \text{Region} + \gamma_1 InterestRate + \beta_3 Time + \varepsilon$$

Table 3-3 Model 1 Results

Land Model 1	*Coefficient*	*Standard Error*	*p-value*	*95% Confidence Interval*	
*Farm Income****	0.288	0.017	0.000	0.254	0.320
*Interest Rate****	33.146	2.789	0.000	27.672	38.620
*Region 1****	-86.611	25.067	0.001	-135.812	-37.409
Region 2	-17.154	23.428	0.464	-63.140	28.832
*Region 3****	191.050	24.007	0.000	143.928	238.172
Region 4	38.195	24.651	0.122	-10.192	86.582
*1969****	-133.630	23.996	0.000	-180.829	-86.531
*1974****	-374.379	23.042	0.000	-419.606	-329.151
*1978****	256.015	24.554	0.000	207.819	304.2113
*1987****	-225.072	24.236	0.000	-272.644	-177.500
1992	-16.018	25.709	0.533	-66.482	34.444
*Constant****	-153.4024	33.383	0.000	-218.927	-87.878
R^2	0.569				
N	840				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Now that model 1 determined that the Flint Hills land values are statistically different than two of the regions at the one percent level, we used all the county level data to determine the average impact that being in the Flint Hills has on a county’s land values. Results of this model can be found in Table 3-4. This model explains 68.8% of the variation in the data.

The Flint Hills coefficient demonstrates that when a county is in the Flint Hills, land values are, on average, $37.923/acre lower than other counties. That is significant at the five percent level because the p-value is 0.037. When total Kansas farm income increases by $1 million, we expect land rents to increase by $0.28/acre from these results.

Including population, when population increases by one person, we expect land values to increase by $0.003. In other words, if population increases by one thousand people, we expect land values will increase $3/acre. This is significant at the one percent level with a p-value of 0.000. Similar to the first model, a one percent increase in interest rates will increase land values by $33.01, has a p-value of 0.000, and is ultimately statistically significant at the one percent level.

$$LandPrice^{County\ X} = \alpha_0 + \beta_1 Flint\ Hills + \beta_2 Time + FarmProf + \gamma_1 InterestRate + \gamma_2 Population + \varepsilon$$

Table 3-4 Model 2 Results

Land Model 2	*Coefficient*	*Standard Error*	*P-Value*	*95% Confidence Interval*	
*Flint Hills***	-37.923	18.135	0.037	-73.518	-2.327
*Farm Income****	0.283	0.014	0.000	0.255	0.310
*Population****	0.003	0.0001	0.000	0.003	0.003
*Interest Rate****	33.012	2.371	0.000	28.358	37.666
1969	-132.635	20.400	0.000	-172.677	-92.593
1974	-369.413	19.590	0.000	-407.866	-330.961
1978	254.675	20.875	0.000	213.700	295.65
1987	-221.928	20.605	0.000	-262.373	-181.483
1992	-17.084	21.857	0.435	-59.986	25.817
Constant	-172.084	21.857	0.000	-218.411	-126.850
R^2	0.688				
N	840				

Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Difference models were used to compare the Flint Hills to every other region. It was not surprising that this model for regions 2 and 4 did not yield significant results at the ten percent level, as they were not statistically different from the Flint Hills in the first model. The outputs for these two insignificant models can be found in Table 3-8, Table 3-9 and Table 3-10.

For region 1, using the kinked adoption method, switching to intensive early stocking increased land value differences by $109.54/acre over the whole period. This means for a 1% increase in adoption, we expect land value difference to increase by $1.10/acre. This estimate is statistically significant at the one percent level and explains 17.4% of variation in the data. Using the smooth adoption method, a 100% adoption of the practice would result in a $181.02/acre increase in land values. So, for a 1% increase in adoption, we expect a $1.81/acre increase in the spread of land values between the Flint Hills and region 1. These results fit our expectations. As additional adoption of intensive early stocking occurred, profitability of cattle grazing in turn increased demand for Flint Hills pasture and hence land values.

Lastly, if adoption was as simple as an overnight change, in the third model for region one, we expect a $59.01/acre increase in the difference in land values when adoption increases to 100%. Or, if adoption increases 1%, we expect land value spread to increase by $0.59/acre. The simple adoption is a highly simplified version of the world, and it did not occur this way, but this would indicate that early adopters would not get benefit as compared to a different adoption estimate.

$$LandPrice^{Flint\ Hills} - LandPrice^{Non-Flint\ Hills} = \alpha_0 + \beta_1 Adoption\% + \beta_2 Time + \varepsilon$$

Table 3-5 Region 1 Difference Model 1 Results

Diff Model 1	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
*Kink****	109.543	24.151	0.000	61.617	157.4697
*Constant****	43.027	9.441	0.000	24.292	61.762
R^2	0.174				
N	100				

Table 3-6 Region 1 Difference Model 2 Results

Diff Model 2	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
*Smooth****	181.019	25.703	0.000	110.167	251.871
*Constant****	43.367	8.835	0.000	25.834	60.900
R^2	0.208				
N	100				

Table 3-7 Region 1 Difference Model 3 Results

Diff Model 3	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
*Simple****	59.008	14.261	0.000	30.707	87.309
*Constant****	36.925	11.047	0.001	15.003	58.847
R^2	0.149				
N	100				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Table 3-8 Region 2 Difference Model 1 Results

Diff Model 1	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
Kink	37.1222	26.545	0.165	-15.556	89.801
Constant	4.120	10.377	0.687	-16.392	24.792
R^2	0.02				
N	100				

Table 3-9 Region 2 Difference Model 2 Results

Diff Model 2	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
*Smooth***	81.60	39.645	0.044	2.386	159.734
Constant	1.160	9.820	0.906	-18.209	20.629
R^2	0.041				
N	100				

Table 3-10 Region 2 Difference Model 3 Results

Diff Model 3	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
Simple	1.925	15.597	0.902	-29.028	32.878
Constant	12.975	12.082	0.285	-11.001	36.951
R^2	0.000				
N	10				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Results for region three can be found in Table 3-11, Table 3-12 and Table 3-13. When using the kinked method of adoption, when adoption increases by 1%, we expect the spread in region 3 and Flint Hills land values to decrease by $2.03/acre, or $203.29 for the whole 100% adoption. That is statistically significant at the 1 percent level, had a p-value of 0.000 and the model explained 21% of the variation in the data.

Using the smooth estimate of adoption, the model explains 17.2% of the variation in the data. When adoption is increased by1%, the spread in regions 3 and the Flint Hills decreases by $2.78/acre, or $277.56/acre for the whole adoption period. This is significant at the one percent level because the p-value is 0.000.

The third adoption model for the difference in region 3 and the Flint Hills explains 19.2% of the variation in the data. When adoption is increased to 100%, the spread in values decrease by $113.11/acre, or $1.13/acre for every 1% increase in adoption. This is significant at the one percent level with a p-value of 0.000.

Table 3-11 Region 3 Difference Model 1 Results

Diff Model 1	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
Kink	-203.289	39.827	0.000	-282.324	-124.254
Constant	-20.710	15.569	0.187	-51.605	10.185
R^2	0.210				
N	100				

Table 3-12 Region 3 Difference Model 2 Results

Diff Model 2	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
Smooth	-277.560	61.580	0.000	-399.763	-155.356
Constant	-30.680	15.238	0.047	-60.920	-0.441
R^2	0.172				
N	100				

Table 3-13 Region 3 Difference Model 3 Results

Diff Model 3	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
*Simple****	-113.108	23.435	0.000	-159.615	-66.602
Constant	-7.225	18.153	0.691	-43.249	28.799
R^2	0.192				
N	100				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Region four results can be found in Table 3-14, Table 3-15 and Table 3-16. We know from model one that there is no statistical difference in the Flint Hills and counties in region four, because the p-value in model 1 was 0.122. That is reinforced with a p-value greater than 0.10 in each of the models, of 0.214 and 0.396.

Table 3-14 Region 4 Difference Model 1 Results

Diff Model 1	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
Kink	-74.242	62.525	0.214	-202.320	45.836
Constant	-27.180	24.441	0.269	-75.683	21.322
R^2	0.016				
N	100				

Table 3-15 Region 4 Difference Model 2 Results

Diff Model 2	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
Smooth	-80.844	94.813	0.396	-268.997	107.309
Constant	-35.175	23.462	0.137	-81.735	11.385
R^2	0.007				
N	100				

Table 3-16 Region 4 Difference Model 3 Results

Diff Model 3	*Coefficient*	*Standard Error*	*P-value*	*95% Confidence Interval*	
*Simple**	-64.433	36.087	0.077	-136.047	7.180
Constant	-9.45	27.953	0.736	-64.922	46.022
R^2	0.032				
N	100				

Statical Significance *** α= 0.01, ** α= 0.05, * α= 0.10

Conclusions and Implications

Combined, the results of our estimates yield results that indicated IES raised land values in the Flint Hills. In the simple model, the impact of IES on land values is an average of $1.17/acre for each 1% increase in adoption. When using the difference models, we know that regions two and four are not statistically different from the Flint Hills. That was even shown when we evaluated difference model results, they are statistically insignificant at the ten percent level (p-values were 0.464 and 0.122). We hypothesize that the difference models represent the closest estimate of the real impact of IES on land values. The difference model minimizes the effect of farm income and interest rates, because those in other counties do not face a different interest rate and farm income is an aggregate number.

Future research in this area could address this topic with more specific data with a longer time horizon. We used what was the best data available at the time but using county level net farm income estimates could yield a result that is more accurate and explain addition of variation in the data. A lesson learned in this study was to confirm where data originated in order to find the rest of the set. The USDA census data we had was from 1870-1997 and upon a quick search, data from 1997-2017 was available on USDA NASS Quickstats.

Chapter 4 - Survey

Our survey was conducted to accomplish a few objectives. First, Dr. Clenton Owensby has a proposed new grazing system, IES plus a late season grazing rotation, and we wanted to model how producer adoption might occur based on parameters like average daily gain and labor costs. Additionally, it worked well to conduct a base joint survey with Claudia Hissong on her project on limit feeding and beef sustainability.

Intensive early stocking plus late season grazing (IES+LSG) is a new system from Owensby and Auen (2008). In this system, similar to IES, cattle are stocked at twice the density for the months of May through July. In July, half the cattle are removed, and the remainder are allowed to graze until October. With a two-pasture system, pasture A and Pasture B, IES and IES+LSG rotate between A and B. The advantage of using the IES and IES+LSG rotation result in a 75% increase in net return per acre as compared to convention season long stocking (Owensby and Auen 2018).

Data

The survey was sent to cattle producers in the United States in April of 2020. The Kansas State University Research Compliance Office determined that it is exempt from review the Committee on Research Involving Human Subjects and Institutional Review Board. In short, we were approved by the university to conduct this survey but because the survey is voluntary, we did not need oversight from the board. Documentation can be found in Appendix B.

We considered several key factors as we designed this survey. The survey was designed to understand the expectations of the respondent under a given set of parameters. For example, we used average daily gain in our choice experiment, but we also asked questions about average daily gain earlier in the survey to ascertain the level of average daily gain that a producer would typically manage for over a grazing season. We used average daily gain and labor costs because these are two levels are important to the grazing systems. Recall that Owensby (1970) found cattle that were intensive early stocked had a higher average daily gain that those who were stocked season long. Additionally, using labor costs, we assumed that if a producer used intensive early stocking plus late season grazing, at some point in the summer they would have to sort out the heavier cattle and it would increase their labor cost per head.

An example of a choice experiment question is show in Figure 4-1. Before the questions, we explained the different grazing systems. We offered each producer three of these questions with varied levels of average daily gain and labor costs.

a. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS + LSG	EIS	Neither
ADG (lbs/day)	1.85	3.45	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.19	$2.99	
I would choose:	______	______	______

Figure 4-1 Choice Experiment Question Example

The base levels were selected based on Kansas Farm Management Association and work from Owensby and Auen (2018). Table 4-1 shows the levels that were varied in the experiment. The base is denoted as level two. We varied average daily gain plus or minus twenty percent and labor costs by plus or minus fifteen percent. These percentages are somewhat arbitrary, but these by using them we were able to get us above and two pounds of ADG and to a fifty-cent difference for labor costs.

A SAS program determined how to arrange the levels in each question to gain usable results. Specifically, the full factorial of all possible choice combinations was first identified using SAS's PROC PLAN. Then from this full factorial, a subset of choice combinations was selected using PROC OPTEX. Here a saturated design was identified enabling all main and two-way interaction effects to be estimated if needed.

Table 4-1 Choice Experiment Levels

Levels	*ADG*	*Labor Costs*
1	*1.85*	*2.19*
2	*2.65*	*2.59*
3	*3.45*	*2.99*

We had respondents returned a survey. Of those, 124 completed the choice experiment portion. Of these 124, 33 respondents answered something other than neither at least once, and completed all presented scenarios. When changing these data to panel data, that resulted in 297 observations. For a complete overview of the survey, please see Appendix C.

Continuous variables collected about the demographics of the survey respondents can be found in Table 4-2. The average age of these 33, is 58.24 with a standard deviation of 13.72. The oldest respondent was 81 and the youngest was 33. There was a large variation in the number of cows, calves, yearlings and finished cattle for each of these responses. There was a minimum of 0 for each of the categories. The average number of cows owned was 193.09, calves was 187.46, yearlings was 248.06 and finished cattle was 69.88. The largest number of cows owned was 1400, calves owned was 2700, yearlings owned was 1800 and finished cattle was 500.

Table 4-2 Survey Continuous Summary Statistics

Variable	*Units*	*Mean*	*Standard Deviation*	*Min*	*Max*
Age	Years	58.242	13.372	33	81
Cows	Head	193.091	264.889	0	1400
Calves	Head	187.455	475.495	0	2700
Yearlings	Head	248.061	405.464	0	1800
Finished	Head	69.879	141.531	0	500

Categorical variables collected in the survey can be found in Table 4-3. Of the 33 usable responses, 29 were owner and manager, or 87.88%, and 4 were only the owner of the operation, or 12.12%. The two most common operation types were stocker and backgrounders with cow-calf and feedlot, and stocker and backgrounder with cow-calf. These two categories account for 26 of 33 responses. Education of respondents was split fairly evenly. Those having at-most a high school diploma composed 30.30%, or 10 responses. Equal numbers of respondents had a technical degree or a bachelor's degree, 9 responses each, or 27.27%. Only 5 had a graduate or professional degree that includes Doctor of Veterinary Medicine, PhD., master's degree, or law degree, or 15.15%.

The majority of respondents, 25, have been raising cattle for more than 30 years. The next most has been in the cattle business for 11-20 years, at 4 responses. Three responses have been raising cattle for 21-29 years and the last response has been raising cattle for less than 10 years.

Next, we asked the survey takers what their total income was, and only 31 answered. Of those 31, 6 answered in categories less than $50,000 annually, 13 earned above $50,000 to

$99,999, and 12 earned more than $100,000 on an annual basis. To gain a better understanding of how income from cattle fits into their total income, we asked what percent of their income is generated from cattle operations. Those who have less than 25% of their income generated from cattle, accounted for 11 respondents. Next most, at 10 respondents, is the 26%-50% category, followed by 51%-75% with 5, 100% with 4, and last but not least 76%-99% with 2. This question was answered by 32 of 33 respondents.

Given that this survey has a choice experiment regarding grazing practices, we thought it was pertinent to ask about current grazing practices. When asked if they graze cattle and remove them all at once, 16 indicated that they followed this practice while 14 indicate that they remove some and the rest later. Only 32 answered this question, and two indicated that they have some other grazing scheme. In addition to asking about grazing, we asked about seasonality, and 29 answered this question. Three only place one set in the spring, 12 place one set in the fall, and 14 place multiple sets of feeder cattle throughout the year.

Table 4-3 Survey Categorical Summary Statistics

Variable	*Categories*	*Percent*	*Frequency*
Operator Status	Owner	12.12	4
	Owner and Manager	87.88	29
		Total	33
Operation Type	100% Stocker/ Backgrounder	12.12	4
	Stocker/Backgrounder with cow-calf and feedlot	36.36	12
	Stocker/Backgrounder with cow-calf	42.42	14
	Stocker/Backgrounder with feed lot	6.06	2
	Other	3.03	1

		Total	33
Education Level	High School Diploma	30.30	10
	Technical Training or Associates	27.27	9
	Bachelor's Degree	27.27	9
	Graduate or Professional Degree	15.15	5
		Total	33
Years raising Cattle	Less than 10 years	3.03	1
	11-20 years	12.12	4
	21-29 years	9.09	3
	30 years or more	21.21	25
		Total	33
Total Income	Less than $25,000	6.45	2
	$25,000-$49,999	12.90	4
	$50,000-$74,999	22.58	7
	$75,000-$99,999	19.35	6
	$100,000-$124,999	9.68	3
	$125,000 or more	29.03	9
		Total	31
Income from Cattle	Less than 25%	34.38	11
	26% to 50 %	31.25	10
	51% to 75%	15.62	5
	76% to 99%	6.25	2
	100%	12.50	4
		Total	32
Grazing	Take some out, then take the rest out at a later date	50	16
	Take them all out at the same time	43.75	14
	Other	6.25	2
		Total	32
Seasonality	Typically places multiple sets in one year	48.28	14

Typically places one set in the spring	10.34	3
Typically places one set in the fall	41.38	12
	Total	29

A full description of all producers that took the survey can be found in Appendix A.

Methods

To model decision behavior based on our choice experiment we converted the raw survey data to panel data. This created nine observations per respondent. Three observations are for each question, and three more for the choices in each question, for a total of nine. From this, we were able to create a dummy variable that marks the decision and ties it to a certain outcome. Coding this as a special dataset in Stata allows the program to understand the panel nature of the data. An example of what this looks like is in Table 4-4. In this example, respondent 1 chose IES+LSG for question 1, IES for question 2, and Neither for question 3. In the case of choosing neither, we coded the average daily gain and labor costs as the mean of the two shown in the question.

Table 4-4 Survey Panel Data Example

Respondent #	Question #	Options	Selection	ADG	Labor Cost
1	1	IES	0	1.85	2.19
1	1	IES+LSG	1	2.65	2.59
1	1	Neither	0		
1	2	IES	1	3.45	2.19
1	2	IES+LSG	0	2.65	2.19

1	2	Neither	0		
1	3	IES	0	1.85	2.19
1	3	IES+LSG	0	1.85	2.99
1	3	Neither	1		

This dataset includes all collected observations that answered all three questions and answered something other than neither at least once. It is important to note that we could have taken out observations that chose the same option every time, but for robustness, they were included.

From the given levels, we used a conditional logit model to estimate producer choice. The variables used included the average daily gain and labor costs as varied in Table 4-3, as well as whether or not a respondent had a bachelor's degree or not. The base alternative is that they chose neither system. Other variables, like seasonality, whether or not they were in Kansas, number of head, amount and percent of income from cattle were used and found to be insignificant and omitted. A mathematical representation is show in Equation 5.

Equation 5 Choice Experiment Model

$$Choice_X = \beta_1 ADG \ + \ \beta_2 Labor\ Costs \ + \ \gamma_1 IES \ + \ \gamma_2 (IES + LSG) \ + \ \gamma_3 IES * Bach\ Plus$$
$$+ \gamma_3 (IES + LSG) * Bach\ Plus \ + \ \varepsilon$$

The option the producer chose in the survey is our y variable and is denoted above as Choice. Since this is an estimation and it does not explain all of the variation in the data, ε is the difference between the estimated values and the actual values in the dataset. β_1 and β_2 are the marginal impact of average daily gain and labor costs on choice. γ_1 and γ_2 represent the choices, recall in Table 4-4, that each respondent had three options and all three are reflected in the data.

Neither is excluded because it is the baseline choice. γ_3 and γ_4 are the impact of bachelor's degrees or more on choice. It is an interaction term, multiplied by the choice of IES or IES+LSG, because it does not differ between questions for each respondent.

Results

Results from the choice experiment provide an understanding of what factors influence the choice of grazing systems. From table 4-5, the only insight we were able to glean is the direction and significance of impact, and not the direct size of impact. However, we were able to compare the sizes of choosing different options based on a single attribute, like having a bachelor's degree.

Average daily gain is significant at the one percent level, with a p-value of 0.000. That had a positive coefficient, and as average daily gain increases, we expect the likelihood of choosing IES or IES+LSG to also increase as compared to choosing neither.

Labor cost is insignificant in this model, because the p-value is greater than our largest threshold of 10% at 0.547. The fact that the coefficient for labor costs is negative signals that as labor costs increase, the probability of choosing IES or IES+LSG will decrease. Intuitively, when labor costs increase, producers will choose something with lower costs, however, this model results in no preference for labor costs.

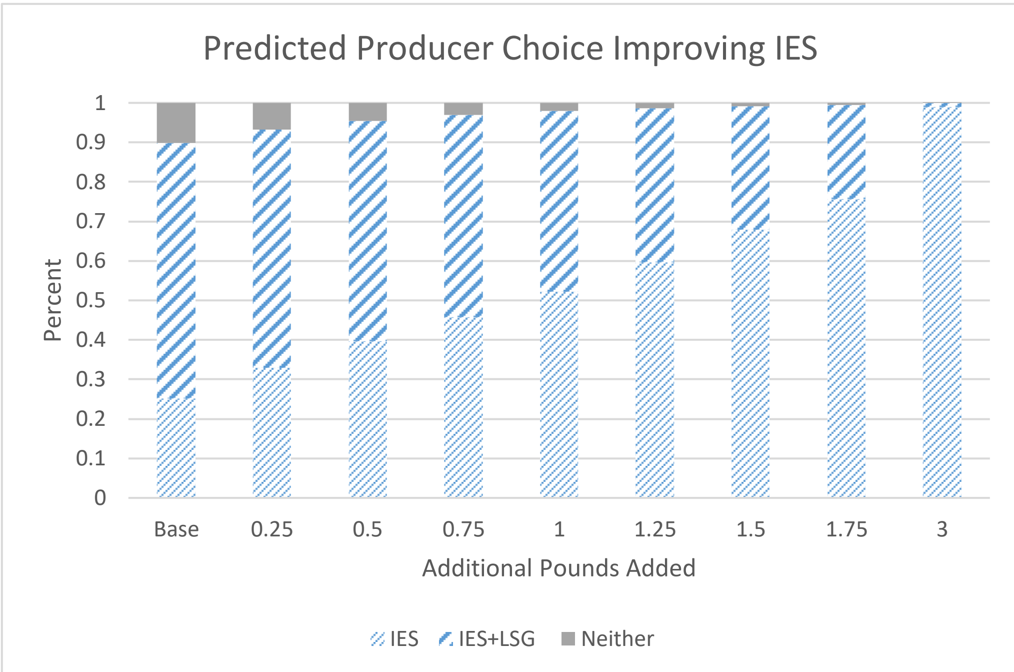
Having a bachelor's degree increases the probability that that individual will choose intensive early stocking. This is significant at the one percent level. The same can be said about having a bachelor's degree and choosing IES+LSG rotation. It is significant at the one percent level, (p-value is 0.000) but has a coefficient that is 0.369 less than that for IES. That difference indicates that a respondent having a bachelor's degree made them slightly more likely to select IES over IES+LSG.

The constant in Table 4-5 shows producer's preferences. The base alternative is choosing neither, and the constant value tells us how producers prefer IES or IES+LSG to neither. For IES, the constant is -0.52, we could infer that producers prefer neither to IES, but this is inconclusive because the p-value is greater than 0.05 at 0.140. When we compare IES+LSG to neither the constant is 1.236, and this indicates that producers prefer IES+LSG to neither. We can infer this because this value is significant at the five percent level because the p-value equals 0.031. However, we cannot compare how producers prefer IES to IES+LSG in this model. We can observe how producers will change their choice when attributes like average daily gain and labor costs are changed.

Table 4-5 Survey Logit Model Results

Choice	*Coefficient*	*Robust Standard Error*	*P-value*	*95% Confidence Interval*	
*Average Daily Gain****	3.650	0.731	0.000	2.218	5.082
Labor Cost/Head	-0.668	1.110	0.547	-2.844	1.508
IES					
*Bachelors Plus****	14.524	0.620	0.000	13.309	15.740
Constant	-0.522	0.353	0.140	-1.215	0.171
IES+LSG					
*Bachelors Plus****	14.155	0.824	0.000	12.540	15.769
*Constant***	1.236	0.574	0.031	0.112	2.360
Neither	(base alternative)				

Using STATA's margins command allows us to understand when changing an attribute, how we expect a respondent's selection will change. We varied average daily gain to observe this because it is statistically significant and a core component of producer decision-making. Figure 4-2 displays these results for improving IES incrementally. We improved it by adding a quarter pound at a time to the base average daily gain observed in the dataset. The base shows the probabilities that a person chooses, IES, IES+LSG or neither. As we increase average daily gain for IES, more people are going to substitute from IES+LSG to choosing IES. As compared to the base level, increasing ADG by 0.75 pounds, increases the number of people who choose IES+LSG by 25%. At an increase in average daily gain of 3 pounds, we see that nearly all



respondents would choose IES.

Figure 4-2 Predicted Producer Choice Improving ADG for IES

When we increase ADG for IES+LSG, we see that the switching systems occurs much quicker. In Figure 4-3, we can see that close to 95% of respondents will choose IES+LSG by increasing the average daily gain observed by half a pound. In comparison to IES, IES+LSG selections increase at a faster rate. At the mean average daily gain, IES+LSG is chosen by the majority of producers. Therefore, it is logical that increasing average daily gain predicts producers could choose IES+LSG.

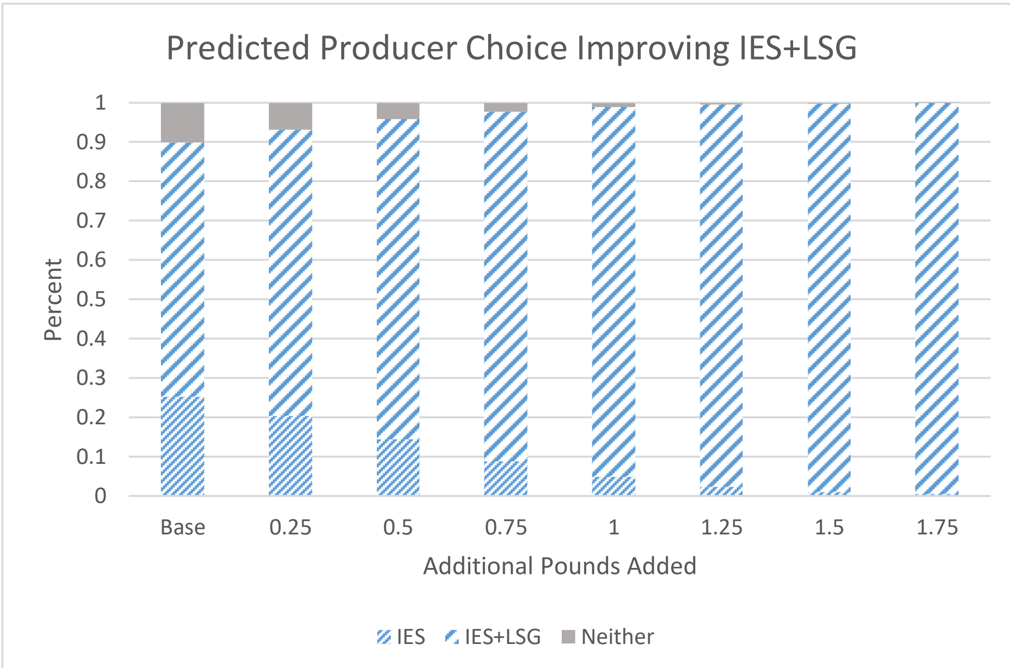


Figure 4-3 Predicted Producer Choice Improving ADG for IES+LSG

Conclusion and Implications

While surveys are not a guaranteed prediction of producer behavior, this survey does yield valuable information of what could occur. However, there is definitely room for improvement. To get a more accurate prediction of producer behavior, it would be fitting for future research to only survey producers that graze cattle in the Flint Hills. Additionally, those that are specifically stocker cattle producers. This would also be pertinent because the values we showed them in the choice experiment came from the Kansas Farm Management Association. To gain a greater level of participation in this type of survey, we could survey producers at different extension functions as part of another presentation, they would have a shorter demographics section, but the choice experiment could be the same. Additionally, Kansans might value research at Kansas State more than other states and would be more willing to participate in a survey that could directly benefit them. Because our survey was nationwide, this could be why labor costs were insignificant in our model.

Chapter 5 - Implications and Conclusions

In this study, there are a few key findings that can shine a light on the impact of Intensive Early Stocking in the Flint Hills Region. Cattle prices and land values both increased as adoption increased. Our survey also showed that producers would adopt IES or IES+LSG over neither grazing system.

Feeder cattle prices increased because of this grazing regime. The range of the increase in price was \$0.05/cwt per one percent increase in adoption to \$0.29/cwt per one percent increase in adoption. The \$0.05/cwt estimate is from the simple model where adoption would have occurred overnight and is likely not what happened. We suggest that the true value of the increase is between \$0.28/cwt to \$0.29/cwt for each additional percent of adoption.

Land values in the Flint Hills were positively affected by Intensive Early Stocking. The average estimate of the land value increase is \$1.17/acre per one percent increase in adoption. As a note, this figure would be more accurate if we were able to obtain a longer data series to 2010 when 95% adoption is hypothesized.

Producers in the survey did not consider labor costs, at a statistical significance viewpoint, in their decision making. However, average daily gain was statistically significant in their choice. Of the producers surveyed, they preferred IES and IES+LSG to neither grazing regime. Lastly, producers substitute to IES+LSG at a quicker rate than IES when we improve average daily gain.

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Appendix A - Weight Marginal Impact Calculations

Marginal Impact of Adoption & Weight for Kinked Adoption Type

$$Feeder\ Price = 3.012 + 70.138 * Adoption_{Smooth} - 0.011 * Weight - 4.902 * Corn\ Price + 1.333 * Fed\ Price - 0.069 * Weight * Adoption + \sum Time$$

First Order Conditions

$$\frac{\partial Feeder\ Price}{\partial Adoption_{Kink}} = 70.138 - 0.069 * Weight$$

Mean weight is 600 so Adoption-kink

$$Marginal\ Impact = 70.138 - 0.069(600) = 28.738$$

Average adoption % for Kinked= 0.597

$$\frac{\partial Feeder\ Price}{\partial Weight} = -0.011 - 0.069 * Adoption$$

$$Marginal\ Impact\ of\ Weight = -0.011 - 0.069(0.597) = -0.052$$

Marginal Impact of Adoption & Weight for Smooth Adoption Type

$$Feeder\ Price = 11.855 + 61.317 * Adoption_{Smooth} - 0.024 * Weight - 5.200 * Corn\ Price + 1.402 * Fed\ Price - 0.061 * Weight * Adoption + \sum Time$$

Marginal Impact of Adoption

$$\frac{\partial Price}{\partial Adoption_{Smooth}} = 61.317 - 0.061 * Weight$$

$$Marginal\ Impact\ Adoption_{Smooth} = 61.317 - 0.061(600) = 24.717$$

Marginal Impact of Weight

Smooth= 0.451

$$\frac{\partial Feeder\ Price}{\partial Weight} = -0.024 - 0.061 * Adoption$$

$$Marginal\ Impact\ of\ Weight = -0.024 - 0.061(0.451) = -0.052$$

Marginal Impact of Weight for Simple Adoption Type

$$Price = 3.467 + 28.723 * Adoption_{Simple} - 0.017 * Weight - 4.713 * Corn\ Price + 1.406 * Fed\ Price - 0.038 * Weight * Adoption + \sum Time$$

Marginal Impact of Adoption

$$\frac{\partial Price}{\partial Adoption_{Smooth}} = 28.723 - 0.038 * Weight$$

$$Marginal\ Impact\ of\ Adoption = 28.723 - 0.038(600) = 5.923$$

Marginal Impact of Weight

Simple= 0.932

$$\frac{\partial Feeder\ Price}{\partial Weight} = -0.017 - 0.038 * Adoption$$

$$Marginal\ Impact\ of\ Weight = -0.017 - 0.038(0.932) = -0.052$$

Appendix B - Surveys

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: Dr. Glynn Tonsor
Agricultural Economics
Waters Hall

Proposal Number: 10166

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: 06/04/2020

RE: Proposal Entitled, "Stocker Producer Survey 2020"

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §46.101, paragraph b, category: 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

OPERATION:

1. How would you describe your operation?

- ❑ 100% Stocker/ Backgrounder
- ❑ Stocker/ Backgrounder with cow-calf
- ❑ Stocker/ Backgrounder with feedlot
- ❑ Stocker/ Backgrounder with both cow- calf and feedlot
- ❑ Other (specify): ______________________________

2. For this operation I am the:

- ❑ Owner and Manager
- ❑ Owner
- ❑ Manager
- ❑ Other (specify): ______________________________

3. I am ❑ Male ❑ Female ❑ Wish to not disclose

4. How old are you? ______________ years

5. My operation is located in which state? (If multiple states, indicate your primary state):

____

6. The best description of my educational background is:

- ❑ Did not obtain a High School Diploma
- ❑ High School Diploma
- ❑ Technical training (certification or associates degree)
- ❑ Bachelor's Degree
- ❑ Graduate or Professional Degree (M.S., Ph.D., D.V.M., Law Degree)
- ❑ Other (specify): ____________________________

7. How many years have you been raising cattle?

❑ Less than 10 years ❑ 21-29 years
❑ 11-20 years ❑ 30 years or more

8. Please estimate your annual pre- tax household income:

❑ Less than $25,000 ❑ $75,000- $99,999
❑ $25,000- $49,999 ❑ $100,000- $124,999
❑ $50,000- $74,999 ❑ $125,000 or more

9. Approximately what proportion of your household income is from the beef cattle operation?

❑ Less than 25% ❑ 51% to 75% ❑ 100%
❑ 26% to 50% ❑ 76% t 99%

10. How many employees does your operation employ?

❑ Less than 5	❑ 15 to 24
❑ 5 to 14	❑ 25 or more

11. What is your current average labor wage paid to employees? (wage/ hour)

❑ Under $7.25 ❑ $18.00- $20.99
❑ $7.25- $11.99 ❑ $21.00 or more
❑ $12.00-$14.99 ❑ Non-applicable, I do not have paid employees
❑ $15.00- $17.99

12. How many cattle (# head) did your operation have in inventory at the following production stages on January 1st, 2020? (a best guess is acceptable)

__________ Cows __________ Yearlings

__________ Calves __________ Finished cattle

13. Who owns the land or lot in which you raise the majority of your cattle? *(☑ all that apply)*

- ❑ I lease land from the government, school sections, etc.
- ❑ I lease the land from a private individual or other operation.
- ❑ My Family and/or I own the land
- ❑ Other (specify): ____________________________

14. Referring to 2019, what percentage of feeder cattle placed in your backgrounding/ stocker operation were sourced from each of the following sources:

	Average % of Cattle		Average % of Cattle
Retained from my own cow-calf operation	________	Purchased direct from individual cow-calf ranches	________
Purchased from auction market without knowledge of source ranches	________	Purchased from internet/ video auctions	________
Purchased from auction market with knowledge of source ranches	________	Other (specify): ______________________________	________

15. What month and weight do you usually BUY stocker/ backgrounders?

Month: _______ Weight: _________

16. What month and weight do you usually SELL stocker/ backgrounders?

Month: _______Weight: _________

17. Once you place your cattle on grass or in a lot, do you usually:

- ❑ Take them all out at the same time
- ❑ Take some out, and take the rest out at a later date
- ❑ Other (specify): ____________________________

18. How would you describe the cattle you typically purchase? *(☑ all that apply)*

❑ Black hided ❑ Purebred
❑ Colored ❑ Crossbred
❑ Eared or some Brahman influence

Choice Experiment Version 1

Consider a new grazing system that you could potentially implement without buying or leasing additional land. Using two plots A and B, you will turn cattle out to graze on April 15- May 1st.

On plot A, you early intensive stock (**EIS**) at double normal traditional, full-season stocking rate and take all cattle off around the 15th of July.

On plot B, you EIS at double the normal traditional stocking rate like plot A until July 15th and then you pull **half the cattle** off on the 15th of July. Then, you leave the remaining cattle on plot B until October 3rd, as late season grazing (**LSG**). The following season you switch the grazing scheme between the A and B pastures thereby rotating the EIS and LSG treatments among years

Please consider the following **three** scenarios, which vary labor costs and average daily gain (ADG), and select which option would best reflect your management decision in each case.

a. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS	EIS + LSG	Neither
ADG (lbs/day)	2.65	2.65	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.99	$2.99	
I would choose:	______	______	______

b. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS	EIS + LSG	Neither
ADG (lbs/day)	1.85	2.65	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.19	$2.19	
I would choose:	______	______	______

c. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS	EIS + LSG	Neither
ADG (lbs/day)	3.45	2.65	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.59	$2.59	
I would choose:	______	______	______

d. Considering the previous three questions, what best describes your responses and the question sequence presented? Please select one of the following.

- ❑ The questions were easy and straight-forward to understand. Accordingly, I am confident in my selections.
- ❑ The questions were easy and straight-forward to understand. However, I am *not* confident in my selections.
- ❑ The questions were *not* easy and straight-forward to understand. However, I am confident in my selections.
- ❑ The questions were *not* easy and straight-forward to understand. Accordingly, I am *not* confident in my selections.

Choice Experiment Version 2

Consider a new grazing system that you could potentially implement without buying or leasing additional land. Using two plots A and B, you will turn cattle out to graze on April 15- May 1st.

On plot A, you early intensive stock (**EIS**) at double normal traditional, full-season stocking rate and take all cattle off around the 15th of July.

On plot B, you EIS at double the normal traditional stocking rate like plot A until July 15th and then you pull **half the cattle** off on the 15th of July. Then, you leave the remaining cattle on plot B until October 3rd, as late season grazing (**LSG**). The following season you switch the grazing scheme between the A and B pastures thereby rotating the EIS and LSG treatments among years

Please consider the following **three** scenarios, which vary labor costs and average daily gain (ADG), and select which option would best reflect your management decision in each case.

a. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS	EIS + LSG	Neither
ADG (lbs/day)	2.65	1.85	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.19	$2.59	
I would choose:	______	______	______

b. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS	EIS + LSG	Neither
ADG (lbs/day)	2.65	3.45	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.59	$2.19	
I would choose:	______	______	______

c. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS	EIS + LSG	Neither
ADG (lbs/day)	1.85	3.45	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.99	$2.59	
I would choose:	______	______	______

d. Considering the previous three questions, what best describes your responses and the question sequence presented? Please select one of the following.

- ❑ The questions were easy and straight-forward to understand. Accordingly, I am confident in my selections.
- ❑ The questions were easy and straight-forward to understand. However, I am *not* confident in my selections.
- ❑ The questions were *not* easy and straight-forward to understand. However, I am confident in my selections.
- ❑ The questions were *not* easy and straight-forward to understand. Accordingly, I am *not* confident in my selections.

Choice Experiment Version 3

Consider a new grazing system that you could potentially implement without buying or leasing additional land. Using two plots A and B, you will turn cattle out to graze on April 15- May 1st.

On plot A, you early intensive stock (**EIS**) at double normal traditional, full-season stocking rate and take all cattle off around the 15th of July.

On plot B, you EIS at double the normal traditional stocking rate like plot A until July 15th and then you pull **half the cattle** off on the 15th of July. Then, you leave the remaining cattle on plot B until October 3rd, as late season grazing (**LSG**). The following season you switch the grazing scheme between the A and B pastures thereby rotating the EIS and LSG treatments among years

Please consider the following **three** scenarios, which vary labor costs and average daily gain (ADG), and select which option would best reflect your management decision in each case.

a. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS + LSG	EIS	Neither
ADG (lbs/day)	1.85	3.45	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.19	$2.99	
I would choose:	______	______	______

b. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS + LSG	EIS	Neither
ADG (lbs/day)	3.45	3.45	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.99	$2.19	
I would choose:	______	______	______

c. Indicate if you would choose EIS, EIS + LSG, or Neither

	EIS + LSG	EIS	Neither
ADG (lbs/day)	1.85	1.85	I would choose not to EIS or EIS+LSG
Labor Costs ($/head/month)	$2.99	$2.59	
I would choose:	______	______	______

d. Considering the previous three questions, what best describes your responses and the question sequence presented? Please select one of the following.

- ❑ The questions were easy and straight-forward to understand. Accordingly, I am confident in my selections.
- ❑ The questions were easy and straight-forward to understand. However, I am *not* confident in my selections.
- ❑ The questions were *not* easy and straight-forward to understand. However, I am confident in my selections.
- ❑ The questions were *not* easy and straight-forward to understand. Accordingly, I am *not* confident in my selections.

Appendix C - Survey Summary Statistics

U.S. Stocker Operations

2020 Survey Summary

- Survey conducted by Kansas State University.
- Survey distributed by BEEF Magazine.
- Data collected April 2020 to May 2020.

Kansas State University
Department of Agricultural Economics

Objective

This survey was conducted to understand demographics of U.S stocker producers, current management decisions, and their risk management views and practices. Operations included in the survey are purely stocker operations or stocker operations that engage in another sector of the beef industry.

Survey and Sample Design

This survey was developed by Claudia Hissong and Meghan Brence, both M.S. students at Kansas State University, and Glynn Tonsor, professor of agricultural economics at Kansas State University. After developing the survey instrument, Informa Engage formatted the final copy sent to producers.

The survey was sent to producers from a BEEF Magazine subscriber list. To encourage participation, a $1 bill, cover letter and postage-paid return envelope were included with each survey.

Data Collection and Survey Responses

Survey procedures were approved by the Kansas State University Committee on Research Involving Human Subjects, approval #10166. On April 8th, 2020 3,500 surveys were sent out through BEEF Magazine. There was a total of 645 surveys completed for a response rate of 18.43%.

The survey included questions regarding numerous aspects of stocker cattle operations and production practices. Topics included management demographics, operation characteristics, seasonality, cattle source, employees and labor wage, stocking rate, marketing preferences, and risk management practices and views. The survey involved a variety of questions from write in, select one, select multiple, and rate your agreement to the statement.

Table 1 provides summary statistics for operator characteristics from the survey responses. The number of responses reported in the table for specific questions does not always equal the total number of survey responses due to some questions being left unanswered by the respondent.

The mean age of survey respondents was 63.68 years old with 94.13% (593 survey respondents) being male, 4.92% (31 survey respondents) being female, and .95% wished not to respond (6 survey respondents). Of the 638 respondents, 520 (81.5%) were the owner and manager of the operation, 101 (15.83%) were the owner, and 6 (.94%) were the manger as shown in figure 1.

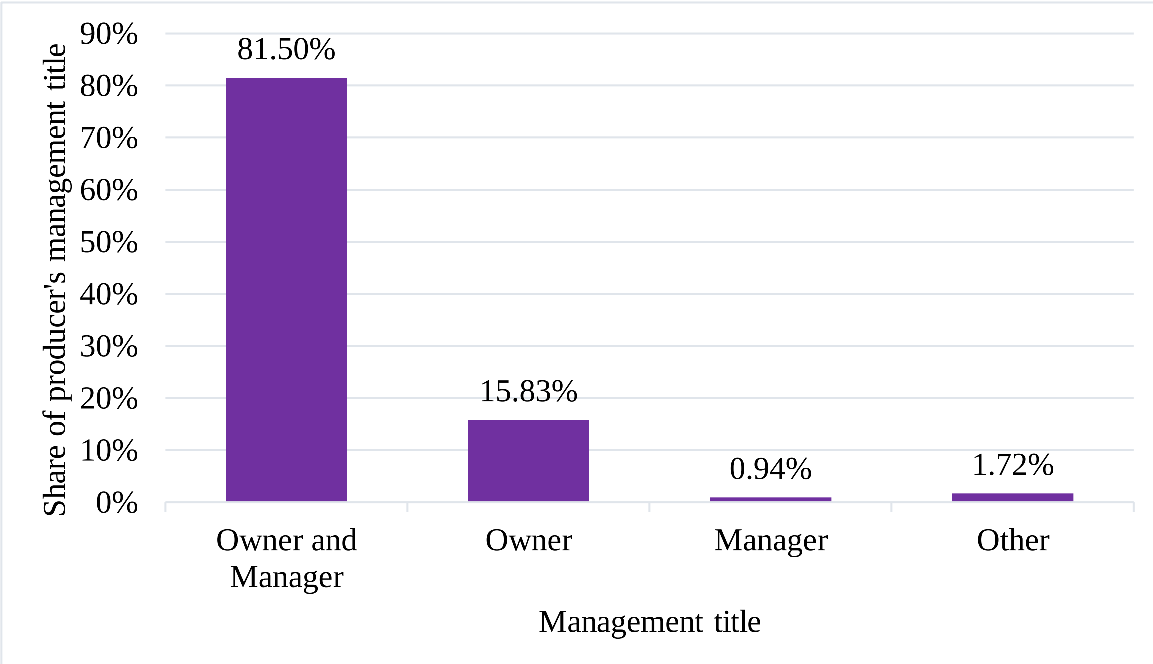

Figure 6-1 Producer's Management Title

Figure 2 shows the number of responses per state, 38 of 50 states are represented in this survey. Nebraska had the highest number of responses with 63. Kansas and Missouri had the second and third highest with 56 and 55, respectively. Iowa had 51 responses, South Dakota had 45, North Dakota had 32 and Texas had 31. All other states had less than 30 and can be found in Table 1.

Additionally, most of the producers noted they had received at least a high school diploma when asked about the best description of their educational background. As shown in figure 3 producers with at least a high school diploma totaled 254 (39.94%). Those that selected they obtained a bachelor's degree comprised 176 (27.67%) respondents, followed by 122 (19.18%) respondents that received technical training. Survey respondents that had earned a graduate or professional degree totaled 56 (8.81%) and those that did not obtain a high school diploma accounted for 16 (2.52%) respondents.

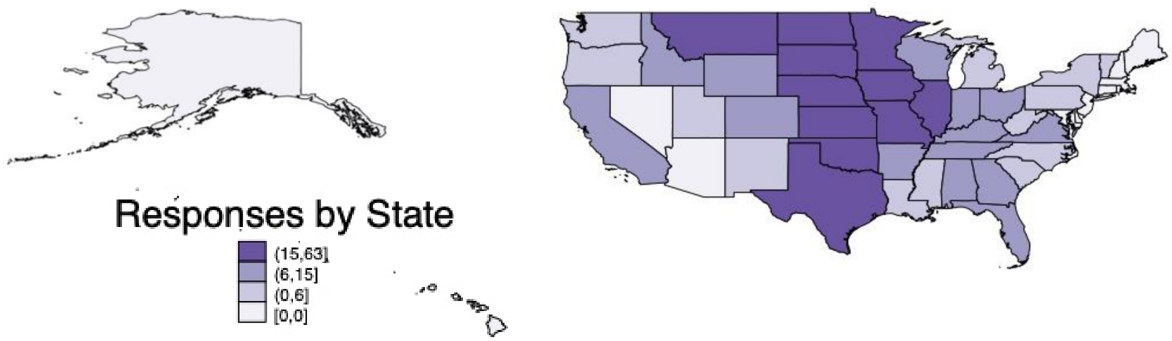

Figure 6-2 Responses by State

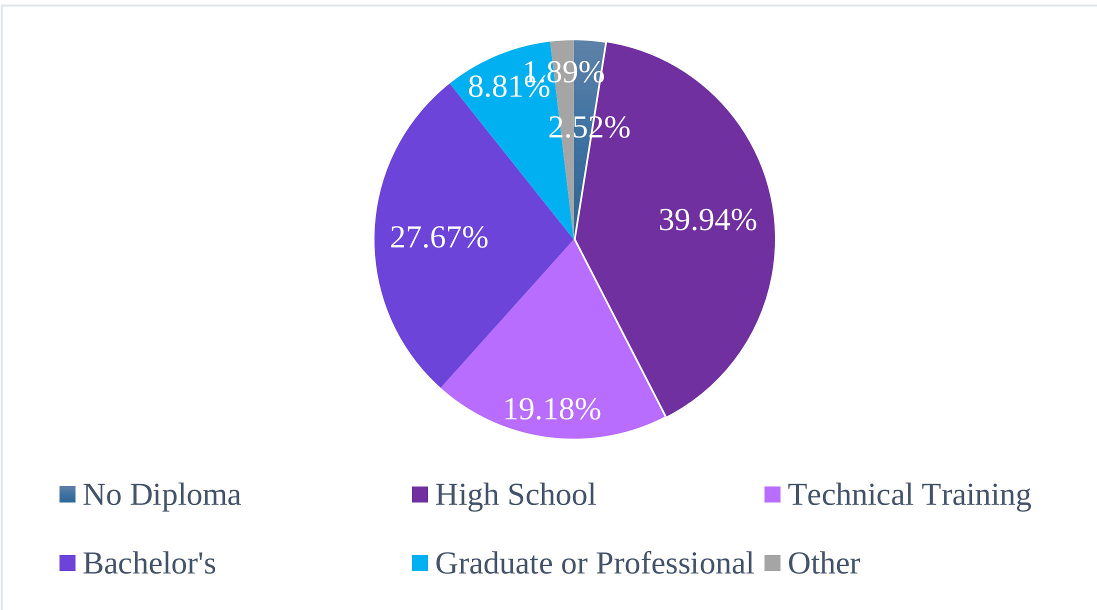

Figure 6-3 Producer's Educational Background

Survey respondents were asked to select how many years they have been raising cattle. Figure 4 shows 82.81% (530 survey respondents) indicated that they had been raising cattle for 30 years or more. Following this was 9.53% (61 survey respondents) who selected that had been raising cattle for 21- 29 years. Additionally, 6.25% (40 survey respondents) and 1.41% (9 survey respondents) indicated they had 11- 20 years of experience or less than 10 years, respectively.

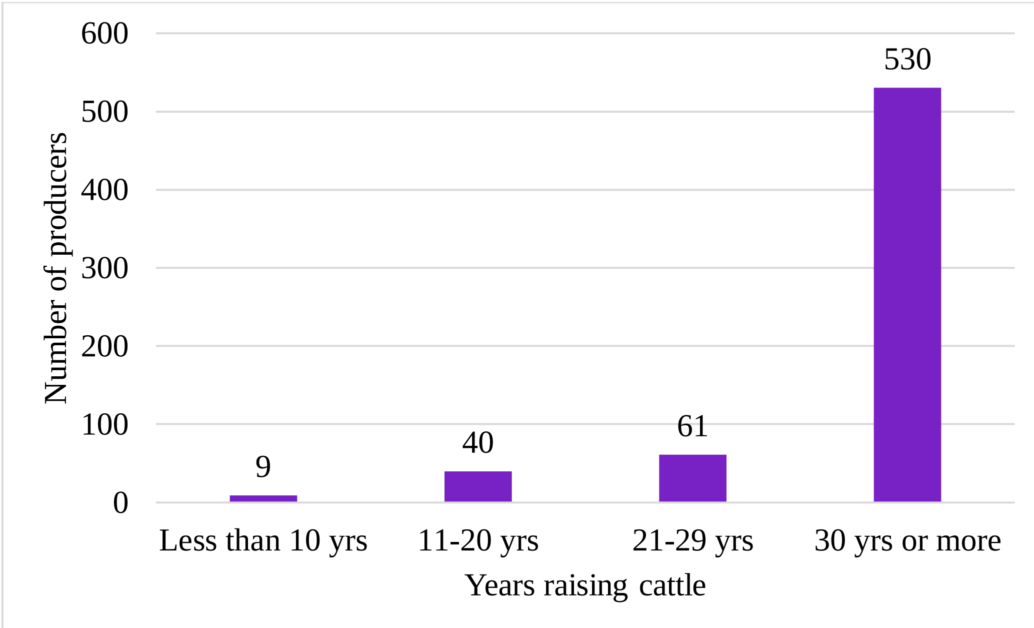

Figure 6-4 Producer's Experience

When producers indicated their pre-tax household income, the most selected answer was $125,000 or more as shown in figure 5. This included 162 respondents (29.51%). Producers with a pre-tax household income of $75,000-$99,000 was comprised of 117 respondents (21.31%) which was followed by 88 respondents (16.03%) who indicated they had a pre-tax household income of $50,000-$74,000. Those with a pre-tax income of $100,000-$124,000 encompassed 78 respondents (14.21%). Additionally, 76 respondents (13.84%) and 28 respondents (5.10%) indicated their pre-tax household income was $25,000- $49,000 and less than $25,000, respectively.

In the survey producers were asked what proportion of their household income is from the beef cattle operation. Figure 6 shows that 29.47% (173 survey respondents) indicated that 26%-50% of their income comes from the cattle operation. This was followed by 25.04% (147 survey respondents) and 22.83% (134 survey respondents) who selected less than 25% and 51%-75% of their income comes from the beef cattle operation, respectively. Additionally, 13.97% (82 survey respondents) indicated that 76%-99% of their income comes from the operation while 8.69% (51 survey respondents) 100% of their income comes from the cattle operation.

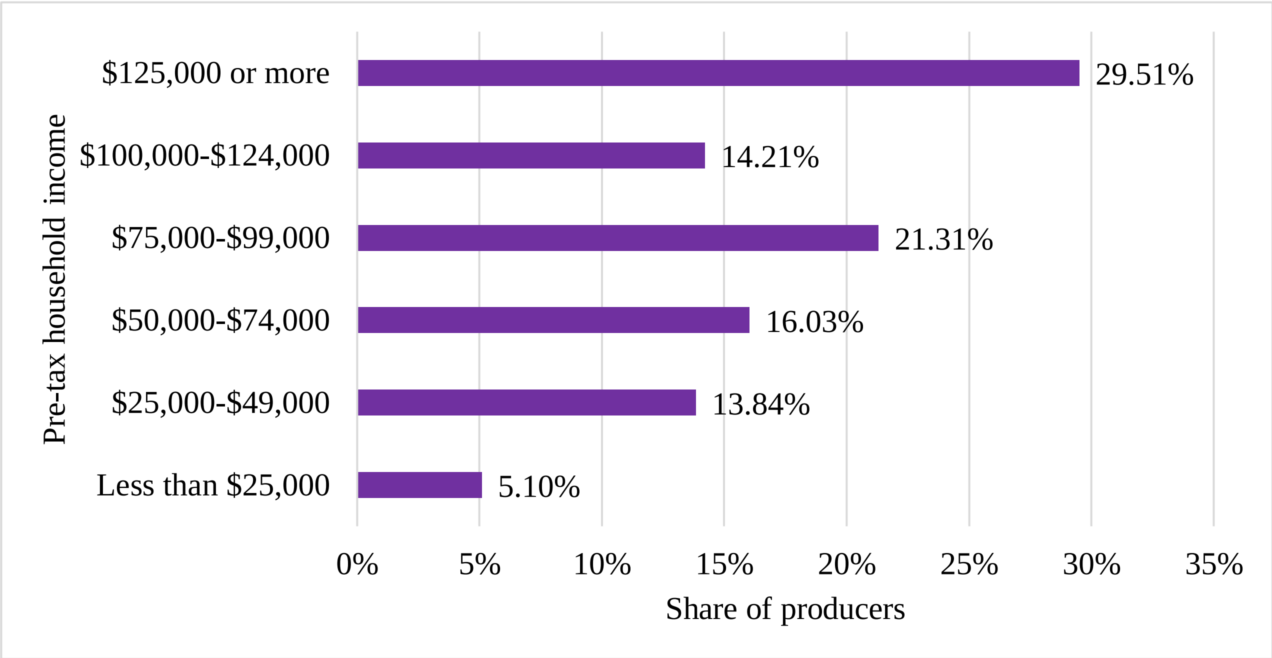

Figure 6-5 Pre-Tax Household Income

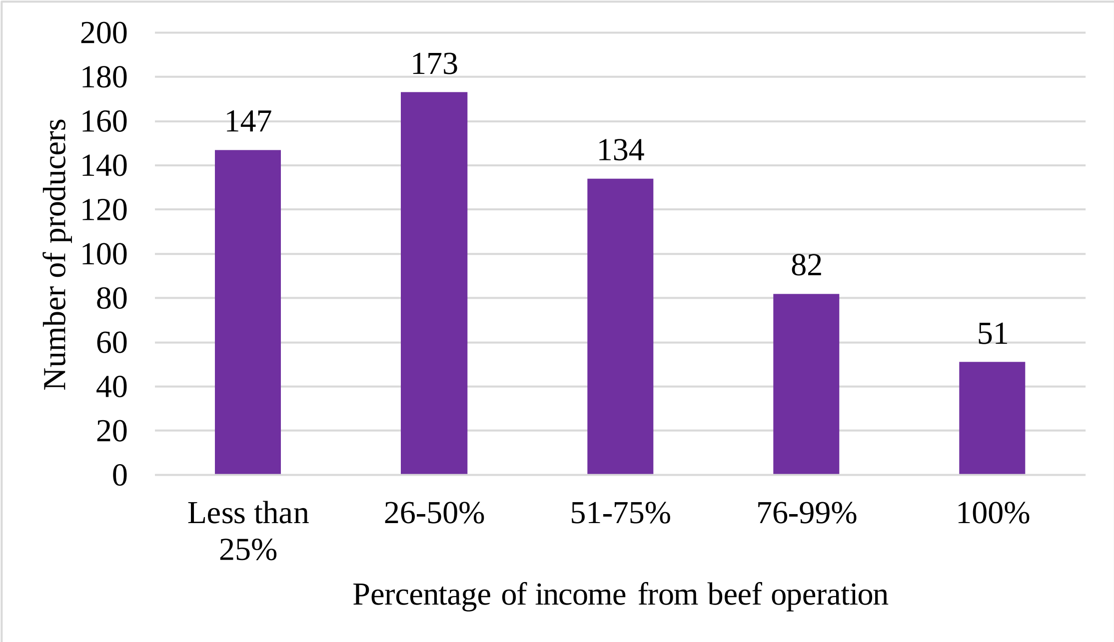

Figure 6-6 Percentage of Income from Beef Operation

As figure 7 shows the majority of the survey respondents describe their operation as a stocker/backgrounder with cow-calf. This included 282 respondents (44.41%) of the total 635 producers. Producers that describe their operation as stocker/backgrounder with cow-calf and feedlot totaled 160 respondents (25.2%). This was followed by stocker/backgrounder with feedlot which was comprised of 52 respondents (8.19%) and then purely stocker/backgrounder operations accounted for 40 respondents (6.3%).

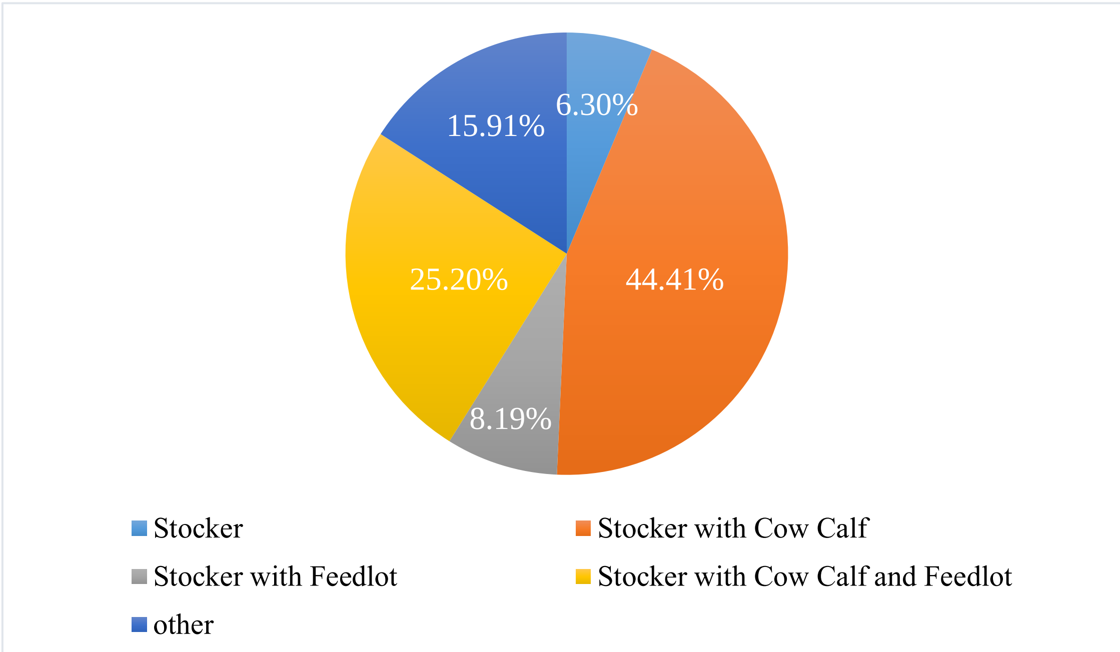

Figure 6-7 Operation Description

Operation and Management Characteristics

Table 2 continues to summarize operation and management characteristics. Producers were asked questions regarding cattle they had in inventory at varying production stages, the number of employees employed at the operation and labor wage if applicable. Additionally, they were asked questions relating to land ownership, cattle source, seasonality, frequency, cattle description, forage source, the typical length of time they manage cattle for, what ADG they manage to achieve, their current stocking rate, and then how they market their cattle.

The survey asked respondents how many head of cattle their operation had in inventory at each production stage on January 1, 2020. Of the 506 survey respondents that had cows, the average was 266.65 head as shown in figure 8. In terms of calves, 416 respondents had an average of 232.25. At the beginning of the year, 378 respondents had yearlings in production with an average of 355.21 head. Regarding finished cattle, 168 survey respondents averaged 451.1 head of finished cattle. Indicating the number of survey respondents decreased when moving through the production cycle, but the average head per operation increased with the exception of calves.

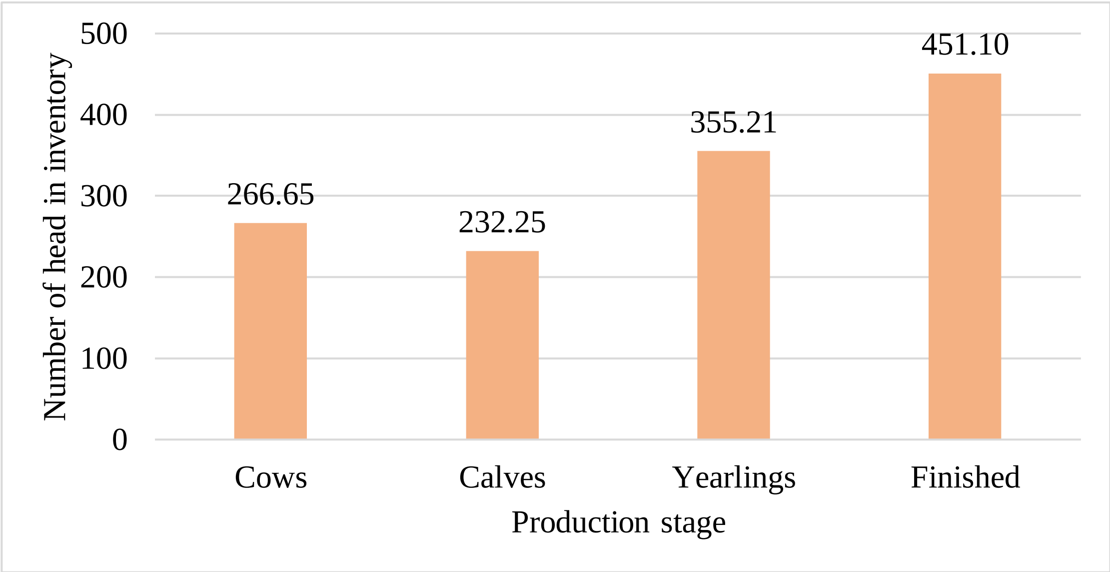

Figure 6-8 Cattle Inventory

Survey respondents were then asked to select how many employees their operation employs. As shown in figure 9 most respondents selected less than 5 for a total of 523 respondents (92.57%) out of 565 respondents who answered the question. Followed by 34 respondents (6.02%) who selected 5-14 employees. 15-24 and 25 or more were each selected by 4 respondents (0.71%). As a follow up, producers were asked what the current average labor wage paid to their employees is. The most common answer was non-applicable, I do not have paid employees which 31.91% (179 survey respondents) of respondents selected that, as shown in figure 10. This was followed with 23.17% (130 survey respondents) of producers selecting $12-$14.99. At a labor wage of $7.25-$11.99 17.29% (97 survey respondents) indicated that was the current average wage of their employees. Additionally, 15.51% (87 survey respondents), 7.84% (44 survey respondents), and 2.32% (13 survey respondents) selected $15.00-$17.99, %18.00-$20.99, and under $7.25, respectively. The least number of producers indicated the current average labor wage is $21.00 or more, which accounted for 1.96% (11 survey respondents).

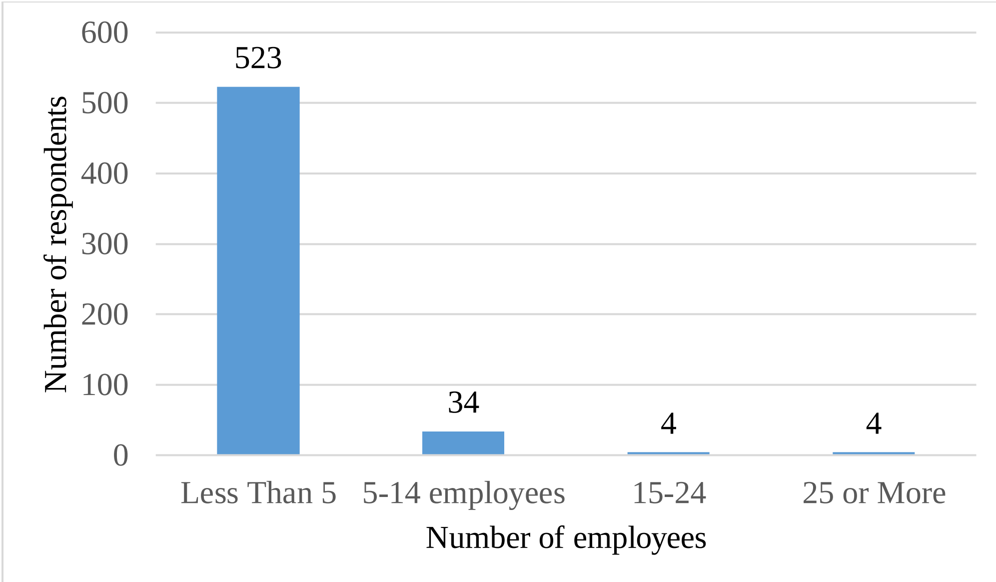

Figure 6-9 Number of Employees

Figure 6-10 Labor Wage

Producers were also asked to indicate who owns the land or lot in which they raise most of their cattle. For this question, survey respondents could select all that applied to their operation. Responses totaled 707, of the 645 surveys returned, many of those surveyed selected more than one landowner in their operation. The majority of respondents selected my family and/or I own the land as shown in figure 11. This included 551 respondents (77.93%). Following this was 133 respondents (18.18%) who indicated they lease the land from a private individual or other operation. Additionally, 18 producers (2.55%) selected that they lease the land from the government, school sections, etc.

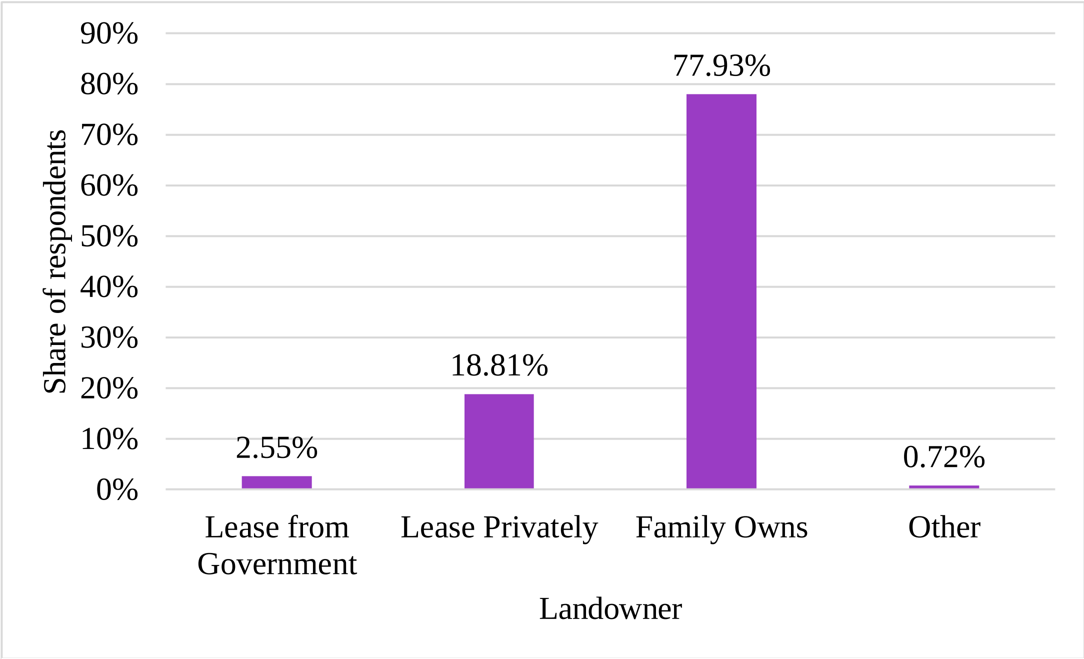

Figure 6-11 Land Ownership

Survey respondents were asked to refer to 2019 to indicate the percentage of feeder cattle placed in their backgrounding/ stocker operation that were sourced from each option provided. Figure 12 shows 763 total responses were recorded with the majority selecting retained from my own cow-calf operation (414 survey respondents). The mean percentage for this category was 82.28%. In terms of purchasing at auction, 125 producers selected purchased from auction without knowledge of source ranches and 93 producers selected purchased from auction with knowledge of source ranches. The mean percentages were 56.1% and 40.77% of feeder cattle, respectively. Respondents also indicated 95 producers purchased direct from individual cow-calf ranches with a mean percentage of 36.33% of cattle. Additionally, 22 producers selected that they purchased cattle from internet or video auctions with a mean percentage of 40.91%.

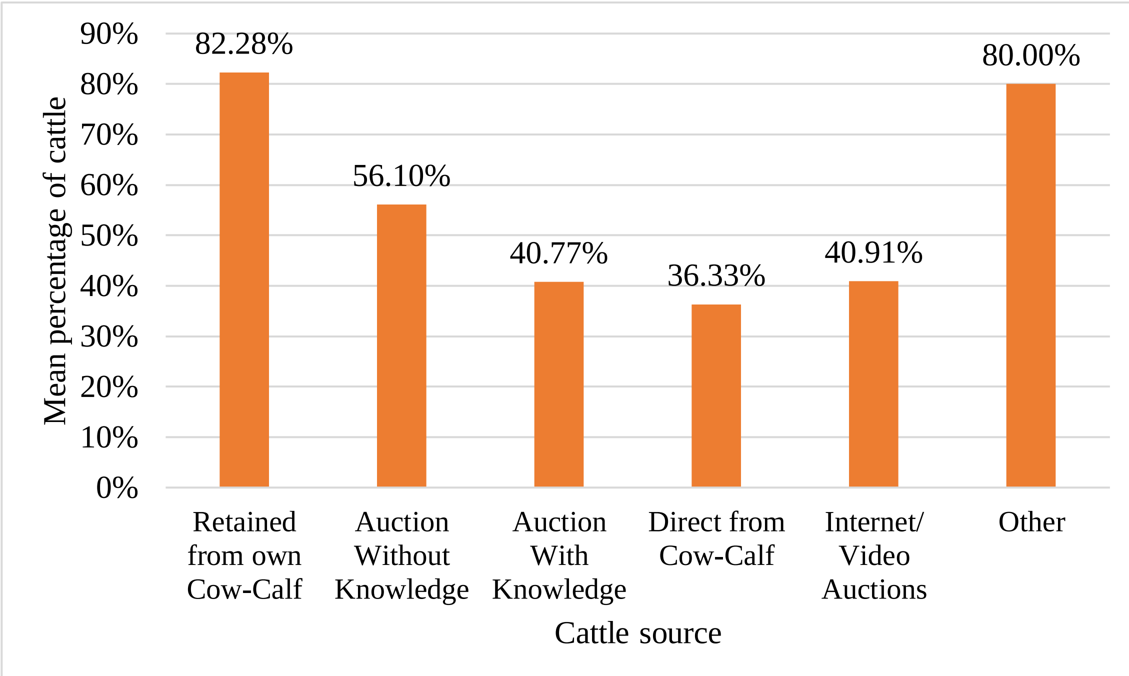

Figure 6-12 Mean Percentage of Cattle from Each Source

As figure 13 shows, the most common month for producers to purchase stocker/ backgrounders is October with 44 producers selecting that month. All year, November, and December followed with 39, 34, and 33 producers indicating that is when they purchase cattle. Only two producers indicated that they purchase stockers/ backgrounders in July. This was followed by 5 and two sets of 6 producers which indicated they purchase cattle in June, February, and May, respectively. Producers were also asked to indicate the weight they usually buy stocker/ backgrounders at. The mean weight was 531.5 pounds with the minimum weight being 100 pounds and the maximum weight being 900 pounds.

As shown in figure 14 the month that the majority of producers indicated they sell stocker/ backgrounders is January. Of the 403 responses, 43 indicated January. March followed with 42 producers indicated that was the month they sell stockers. April and November followed with 38 and 37 producers indicating those months, respectively. In comparison to when producers purchase stockers/ backgrounds the months when they sell cattle vary much more showing the diversity in management at the stocker level. Only 12 producers indicated that they sell stockers/ backgrounders in July. This was followed by June which 23 producers indicated that was then they sell stockers/ backgrounders. The mean weight that producers usually sell stocker/backgrounds was 828.45 pounds with the minimum weight being 250 pounds and the maximum weight being 1650 pounds.

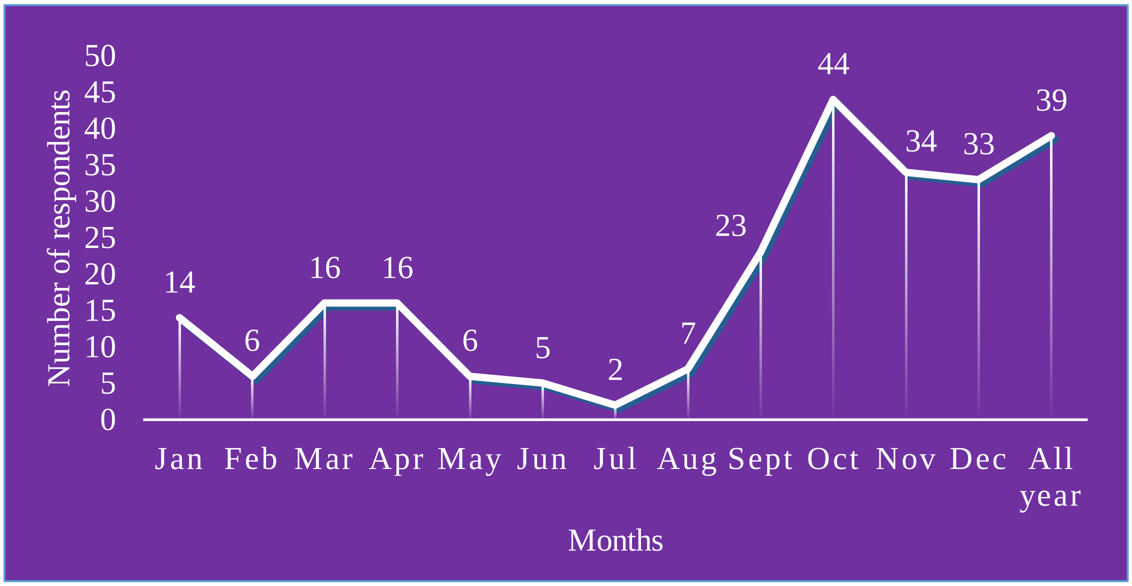

Figure 6-14 Month Producers Purchase Cattle

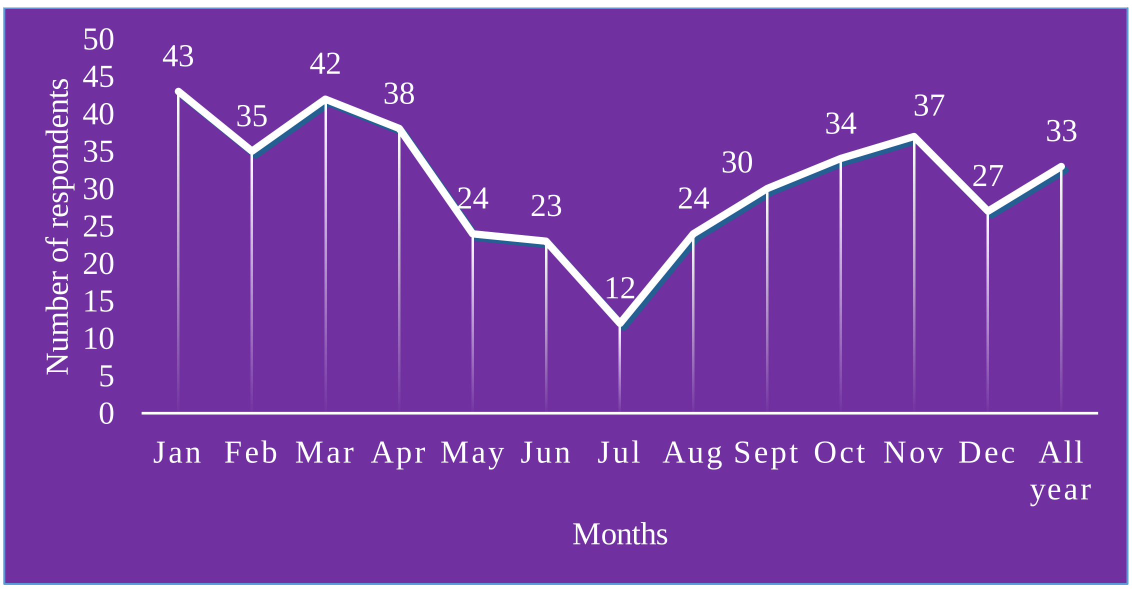

Figure 6-13 Month Producers Sell Cattle

Producers were then asked, once they place cattle on grass or in a lot, do they usually take them out at the same time, take some out, and take the rest out at a later date, or another management strategy. Taking some out, and taking the rest out later was selected by 295 producers (54.13%) while 232 survey respondents (42.57%) indicated that they take them all out at the same time as shown in figure 15.

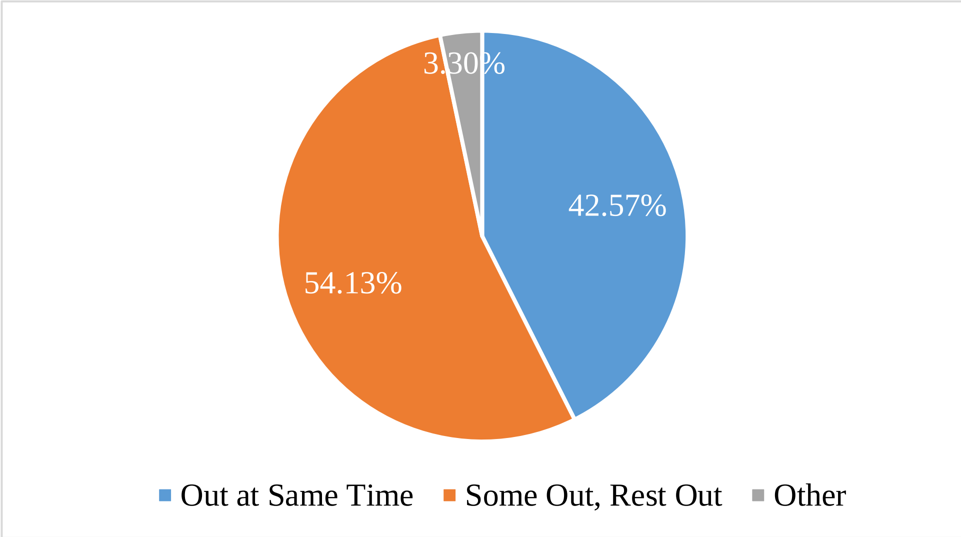

Figure 6-15 Cattle Placement and Removal

Survey respondents were then asked how they would describe the cattle they typically purchase. The options included black hided, colored, eared or some Brahman influence, purebred, and crossbred. For this question, survey respondents could select all that applied to their operation. Responses totaled 750, of the 645 surveys returned, Producers were asked to select all that apply. Figure 16 shows a majority (334 responses) selected black hided. This was followed by 179 responses and 135 responses which selected crossbred and colored, respectively. Purebred was selected by 71 responses. Additionally, 31 responses indicated that they typically purchase eared or some Brahman influenced cattle.

The survey then asked producers to select the best description of the frequency and seasonality of their backgrounder/ stocker operation. Of the total 498 respondents, 220 producers (44.18%) selected that they typically place multiple sets of feeder cattle within one year as shown in figure 17. That was followed with 193 survey respondents (38.76%) who indicated they typically place one set of feeder cattle in the fall and 85 survey respondents (17.07%) who indicated they typically place one set of feeder cattle in the spring.

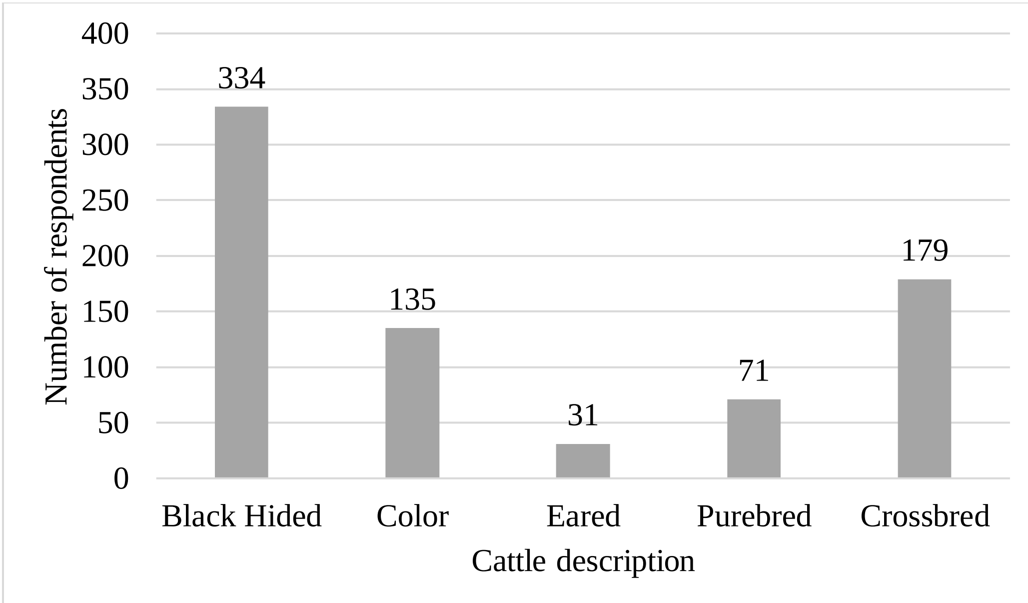

Figure 6-16 Description of Cattle

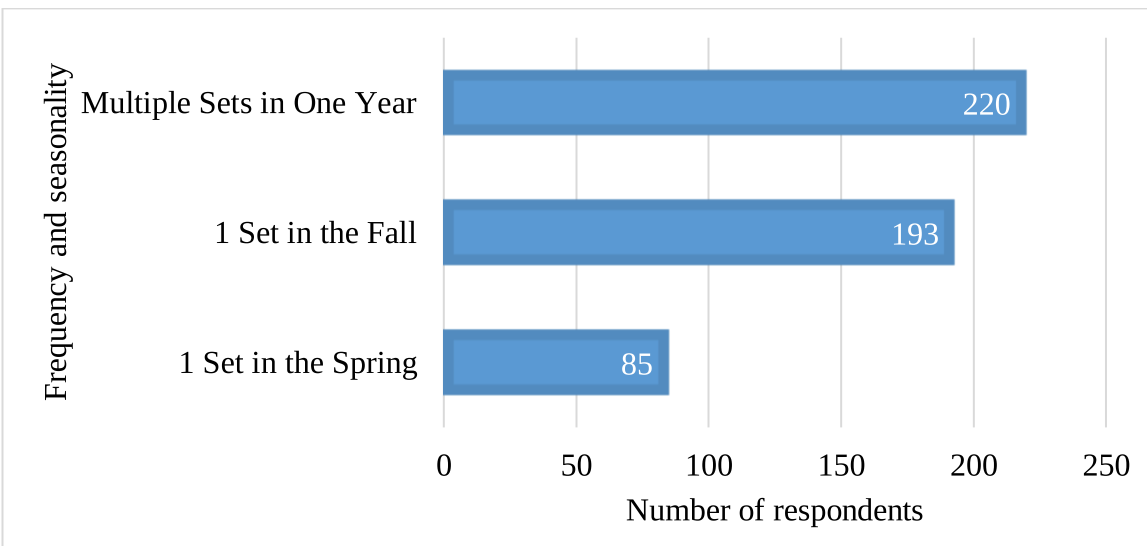

Figure 6-17 Frequency and Seasonality

The most common response regarding stocker/ backgrounders was producers indicated that they own/ manage stocker/ backgrounders for More than 180 days. As figure 18 shows this group was comprised of 191 producers (39.06%). The group of producers that typically own/ manage stocker cattle for 121-180 days consisted of 128 (26.18%) and this was followed by 74 producers that manage/ own cattle for 91-120 days (15.13%). Additionally, 70 (14.31%), 21 (4.29%), and 5 (1.02%) survey respondents indicated they typically own/ mange cattle for 61-90 days, 31-60 days and 30 days or fewer, respectively.

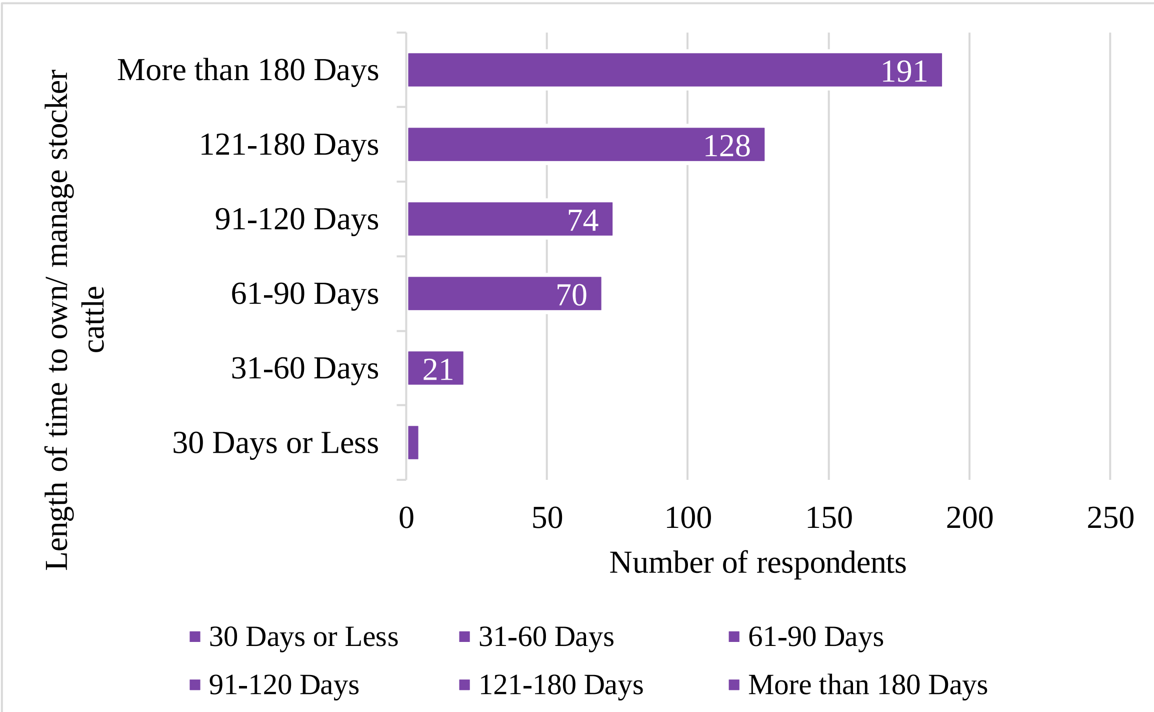

Figure 6-18 Length of Time Owned and or Managed

To obtain an understanding of different forage types that stocker/ backgrounders utilize survey respondents were asked to indicate what percentage of their total stocker/ backgrounder cattle were on each forage type and for how many days. The most popular forage source among respondents was dry lot (bunk fed forage, confined management of harvested feed). According to figure 19, 189 producers indicated that they have a mean percentage of 88.1% of their cattle on dry lot for an average of 176.09 days as shown in figure 20. Producers (97) who indicated a mean of 68.09% of their cattle are on cool season grass pasture (brome, fescue, perennial, ryegrass, etc.) for an average of 134.72 days. This was followed by 58 producers who indicated they have an average of 53.33% of their cattle on warm season grass pasture (switchgrass, big bluestem, etc.) for a mean of 141.67 days. Additionally, 28 producers indicated that they have a mean percentage of 62.82% of their cattle on fall cereal pasture (cereal grain pastures such as winter wheat, oats or ryegrass) for an average of 127.14 days, and 26 respondents indicated a mean percentage of 63.08% of their cattle on dormant winter feed (stockpiled dormant forage and crop residue) for a mean of 114.81 days. The least selected forage type was warm season annual (annually planted specifically for cattle grazing). This group included 11 producers who indicated they have an average of 48.73% of their cattle on warm season annual for a mean of 110 days.

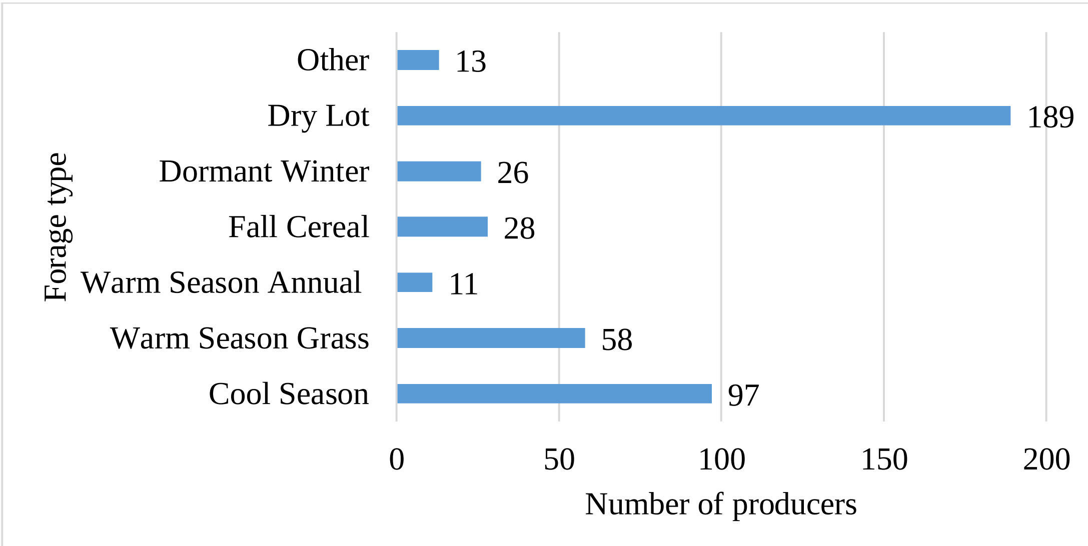

Figure 6-19 Forage Type

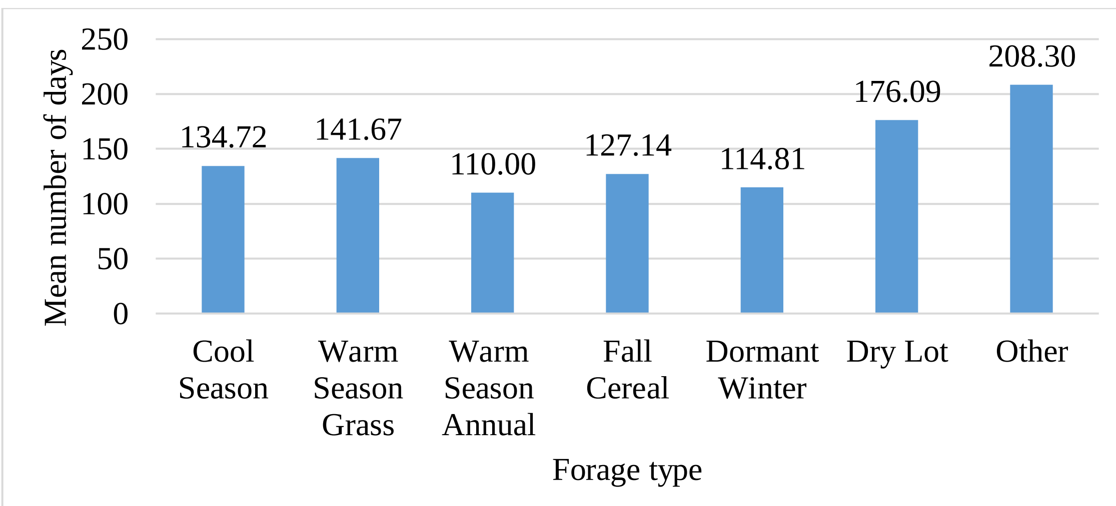

Figure 6-20 Mean Days on Forage

Another component that impacts the diversity of stocker production is the average daily gain (ADG) in which a producer manages to attain. Therefore, the survey asked producers to select which ADG they typically manage. As figure 21 shows most producers selected that they manage for an ADG of 2.01-2.25. This included 28.21% of respondents (134 producers). This was followed by 21.68% (103 producers) and 20.63% (98 producers) of respondents that indicated they manage for an ADG of more than 2.25 and 1.76-2 pounds/ day, respectively. Producers who selected they manage cattle for an ADG of 1.51-1.75 were 15.79% of respondents (75 producers). Additionally, there were 53 (11.16%) and 12 (2.53%) survey respondents who selected they manage for an ADG of 1.26-1.5 and less than 1.26, respectively.

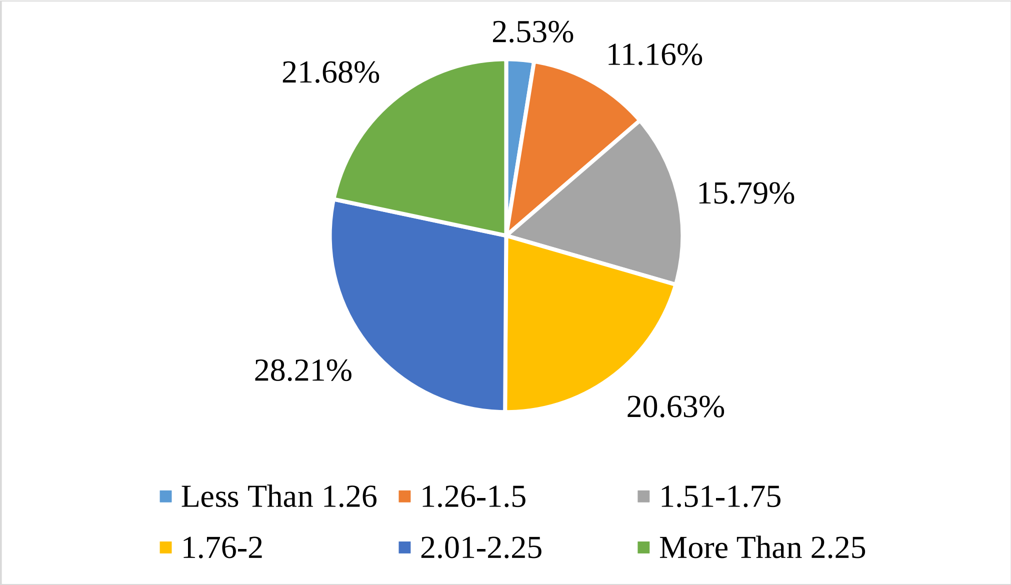

Figure 6-21 AGD (lbs/day) Managed

The survey also gathered information regarding stocking rate. Producers were asked to respond with their current stocking rate in terms of head per acre. The mean stocking rate among 279 producers was 19.14 with a minimum of .03 and a maximum of 500. This question was followed with has your stocking rate changed in the last 5 years? A majority of respondents indicated that their stocking rate has not changed in the last 5 years. This included 343 respondents (76.73%) that indicated their stocking rate has not changed and 104 respondents (23.37%) that indicated their stocking rate has changed.

Survey respondents were then asked, referring to 2019, what percentage of cattle do you market using the following options. Figure 22 shows most respondents (274 producers) indicated that they sell through a traditional live auction. This group of producers indicated that the mean percentage of their cattle sold through a traditional auction market is 84.28%. Following this was 147 producers who indicated that they retain an average percent of 79.63% of their cattle ownership at the feedlot. Producers who sell directly to the feedlot was much lower at 73 survey respondents who indicated that the average percentage of cattle they market this way is 71.37%. Additionally, 35 respondents indicated that they market 71.23% of their cattle through internet/ video auctions.

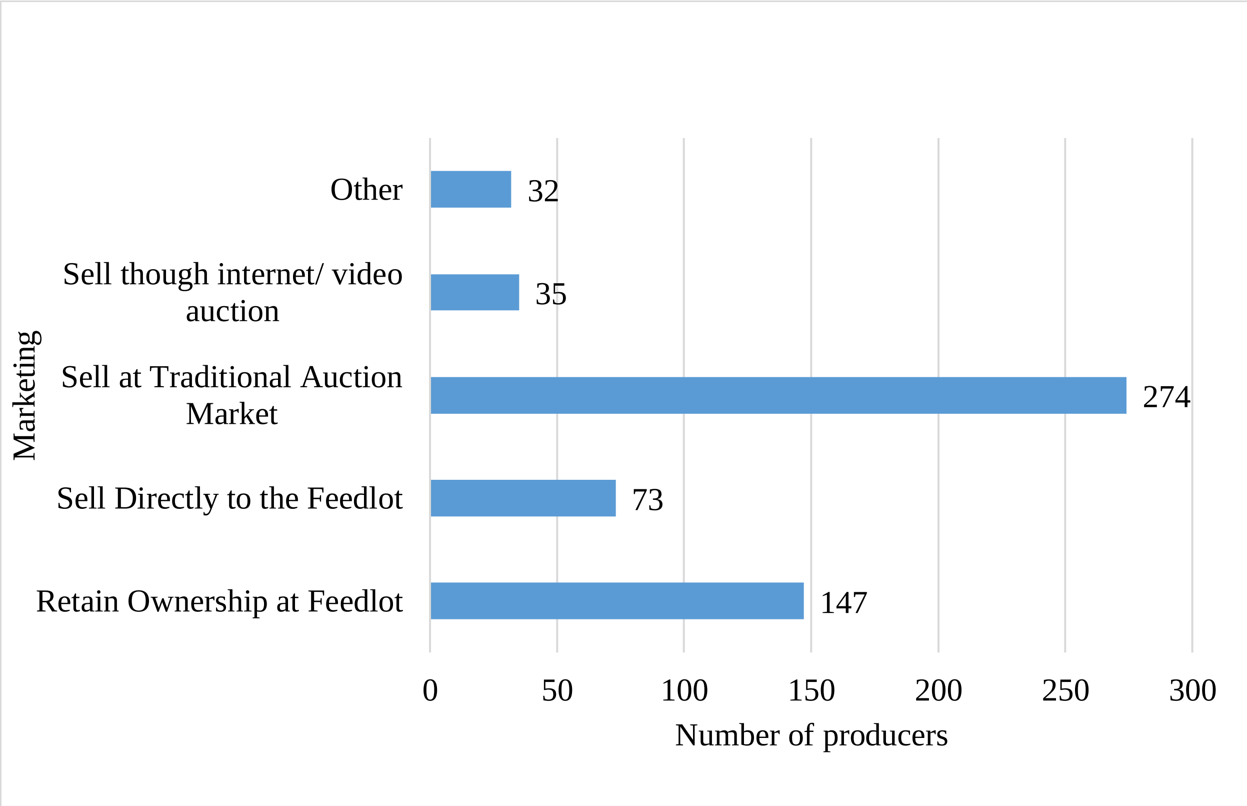

Figure 6-22 Cattle Marketing Mode

Table 3 shows risk management practices that stocker/ backgrounder producers utilize and their preference when it comes to risk, new technology, and adopting new practices.

Table 3 Risk Management and Preferences

Focusing on low cost production is a practice that most producers indicated that they use to manage market or price risk as shown in Figure 23. This included 246 producers. Producers indicating they retained ownership at the feed yard to manage risk totaled 127 respondents. Paying a premium to buy high quality cattle was another way a producer manages risk. This group totaled 108 respondents. Additionally, 71 and 68 producers indicated they utilize futures market contracts and buy lower priced cattle, respectively. Forward contracting inputs/ outputs is a risk management practice for 48 survey respondents. This is followed with 41 respondents which selected that they typically utilize options on future market contracts. Finally, 12 and 2 producers indicated that they use Livestock Risk Protection (LRP) Insurance or Livestock Gross Margin (LGM) Insurance, respectively.

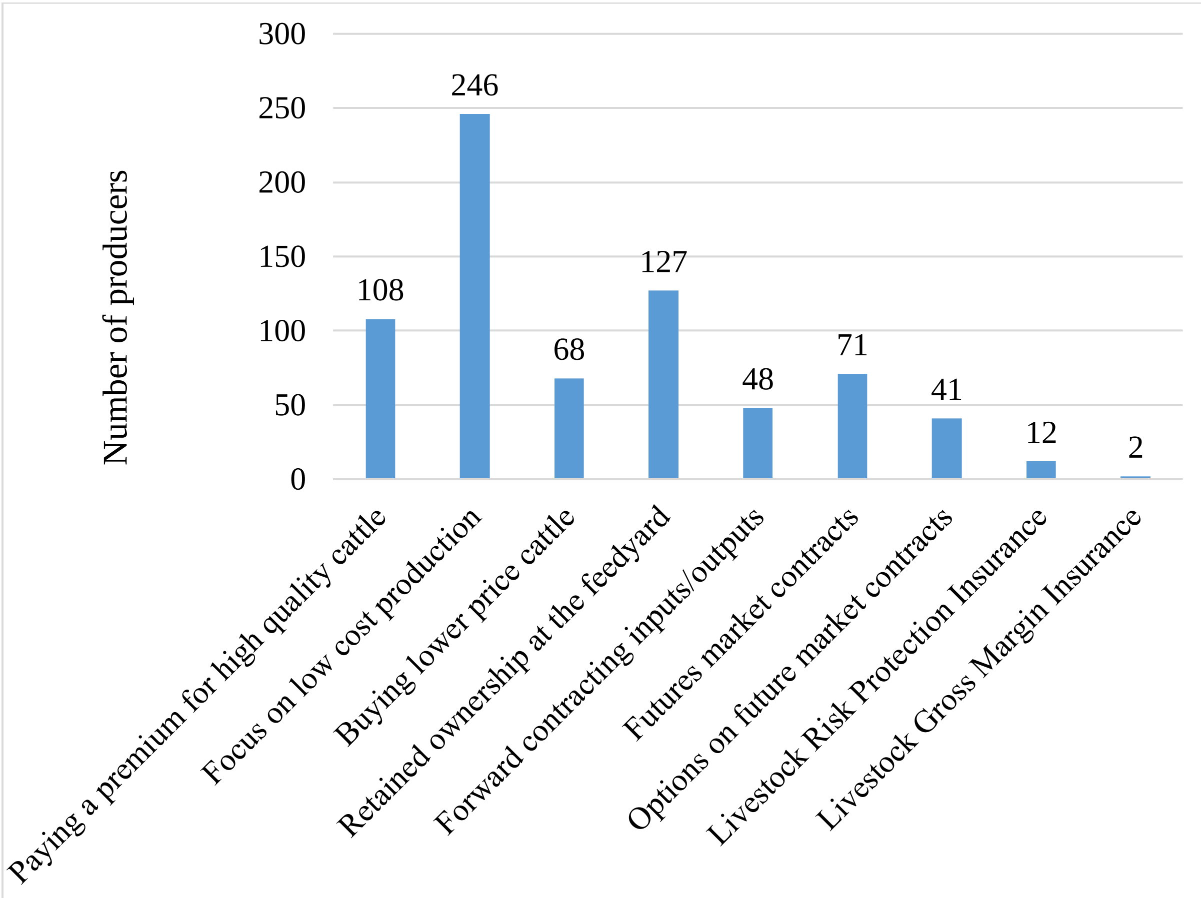

Figure 6-23 Risk Management Practices

Survey respondents were then asked to rate their agreement to the risk related statements listed in table 3. Of the 571 producers that answered, “I usually like playing it safe by doing what I have done for many years,” 124 producers (21.72%) selected they strongly agree, 24 (4.2%) selected they strongly disagree, 3 (.53%) selected they were unsure with 420 producers (73.56%) falling in the middle of strongly agree and strongly disagree. Of the 569 producers that answered, “During my time as a cattle producer, I have tried new technology,” 120 producers (21.09%) selected they strongly agree, 22 (3.87%) selected strongly disagree with 420 producers (73.81%) selecting a rating in the middle, and 7 producers (1.23%) indicating they were unsure. Of the 556 producers that answered, “If there is a new practice, I want to be the first one to implement it in my operation,” 19 (3.42%) selected they strongly agree, 95 (17.09%) selected strongly disagree, 419 (75.36%) selected in the middle, and 23 (4.14%) selected unsure. Of the 561 producers that answered, “With respect to my conduct of business, I dislike risk,” 103 (18.36%) selected they strongly agree, 29 (5.17%) indicated they strongly disagree and 419 (74.69%) selected a rating in the middle. Additionally, 10 producers (1.78%) selected unsure.

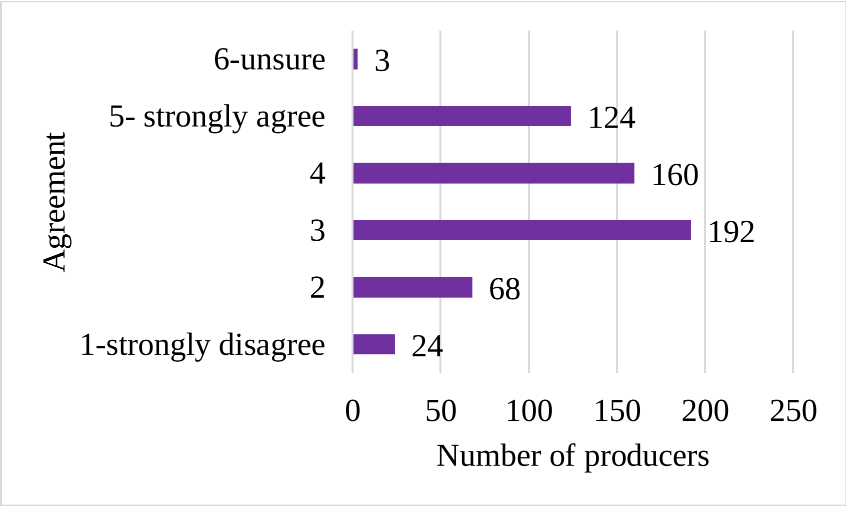

Figure 6-24 "Playing it Safe"

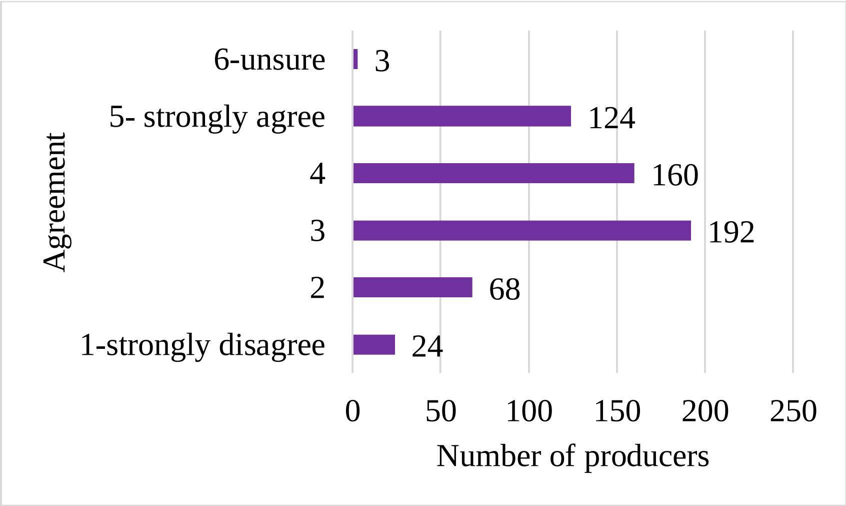

Figure 6-25 Tried New Technology

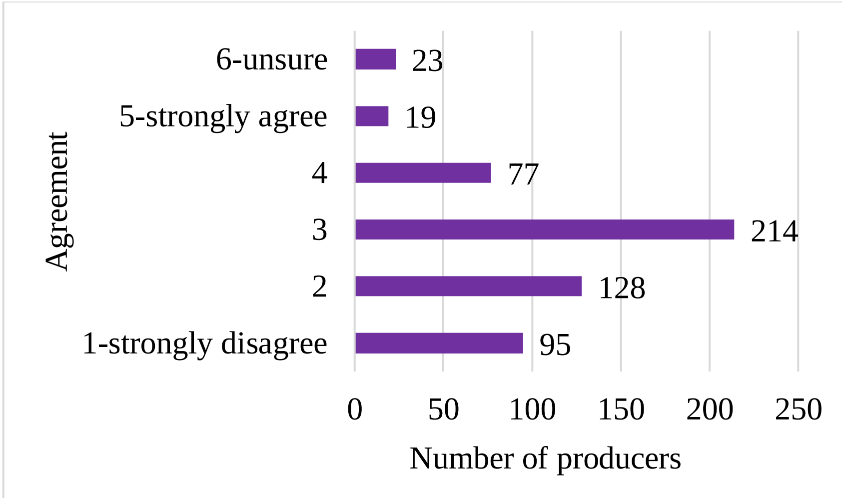

Figure 6-26 First to Implement a New Practice

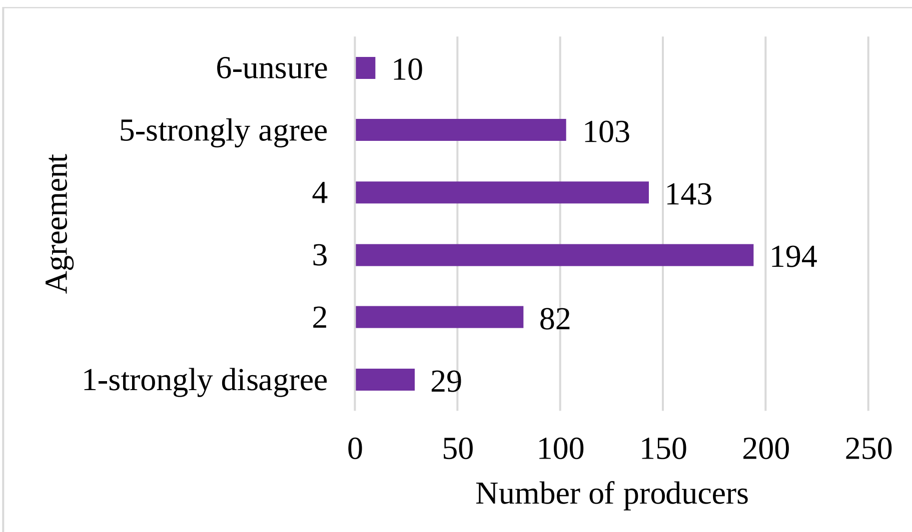

Figure 6-27 "I dislike risk."

The remainder of this document includes tables presenting additional response statistics which augment figures and in- text discussion that appeared earlier in the document.

Tables

Table 6-1 Operator/ Respondent and Management Summary Statistics

Age *What is your age?*

Mean	SD	Min	Max	N
63.68	12.40	25	90	626

Education *The best description of your education is:*	**Frequency %**	**N**
Did not obtain a High School Diploma	2.52	16
High School Diploma	39.94	254
Technical training (certification or associates degree)	19.18	122
Bachelor's Degree	27.67	176
Graduate or Professional Degree (M.S., Ph.D., D.V.M., Law Degree)	8.81	56
Other	1.89	12
	Total Responses	636

Gender *I am:*	**Frequency %**	**N**
Male	94.13	593
Female	4.92	31
Wish not to disclose	.95	6
	Total Responses	**630**

Experience *How many years have you been raising cattle?*	**Frequency %**	**N**
Less than 10 years	1.41	9
11-20 years	6.25	40
21-29 years	9.53	61
30 years or more	82.81	530

Income	*Please estimate your annual pre-tax household income:*	**Frequency %**	**N**
	Less than $25,000	5.10	28
	$25,000-$49,999	13.84	76
	$50,000-$74,999	16.03	88
	$75,000-$99,999	21.31	117
	$100,000-$124,999	14.21	78
	$125,000 or more	29.51	162
		Total Responses	549
		Total Responses	640

Operator	***What is your position in this operation?***	Frequency %	N
	Owner and Manager	81.50	520
	Owner	15.83	101
	Manager	0.94	6
	Other	1.72	11
		Total Responses	638

Income from Cattle Operation	*Approximately what proportion of your household income is from the beef cattle operation?*	**Frequency %**	**N**
	Less than 25%	25.04	147
	26%-50%	29.47	173

51%-75%	22.83	134
76%-99%	13.97	82
100%	8.69	51
	Total Reponses	565

Description of Operation	*How would you describe your operation?*	**Frequency %**	**N**
	100% stocker/ backgrounder	6.30	40
	Stocker/ backgrounder with cow-calf	44.41	282
	Stocker/ backgrounder with feedlot	8.19	52
	Stocker/ backgrounder with both cow-calf and feedlot	25.20	160
	Other	15.91	101
		Total Responses	635

State	*What is the primary state in which you operate?*	**Frequency %**	**N**
	Alabama	1.74	11
	Arkansas	2.05	13
	California	1.74	11
	Colorado	2.37	15
	Florida	1.10	7
	Georgia	1.58	10
	Iowa	8.04	51
	Idaho	1.26	8
	Illinois	3.63	23

Indiana	1.26	8
Kansas	8.83	56
Kentucky	2.21	14
Louisiana	0.63	4
Michigan	0.95	6
Minnesota	4.57	29
Missouri	8.68	55
Mississippi	0.95	6
Montana	3.00	19
North Carolina	0.63	4
North Dakota	5.05	32
Nebraska	9.94	63
New Mexico	0.63	4
New York	0.16	1
Ohio	2.21	14
Oklahoma	4.42	28
Oregon	0.79	5
Pennsylvania	0.63	4
South Carolina	0.32	2
South Dakota	7.10	45
Tennessee	2.37	15
Texas	4.89	31
Utah	0.79	5
Virginia	1.58	10
Vermont	0.32	2
Washington	0.63	4
Wisconsin	1.42	9
West Virginia	0.32	2
Wyoming	1.26	8

Total Responses	634

Table 6-2 Operation Summary Statistics

Head of Cattle	*How many cattle (# head) did your operation have in inventory at the following production stages on January 1st 2020?*	**Mean**	**SD**	**Min**	**Max**	**N**
	Cows	266.65	377.37	0	4010	506
	Calves	232.25	571.55	0	7000	416
	Yearlings	355.21	1225.40	0	20000	378
	Finished Cattle	451.10	1432.21	0	14000	168

Employees	*How many employees does your operation employ?*	**Frequency %**	**N**
	Less than 5	92.57	523
	5-14	6.02	434
	15-24	0.71	4
	25 or more	0.71	4
		Total Responses	565

Labor Wage	*What is your current average labor wage paid to employees (wage/ hour)?*	**Frequency %**	**N**
	Under $7.25	2.32	13
	$7.25-$11.99	17.29	97
	$12.00-$14.99	23.17	130
	$15.00-$17.99	15.51	87
	$18.00-$20.99	7.84	44
	$21.00 or more	1.96	11
	Non-applicable, I do not have paid employees	31.91	179
		Total Responses	561

Land Ownership	*Who owns the land or lot in which you raise the majority of your cattle? (select all that apply)*	**Frequency %**	**N**
	I lease the land from the government, school sections, etc.	2.55	18
	I lease the land from a private individual or other operation	18.81	133
	My family and/ or I own the land	77.93	551
	Other	0.71	5
		Total Responses	707

Cattle Source	*Referring to 2019, what percentage of cattle placed in your background/ stocker operation were sourced from each of the following sources:*	**Mean**	**SD**	**Min**	**Max**	**N**

Retained from my own cow-calf operation	82.28	29.93	0	100	414
Purchased from auction market without knowledge of source ranches	56.1	33.09	0	100	125
Purchased from auction with knowledge of source ranches	40.77	31.85	0	100	93
Purchased direct from individual cow-calf ranches	36.33	31.58	1	100	95
Purchased from internet/video auctions	40.91	29.36	0	100	22
Other	80	32.05	15	100	14
				Total Responses	763

Purchase Month	*What month do you typically purchase your cattle?*	***Frequency %***	*N*
	January	5.71	14
	February	2.45	6
	March	6.53	16
	April	6.53	16
	May	2.45	6
	June	2.04	5
	July	0.82	2
	August	2.86	7
	September	9.39	23
	October	17.96	44
	November	13.88	34
	December	13.47	33
	All year	15.92	39
		Total Responses	245

Buy Weight *What weight do you typically buy your cattle?*

Mean	SD	Min	Max	N
531.5	130.35	100	900	259

Sell Month *What month do you typically sell your cattle?*

	Frequency %	N
January	10.67	43
February	8.68	35
March	10.42	42
April	9.43	38
May	5.96	24
June	5.71	23
July	2.98	12
August	5.96	24
September	7.44	30
October	8.44	34
November	9.18	37
December	6.70	27
All year	8.19	33

Sell Weight *What weight do you typically sell your cattle?*

Mean	SD	Min	Max	N
828.45	252.67	250	1650	412

Placement *Once you place your cattle on grass or in a lot, do you usually:*

	Frequency %	N
Take them all out at the same time	42.57	232
Take some out, and then the rest out at a later date	54.13	295
Other	3.3	18

Total Responses	545

Cattle Description	How would you describe the cattle you typically purchase? *(select all that apply)*	**Number of Responses**
	Black hided	334
	Colored	135
	Eared or some Brahman influence	31
	Purebred	71
	Crossbred	179

Frequency and Seasonality	*What best describes the frequency and seasonality of your background/ stocker operation?*	**Frequency %**	**N**
	Typically place one set of feeder cattle in the Spring	17.07	85
	Typically place one set of feeder cattle in the Fall	38.76	193
	Typically place multiple	44.18	220
		Total Responses	498

Management Time	*What is the total length of time you typically own/ manage most stocker/ backgrounders?*	**Frequency %**	**N**
	30 days or fewer	1.02	5
	31-60 days	4.29	21
	61-90 days	14.31	70
	91-120 days	15.13	74
	121-180 days	26.18	128
	More than 180 days	39.06	191
		Total Responses	489

Forage *Referring to 2019, what percentage or your total stocker/backgrounder cattle were on each of the following and for how long?*

	Mean	**SD**	**Min**	**Max**	**N**
Cool season grass pasture *(brome, fescue, perennial, ryegrass, etc.)*					
Average % of cattle	68.09	33.83	0	100	97
Days	134.72	71.38	30	365	81
Warm season grass pasture *(switchgrass, big bluestem, etc.)*					
Average % of cattle	53.33	32.54	0	100	58
Days	141.67	66.42	20	360	57
Warm season annual *(annual planted specifically for cattle grazing, i.e. Sudan)*					
Average % of cattle	48.73	37.17	6	100	11
Days	110	42.43	30	180	9
Fall cereal pasture *(cereal grain pastures such as winter wheat, oats or ryegrass)*					
Average % of cattle	62.82	32.68	9	1000	28
Days	127.14	44.81	30	180	28
Dormant Winter feed *(stockpiled dormant forage and crop residue)*					
Average % of cattle	63.08	30.43	10	100	26
Days	114.81	72.50	30	365	27
Dry lot *(bunk fed forage, confined management of harvested feed)*					
Average % of cattle	88.10	23.63	10	100	189

Days	176.09	100.30	30	460	140
Other					
Average % of cattle	93.62	15.97	50	100	13
Days	208.3	151.28	60	540	10

ADG *When placing cattle in your stocker/ backgrounder operation, what average daily gain (lbs./day) do you typically manage for?* **Frequency %** **N**

	Frequency %	N
Less than 1.26	2.53	12
1.26-1.5	11.16	53
1.51-1.75	15.79	75
1.76 to 2.0	20.63	98
2.01-2.25	28.21	134
More than 2.25	21.68	103
	Total Responses	475

Stocking Rate Change *Has your stocking rate changed in the last 5 years?* **Frequency %** **N**

	Frequency %	N
No	76.73	343
Yes	23.27	104
	Total Responses	447

Stocking Rate *What is your current stocking rate? (head/acre)*

Mean	SD	Min	Max	N
19.14	59.94	0.03	500	279

Marketing *Referring to 2019, what percentage of cattle do you* **Mean** **SD** **Min** **Max** **N**

market using the following options:					
Retain ownership at the feedlot	79.63	31.13	0	100	147
Sell directly to the feedlot	71.37	29.96	0	100	73
Sell through a traditional auction market	84.28	29.10	2	100	274
Sell through internet/ video auction	71.23	27.89	10	100	35
Other	63.06	38.50	8	100	32
				Total Responses	561

Risk Management	*Which practices do you typically use to manage market or price risk? (select all that apply)*	**Number of Responses**
	Paying a premium to buy high quality cattle	108
	Focus on low cost production	246
	Buying lower priced cattle	68
	Retained ownership to the feed yard	127
	Forward contracting inputs/ outputs	48
	Futures market contracts	71
	Options on future market contracts	41
	Livestock Risk Protection (LRP) Insurance	12
	Livestock Gross Margin (LGM) Insurance	2
	Other	27

Agreement	*Please rate your agreement with these statements (1-strongly disagree, 5- strongly agree, 6- unsure*	***Frequency %***	*N*
	I usually like playing it safe by doing what I have done for many years		
	1- strongly disagree	4.2	24
	2	11.91	68
	3	33.63	192
	4	28.02	160
	5- strongly agree	21.72	124
	6- unsure	0.53	3
		Total Responses	571

During my time as a cattle producer, I have tried new technology		
1- strongly disagree	3.87	22
2	10.02	57
3	25.83	147
4	37.96	216
5- strongly agree	21.09	120
6- unsure	1.23	7

	Total Responses	569
If there is a new practice, I want to be the first one to implement it in my operation		
1- strongly disagree	17.09	95
2	23.03	128
3	38.49	214
4	13.85	77
5- strongly agree	3.42	19
6- unsure	4.14	23
	Total Responses	556
With respect to my conduct of business, I dislike risk		
1- strongly disagree	5.17	29
2	14.62	82
3	34.58	194
4	25.49	143
5- strongly agree	18.36	103
6- unsure	1.78	10
	Total Responses	561