Summer 2015

Management and Production Practices of the Missouri Beef Cattle Industry

Jordan Lee Kinder

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MANAGEMENT AND PRODUCTION PRACTICES OF THE MISSOURI BEEF CATTLE INDUSTRY

A Masters Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Masters of Natural and Applied Sciences, Agriculture

By

Jordan Lee Kinder

July 2015

MANAGEMENT AND PRODUCTION PRACTICES OF THE MISSOURI BEEF CATTLE INDUSTRY

Agriculture

Missouri State University, July 2015

Masters of Natural and Applied Sciences, Agriculture

Jordan Kinder

ABSTRACT

A survey of beef cattle producers in Missouri was conducted to evaluate the management and production practices of the beef cattle industry. Production and demographic data from 112 (response rate of 5.9%) were analyzed to identify areas in need of future research and education. The web-based survey was conducted through Survey Monkey© and distributed by the Missouri Cattlemen's Association to a list of their members. Responding producers were located in 65 of the 114 counties in Missouri, with 63.3% located north of Interstate 44 and 36.7% south of Interstate 44. The majority (47.3%) of producers were between ages 31 and 55, and 63.0% had a Bachelor or Graduate degree. Producers who attend grazing school (49.5%) were more likely to use temporary electric fencing to rotate cattle during the growing season ($p<0.01$) and winter months ($p<0.05$), purposefully stockpile forage ($p<0.01$), move cattle frequently ($p<0.01$), and utilize more stockpiled winter forage ($p<0.01$). Net profit was positively correlated ($p<0.01$) to number of mature cattle (0.792). Large producers (75 or more mature cattle) were more likely to apply fertilizer and lime ($p<0.05$) to their fields and make fencing ($p<0.01$), water source ($p<0.05$), planting ($p<0.05$), and mowing or brushhoging ($p<0.05$) improvements to rented land. Understanding the management practices producers use may allow educators and extension personnel to develop educational programs to meet producer needs.

KEYWORDS: beef cattle, survey, Missouri, rotational grazing, management practices

This abstract is approved as to form and content

_____

Dr. Elizabeth Walker
Chairperson, Advisory Committee
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By

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A Masters Thesis
Submitted to the Graduate College
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I would like to thank Mike Deering and the Missouri Cattlemen's Association for helping me to distribute my survey. Without their help, I would have had a hard time finding enough participants to complete my survey.

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INTRODUCTION

Justification for the Study

The cattle industry is an important part of Missouri's economy, and the demand for meat and milk products continues to grow. Cattle producers need access to current informational resources regarding production and management practices within their industry.

Research has been conducted throughout the United States to evaluate the beef cattle industry; however, few recent studies have been conducted in Missouri. As cattle prices remain high and cattle numbers low, research on management, production, grazing, and profitability is needed to help cattle produces remain productive and sustainable.

Statement of Purpose, Objectives, and Hypothesis

The purpose of this study is to identify the current management, grazing, and production practices of cattle producers in Missouri, and begin the process of addressing long and short term needs of cattle producers. Information obtained from this study will help educators and extension personnel develop educational programs for cattle producers.

Research Objectives:

- Collect demographic data about cattle producers and farms.
- Identify current management and production practices of cattle producers.
- Determine the profitability of Missouri cattle producers.

- Determine prevalence of rotational grazing among cattle producers.
- Identify differences in pasture management practices on rented and owned land.
- Determine the need for future research on Missouri's cattle industry.

I hypothesized that cattle producers would have differences in management characteristics, profitability, and type of operation. I hypothesized that rotational grazing practices would be more heavily utilized by producers who attended grazing school, and that the majority of producers would be of an older demographic. I hypothesized that there would be differences in pasture management practices between producers who owned land and those who rented land.

Definitions

A list of definitions was developed to assist the reader in understanding the terminology used throughout this study. A producer is an individual that raises cattle. An operation refers to the farm, ranch, or business as a whole that raises cattle. Rotational grazing is the practice of intentionally rotating cattle between pastures for the purpose of allowing rest periods and regrowth of the forage.

LITERATURE REVIEW

The livestock sector is an important part of the total US economy. The 2012 Census of Agriculture reported that livestock sales made up $182.2 billion of the nation's total market value of products (USDA, 2014a). In 2013, the US cattle and calf inventory itself contributed $89.3 million to the U.S. economy, and $5.711 billion worth of agricultural products were exported to countries such as Canada, Mexico, and South Korea (USDA, 2014c). Missouri's economy is highly influenced by livestock production. According to 2011 data from the USDA, Missouri ranks second in total beef cow farms and cattle farms, and third in the beef cow numbers with 1,865,000 (NASS, 2011). The majority of the cattle in Missouri are found in the south central and south western part of the state. According to the Missouri Department of Agriculture for the week of November 7, 2014, 226kg feeder steers, sold for $6.10/kg, bringing the value of a 226kg steer to $1,378.60. With these high cattle prices, producers have the opportunity to attain higher profit margins (Fordyce et al., 2014).

History of Cattle

There are no breeds of cattle that are native to the United States. *Bos taurus* breeds of cattle originated in European countries. Charolais and Limousin came from France, Angus from Scotland, and Hereford from England. *Bos indicus* breeds of cattle, such as Brahman, originated from countries of Southeast Asia and Africa (EPA, 2013).

Cattle were originally brought to America on Columbus' second voyage in 1493. Spanish type longhorn cattle were brought into Mexico in 1521, which later spread

throughout the western U. S. Portuguese traders also brought cattle to America in 1553. The English brought over cattle to the Jamestown colony in 1611, and by the 1800s, cattle were distributed throughout the U.S (EPA, 2013).

The total cattle inventory in the U.S. peaked in the 1970s at 1.3 billion. Since then, cattle numbers have been on the decline and have dropped to less than 1 billion (USDA, 2015). The number of cattle operations in the U.S. has also been on a steady decline. In 1992 there were over 1.2 million total cattle operations in the U.S. and approximately 900,000 beef cow operations. In 2012, those numbers were down to 915,000 total cattle operations and 729,000 beef cow operations (USDA, 2014b).

In contrast to the decreasing number of cattle in the U.S., the average herd size has increased. In 1987, half of all fattened cattle were produced on feedlots with an average of 17,532 cattle. In 2007, that number increased to 35,000 cattle (O'Donoghue et al., 2014). Because the number of large and small farms has both increased, this trend of increased herd size has not had a large impact on the overall average farm size in the U.S. In 1996, the average U.S. farm size was 177.3 hectares, and in 2003 it increased only slightly to 178.5 hectares (NASS, 2013). Part of the increase in the number of large scale farms with over 1000 cattle can be attributed to changes in production and marketing practices. The same trend of increased farm size is seen in most other livestock and crop sectors of the U.S. agriculture industry (O'Donoghue et al., 2014).

Missouri Demographics

The total number of farms in Missouri have decreased from 110,000 in 1996 to 106,000 in 2003, while the average farm size has increased from 110.9 hectares in 1996

to 115.3 hectares in 2003 (NASS, 2013). From cropland in the northern part of the state to the rolling hills and pastures in the south, the average farm size in Missouri, by county, varies widely. Table 1 shows the range in farm sizes from 47 hectares in Shannon County to 487 hectares in Pemiscot County.

The number of cattle in Missouri are not evenly distributed throughout the state. Since the northern counties in Missouri, such as Saline and Atchison are better suited for crop production, they contain fewer cattle numbers than the south central and south western counties of the state, such as Howell and Greene. Table 2 show the wide range of cattle numbers in Missouri from 300 in New Madrid County to 105,000 in Polk County.

Cattle Production Methods

Several production methods are used for raising cattle. One common production methods used in Missouri is the cow-calf operation. The cow-calf operation involves maintaining a heard, breeding the females, and selling their calf crop. Most cow-calf producers calve in either spring or fall (Troxel et al., 2007). A calving interval of 82 days or less is preferred, but some producers calve almost year round. When calves are born within an 82 day window or less, they can be weaned and reach market weight at approximately the same time (Short et al., 1972). Other benefits include a reduction in the number of times cattle are gathered for vaccination, pregnancy testing, castration, and parasite control. Since all the cows are in the same stage of production, the management program can be adapted for the entire group. A short calving season also reduces the amount of time spent checking cattle for calving problems, especially heifers. All of these benefits equate to savings of time, money, and labor (Troxel et al., 2007).

Table 1. Average Farm Size in Hectares of Counties in Missouri (USDA, 2007)

County	Hectares	County	Hectares	County	Hectares	County	Hectares
Adair	120	Dallas	66	Livingston	137	Randolph	90
Andrew	98	Daviess	115	Macon	81	Ray	89
Atchison	246	DeKalb	108	Madison	110	Reynolds	124
Audrain	156	Dent	110	Maries	106	Ripley	118
Barry	73	Douglas	91	Marion	108	Saline	98
Barton	135	Dunklin	291	McDonald	128	Schuyler	127
Bates	142	Franklin	61	Mercer	147	Scotland	106
Benton	109	Gasconade	99	Miller	92	Scott	64
Bollinger	99	Gentry	133	Mississippi	459	Shannon	47
Boone	79	Greene	48	Moniteau	86	Shelby	183
Buchanan	91	Grundy	118	Monroe	113	St Charles	113
Butler	167	Harrison	136	Montgomery	117	St Clair	131
Caldwell	97	Henry	124	Morgan	85	St Francois	172
Callaway	87	Hickory	121	New Madrid	440	St Louis	100
Camden	107	Holt	208	Newton	63	Ste Genevieve	166
Cape Girardeau	85	Howard	129	Nodaway	143	Stoddard	178
Carroll	136	Howell	91	Oregon	125	Stone	66
Carter	126	Iron	94	Osage	102	Sullivan	153
Cass	74	Jackson	67	Ozark	135	Taney	99
Cedar	92	Jasper	76	Pemiscot	487	Texas	108
Chariton	133	Jefferson	53	Perry	98	Vernon	134
Christian	61	Johnson	88	Pettis	119	Warren	82
Clark	150	Knox	147	Phelps	86	Washington	100
Clay	77	Laclede	92	Pike	137	Wayne	111
Clinton	105	Lafayette	110	Platte	100	Webster	60
Cole	66	Lawrence	70	Polk	83	Worth	135
Cooper	129	Lewis	141	Pulaski	104	Wright	96
Crawford	111	Lincoln	91	Putnam	178		
Dade	127	Linn	124	Ralls	124		

Table 2. Number of Cattle in Missouri by County (NASS, 2013)

County	Cattle	County	Cattle	County	Cattle	County	Cattle
Adair	36,000	Dallas	55,000	Livingston	25,000	Randolph	30,500
Andrew	24,500	Daviess	32,500	Macon	53,000	Ray	42,000
Atchison	10,300	DeKalb	48,000	Madison	49,000	Reynolds	8,9000
Audrain	39,000	Dent	26,000	Maries	13,300	Ripley	18,300
Barry	83,000	Douglas	42,000	Marion	53,000	Saline	6,300
Barton	48,000	Dunklin	1,700	McDonald	21,000	Schuyler	49,000
Bates	75,000	Franklin	46,500	Mercer	22,000	Scotland	31,500
Benton	38,000	Gasconade	33,500	Miller	53,000	Scott	18,100
Bollinger	30,000	Gentry	35,500	Mississippi	1,300	Shannon	800
Boone	30,500	Greene	62,000	Moniteau	75,000	Shelby	39,500
Buchanan	17,100	Grundy	23,500	Monroe	28,500	St Charles	28,000
Butler	5,100	Harrison	46,500	Montgomery	21,000	St Clair	23,500
Caldwell	31,000	Henry	62,000	Morgan	45,500	St Francois	7,700
Callaway	39,000	Hickory	30,000	New Madrid	300	St Louis	19,000
Camden	21,500	Holt	6,300	Newton	74,000	Ste Genevieve	22,000
Cape Girardeau	45,500	Howard	25,500	Nodaway	67,000	Stoddard	9,600
Carroll	28,500	Howell	93,000	Oregon	45,000	Stone	26,500
Carter	7,800	Iron	11,300	Osage	62,000	Sullivan	51,000
Cass	46,000	Jackson	11,500	Ozark	55,000	Taney	14,000
Cedar	45,500	Jasper	51,000	Pemiscot	400	Texas	67,000
Chariton	44,500	Jefferson	8,800	Perry	34,500	Vernon	71,000
Christian	49,500	Johnson	79,000	Pettis	80,000	Warren	16,700
Clark	20,500	Knox	25,500	Phelps	26,000	Washington	20,500
Clay	24,500	Laclede	61,000	Pike	36,000	Wayne	16,200
Clinton	43,000	Lafayette	35,000	Platte	12,900	Webster	69,000
Cole	42,500	Lawrence	100,000	Polk	105,000	Worth	21,000
Cooper	55,000	Lewis	22,500	Pulaski	22,000	Wright	70,000
Crawford	30,500	Lincoln	17,400	Putnam	46,000		
Dade	60,000	Linn	45,500	Ralls	16,300		

Cow-calf producers generally either buy or raise cows for production. When heifers are raised, they are usually bred at 15 months of age to calve at 2 years of age. The 2 main methods of breeding beef cattle are natural service with a bull and artificial insemination (AI). The most common of these methods among cow-calf producers is natural service. A California study of 5,052 calves representing 15 calf crops over 3 years used bulls ranging from 2 to 11 years of age to determine the number of females serviced per bull. Results determined the average number of conceptions per bull over a 60 to 120 day breeding season to be 18.9 ($p<0.001$) with a range of 0 to 64 (Van Eenennaam et al., 2014).

Artificial insemination is used in approximately 6% of beef cattle operations to further increase productivity (Bader et al., 2003). When used with estrous synchronization, AI can help reduce the calving interval to 45 to 60 days ($p<0.05$). One of the main advantages of AI is the ability to utilize semen from superior bulls and quickly improve the genetic characteristics of following generations (Bader et al., 2003).

Other methods of cattle production common to Missouri are backgrounding and stocker operations. Backgrounding is the process of conditioning freshly weaned calves on forages for the. This process usually lasts from 30 to 60 days. Backgrounding operations commonly purchase small groups of weaned calves and get the calves through the stressful periods of weaning, shipment and diet change. For backgrounders to be successful, it is necessary to have access to an affordable and high quality feed and forage sources (Pruitt et al., 2012).

Stocker operations are similar to backgrounders, except they mainly raise the calves on forage for more than 60 days. The goal of the stocker cattle producer is to

cheaply add weight to the animals. The most important resource for the stocker operator is an abundant supply of high quality forage. Because of this, endophyte infected tall fescue would be a poorer choice of forage because lower weight gains would be expected. The stocker operator has some of the lowest demands for facilities and labor of any production method. After the cattle are received, they spend the majority of their time on pasture until they are ready to go to the feedlot (Pruitt et al., 2012).

Forages: Tall Fescue

Tall Fescue covers over 16 million hectares of pasture and forage land in the U.S., and 6.9 million hectares in Missouri (Roberts, 2000).Tall fescue (*Festuca arundinacea*) is desirable to cattle producers because of its management characteristics, yield potential, forage quality, and growing season. Tall fescue is a deep-rooted, long-lived, C3 perennial grass that forms a sod-like structure above ground. It reproduces by underground stems called rhizomes, as well as by seed (Malinowski and Belesky, 2000). Tall fescue is tolerant of wet and acidic soils, with the ability to grow in soils with a pH range of 4.5 to 9.5. The optimal growth of tall fescue, however, can be seen in soils with a pH of 6.0 to 7.0 (Pitman, 2000). Tall fescue is drought resistant, tolerant to grazing, and provides good erosion control for water-ways and ditches (Malinowski and Belesky, 2000). When harvested at the right time, crude protein levels in tall fescue hay can range from 15% to 25% and TDN levels can range from 60 to 75% (Beck et al., 2006). Dry matter yields of tall fescue can range from 5700 to 6700 kg/ha, with higher yields seen resulting from increasing nitrogen fertilization (Collins, 1991). In addition to high forage production, tall fescue is a relatively high yielding seed crop. In Arkansas, fescue seed yields average 200

kg/ha, with consistent reports as high as 400 to 600 kg/ha. Although seed prices are unpredictable from one year to the next, seed harvest offers producers a secondary product to market (Santillano-Cazares et al., 2010).

Endophyte-Infected Tall Fescue

The majority of tall fescue in the United States is infected with an endophytic fungus called *Neotyphodium coenophialum*, (formerly called *Acremonium coenophialum*). An endophyte is a fungus that grows inside a host plant without causing it any harm, and sometimes provides benefits to the host (Gunter and Beck, 2004). The *Neotyphodium coenophialum* dies in the tall fescue seed after 1 year. At the seedling stage, the endophyte begins its infection at the base of the leaf, where it remains until the plant enters its reproductive phase. The endophyte then moves from the leaf to the stem, and moves up the stem as the stem elongates. After tall fescue forms a seed head, *Neotyphodium coenophialum* moves into the seed (Najafabadi et al., 2010).

Tall fescue gains several benefits from *Neotyphodium coenophialum*. The endophyte produces alkaloids that protect the plant from insects and nematodes, and allows the plant to be more tolerant of marginal soil conditions, harsh management and grazing practices, and drought. Tall fescue is only infected with this endophytic fungus through the seeds of infected plants. Because of this, an infected plant cannot infect an uninfected plant. Infected tall fescue tends to dominate pastures because it is less palatable and grazing animals will selectively graze other plant species first, or uninfected tall fescue. Endophyte infected tall fescue can gain a competitive advantage as the stand density of other plant species in the pasture is decreased due to grazing. Since

the infected seeds are resistant to disease, insects, nematodes, and drought, they can rapidly invade a field (Gunter and Beck, 2004). Some research suggests that an increase in stocking rates can reduce the selective grazing of tall fescue seed heads containing high concentrations of ergo alkaloids. Increased stocking rates did not increase average daily gain of steers, but did increase total weight gain per hectare, suggesting that animal performance on endophyte infected tall fescue is limited by ergot alkaloid toxicity at light stocking rates, and forage availability at low stocking rates (Aiken and Strickland, 2013).

The disadvantage of the endophyte in tall fescue is that it causes negative effects on grazing animals such as cattle and horses. Fescue toxicity is probably the most commonly observed problem associated with endophyte infected tall fescue. As reviewed by Ball et al., 2003, symptoms of fescue toxicity can include decreased feed intake, reduced weight gains, reduced milk production, increased respiration rates, elevated internal body temperatures, rough hair coats, increased time spent in water and/or shade, reduced grazing time, decreased blood serum prolactin concentrations, excess salivation, and decreased reproductive performance (Ball et al., 2003).

Cattle grazing endophyte infected tall fescue can develop several other problems such as fescue foot, lameness, loss of the tips of tails or ears, and sloughing of the hooves. Another disorder, known as bovine fat necrosis, is caused by the presence of masses of hard fat in the abdominal cavities that causes calving and digestive problems. High levels of nitrogen or poultry litter fertilization can contribute to bovine fat necrosis (Ball et al., 2003).

The majority of tall fescue pasture in the United States is used for grazing commercial cow-calf operations (Ball et al., 2003). Cows grazing endophyte infected tall

fescue pasture lose weight, have lower pregnancy rates, and wean smaller calves at 205 days compared to cows grazing endophyte free tall fescue. One study found that cows grazing heavily infected tall fescue compared to low levels of infection lost 0.05 kg per day compared to gaining 0.46, had pregnancy rates of 55% compared to 95%, and weaned 186 kg calves at 205 days compared to 215 kg (Gay et al., 1988).

Several studies have found that the endophyte fungus has had a severe negative effect on weight gains in cattle. In Missouri, yearling Holstein steers and heifers grazing tall fescue with a low level of endophyte (3%) gained an average of 0.62 kg per day, while cattle grazing tall fescue at higher endophyte levels (83%) only gained an average of 0.21 kg per day (Crawford et al., 1989). In Addition, cattle grazing in Arkansas on endophyte free tall fescue (0%) pasture gained an average of 0.71 kg per day, while gaining only 0.55 kg per day on infected (81%) tall fescue pasture (Goetsch et al., 1988).

Pasture Management

Continuous Grazing. Producers who graze livestock are using their livestock to harvest forage and the livestock themselves become the marketable product of the forage. As the amount of forage that can be produced and grazed increases, so does the amount of animals or kilograms of animal that can be marketed. Different grazing practices can be used to manage tall fescue pastures, ranging from low to high levels of producer involvement. The simplest, and least productive, method of management is continuous grazing, which allows livestock to graze in one pasture throughout the year. The pasture is not allowed a rest period, stocking rates are generally lower, and forage utilization levels are below their potential. Forage mass for rotationally grazed pastures can be as

much as 1,023lkg per hectare higher than continuously grazed pastures (Paine et al., 2013).

Rotational Grazing. Rotational grazing has been shown to increase gains per hectare by up to 40% (Bertelsen et al., 1993). Rotational grazing can generally be defined as the grazing of a pasture for a short amount of time while the others are allowed to rest for 25 to 30 days, or until the forage has had time to grow to a grazable height. Forages are grazed to remain in the vegetative state which allows for regrowth. There are several methods of rotational grazing such as controlled grazing, intensive rotational grazing, intensive grazing, and management intensive grazing (Henning et al., 2000 and Undersander et al., 2002).

Proper grazing management during the spring is important for quality and quantity of cool season pasture because as much as two thirds of the total dry matter of cool season grasses, such as tall fescue, is produced during this time (Bertelsen et al., 1993). Some methods of spring grazing use a light stocking rate of 363 kg per hectare (Gerrish, 2000) or less to ensure an adequate summer supply. One problem with a light stocking density is that it allows the majority of the growth to become overly mature, which results in decreased nutritional quality, and livestock generally prefer not to consume it (Bertelsen et al., 1993). Another management strategy is to use higher stocking rates of 1,098 kg per hectare or more (Gerrish, 2000) and rotational grazing to keep the forage height around 8 or 15 centimeters during the spring months. Plants remain in a young, leafy stage of growth and improve forage quality and intake. Fields not utilized in the spring can then be harvested as hay for later use, allowed to mature and harvested for seed, or grazed in the winter months as stockpiled forage. An Illinois study

found that paddocks rotationally grazed for 6 days with a 30 day resting period had a 40% greater gain per hectare ($p<0.05$) compared to continuous grazing (Bertelsen et al., 1993).

Management-Intensive Grazing. The term Management-Intensive Grazing (MIG) can be credited to Jim Gerrish of the University of Missouri's Forage Systems Research Center (Gerrish and Ohlenbusch, 1998). Gerrish's idea of Management-Intensive Grazing was an understanding by the cattle producer of the complex plant, soil, animal, and climate interactions that took place on the land. The producer then used his understanding of these interactions to make decisions to improve the utilization of the grazing lands. Others since Gerrish have changed the term to Management Intensive Grazing, and the concept has become linked to rotational or cell grazing. This changed the term from an understanding to simply a practice, and the result was a loss of emphasis on managing the plant-soil-animal-climate relationship (Gerrish and Ohlenbusch, 1998). Four major points make up the foundation of a sound grazing management system. The first is to meet the nutritional requirements of the livestock grazing the land. The second and third points are to optimize the yield, quality, and performance of the forage, and to protect and enhance the resource base. The final point is to integrate knowledge and technology to develop a management system that is both practical and economically viable (Gerrish and Ohlenbusch, 1998).

The goal of an intensive grazing system is to make sound management decisions that will allow livestock to obtain the majority of their feed, especially in the warmer months, from grazing. One of the key features of intensive grazing is the rotation of livestock through a number of small pastures, or paddocks, instead of allowing the

animals to continuously graze 1 or 2 large pastures. Pasture rotation promotes more complete utilization of available plant material, as well as increased consumption of less desirable plant species. Intensive grazing also promotes a more even distribution of manure, less nutrient runoff, and higher forage yields per hectare (Hanson, 1995).

Stockpiled Forage. One of the biggest expenses for livestock producers is winter feed costs (Ball et al., 2008). Stockpiling tall fescue to be grazed during the winter months can help to lower expenses and increase profits. Stockpiling forages offers several potential benefits over feeding hay. For example, feeding hay in barns, enclosed areas, or from hay rings causes animals to be concentrated, which results in mud and manure accumulation. Allowing livestock to graze pastures evenly distributes manure and reduces hoof damage to the land. Another benefit of stockpiling tall fescue is improving forage quality which leads to improved animal performance. Young, vegetative pasture or even fall residue is generally considered better quality than mature hay. Feeding stockpiled forage is usually less labor intensive than feeding hay, which can lead to reduced expenses. The fact that hay is almost always more expensive, whether it is bought or produced on the farm, is another cost saving benefit to feeding stockpiled tall fescue (Ball et al., 2008).

Tall fescue is well suited for stockpiled winter grazing, with desirable characteristics such as higher yields of superior quality when compared to other temperate grass species, such as brome and perennial ryegrass. Tall fescue is palatable with highly digestible levels of soluble sugars (sucrose, glucose, and fructose). Tall fescue is tolerant of trampling, and its quality losses from leaf deterioration after frost are lower than most other forage species, such as clovers. The negative effects of endophyte

infected tall fescue are minimized during the winter because the alkaloid levels are lower in the leaf tissue than in the stems and seeds. A 2 year study found that ergovaline concentrations decreased by 85% from early December to January in Missouri (Poore and Drewnoski, 2010).

When stockpiling tall fescue for winter grazing, it is important to consider both the quality and quantity of forage needed. Quality forage is needed for young growing animals or lactating females, and sometimes quantity is needed to stretch limited stored feed supplies. Stockpiling begins when the forage accumulates growth after the last cutting or crazing event, and can begin as early as the beginning of summer or delayed to early autumn (Fribourg and Bell, 1984). Applying nitrogen in the fall is a good way to increase both yield and quality of stockpiled tall fescue. Stockpiled tall fescue in Missouri was found to have crude protein (CP) levels of 12.1% and acid detergent fiber (ADF) levels of 36.5%. Applying nitrogen can reduce the percentage of acid detergent fiber (ADF) and increase crude protein (CP) and in vitro digestibility in tall fescue (Poore and Drewnoski, 2010).

Rotational grazing is a good way to increase the level of utilization of stockpiled tall fescue pasture in the winter. A 40% improvement in animal grazing days can be seen when forage allocation is reduced to a 3 day supply as compared to 2 weeks. The use of strip grazing to give a daily allocation can increase animal grazing days by 73% compared to continuous grazing. Strip grazing can be done with the use of portable electric fencing. A large pasture can be divided into small strips, starting at the water supply. When one strip is grazed, the fence can be move over to give access to another strip. In the winter, there is no need to back fence the previous strip because there will be

no re-growth until spring. Cattle are then allowed to travel back across previously grazed strips to gain access to water (Poore and Drewnoski, 2010).

Grazing Studies. Hanson (1995) conducted a study with 63 dairy farmers in Northeast Pennsylvania to determine the prevalence and profitability of intensive grazing. The qualifications of the study were that at least 40% of warm weather feed be derived from pasture and that the pastures were rotated periodically. In addition, management practices of the sampled farmers were drastically different than the recommended practices for the area. One of the recommendations was that the paddocks be less than 2 hectares in size and stocked with 20 or more cows per paddock hectare. The survey found that the average paddock of respondents was over 12 hectares and stocked at a rate of 0.6 cows per paddock hectare. The study also revealed that farmers relied almost completely on permanent fencing with only 6% having a mobile water source. The second part of the study by Hanson (1995) focused on the economic aspects of intensive grazing compared to an all hay operation. He found that intensive grazing had a yield advantage over hay by 0.52 metric tons per hectare. This increase in yield, combined with drastically lower production costs, gave a net return of $322.55 per hectare by utilizing intensive grazing management and only $51.23 per hectare for hay production alone (Hanson, 1995).

Gerrish (2000) conducted a study to determine both quality and quantity of available forage at stocking rates of 363, 726, 1098, and 1452 kg per hectare of yearling steers. Paddock sizes were 4 hectares, and the study took place over 4 consecutive years. The steers were rotated through 12 equally sized paddocks once a day for the first grazing cycle, and once every 2 days for the remaining cycles, giving each paddock a 22 day rest period. The results of his study found that the paddocks with higher stocking rates had

higher forage quality, but lower total available forage. The lowest stocking rate had lesser quality forage, but higher total forage production. Gerrish implied, as a result of this study, that a balance between forage quality and quantity could be best achieved with a moderate stocking rate as opposed to a higher or lower stocking rate (Gerrish, 2000).

Profitability

Research has been done to evaluate the profitability of various production methods and management practices of raising cattle. A study was by Ramsey et al., in association with the Southern Agricultural Economics Association, to evaluate costs, production, and profits of beef cow herds. The cost model was specified as economic pretax cost before non-calf revenue adjustment. The production model was defined as kilograms weaned per exposed female, and the profit model was defined as percent return on assets calculated on a cost basis. Researchers found that herd size was significant ($p<0.05$) to a cost and profit model, and the cost per-unit decreased9 with the increased number of animals ($p<0.05$). Researchers also found that herd size was not significant ($p>0.05$) in the production model, which implies that increased herd size may not necessarily improve productivity. Increased equipment and machinery ownership was found to increase ($p<0.05$) cost per-unit without equally increasing production or profitability (Ramsey et al., 2005).

When overall kilograms of feed fed were assessed, researchers found that increased kilograms of feed fed increased per-unit costs, but did not improve production ($p<0.05$). In their profit model, amount of feed fed was inversely related to profit ($p<0.05$), and increased feeding was associated with lower profits ($p<0.05$). The

researchers suggested that feeding should be done strategically to increase conception and or weaning weights to significantly increase production. Calving was also evaluated, and found that increased calving percentage decreased per-unit cost ($p<0.05$), increased production ($p<0.05$), and increased profits ($p<0.05$). Researchers found that high calf death/loss increased per-unit cost and decreased production ($p<0.05$). In addition, increased length of breeding season ($p<0.05$) was associated with increased costs and decreased production (Ramsey et al., 2005).

A study conducted by Michigan State University found a tendency for MIG dairies to be more economically profitable and somewhat more sustainable than conventionally managed dairies. Researchers found an increase in capital efficiency, measured in production per dollar of assets, of 11% in MIG dairies compared to conventionally managed dairies. Researchers also found MIG dairies to have higher operating and labor efficiencies than conventionally managed dairies (Dartt et al., 1999

Survey Research

Wisconsin. There have been several surveys conducted throughout the United States to evaluate the production and management practices of beef cattle operations. Wisconsin is well known for its dairy production, but a survey found that the state had approximately 245,000 beef cows in 2005, which accounted for 23% of the total cattle population of the state (UW-Madison College of Agriculture and Life Sciences, 2008). The survey was mailed to a random sample of 400 beef farmers from a list of 2,500 beef cattle producers. The survey obtained a 70% response rate from the 400 questionnaires. Researchers found the majority of the beef cattle producers in Wisconsin were cow-calf

producers with an average herd size of 45 cows owned by the farmer-operator. Sixty percent of the respondents had a commercial herd, 34% ran a feedlot operation, 32% had a seedstock operation, and 7% had a stocker operation. Stocker operators had an average of 30 head per year, and finisher operations had around 40 head per year. The typical beef operation in 2005 owned 107 hectares, leased an additional 19 hectares. The majority of the beef producers also produced crops, using 73 hectares of their land for crops and 24 hectares for pasture (UW-Madison College of Agriculture and Life Sciences, 2008).

Because Wisconsin is much farther north than Missouri, the majority of the beef cattle producers fed hay for 150 to 180 days per year. Most of the cow-calf producers raised their cattle primarily on pasture with a stocking density of 2.5 cow-calf pairs or 2.5 stockers per hectare. Pasture management practices tended to be less intensive for beef producers ($p<0.05$) than dairy producers. Labor inputs were also much lower ($p<0.05$), with nearly 80% of beef operations being part-time income activities. Eighty-five percent of the respondents did not implement practices to improve their pastures. Even still, the most common pasture improvement was fertilization. Less than one-third of participants conducted soil samples. Approximately one-third of beef producers used continuous grazing, and 40% moved their cattle every 2 to 4 weeks. Survey participants stated that their grazing season typically started between April 30 and May 15, and the grazing season ended between October 30 and November 15, depending upon frost dates. Approximately two-thirds of respondents had total household incomes between $50,000 and $200,000 (UW-Madison College of Agriculture and Life Sciences, 2008).

North Dakota. The NDSU Extension Service conducted a survey to evaluate the North Dakota beef industry. Two thousand five hundred surveys were mailed and 527

were returned, giving a response rate of 21.1%. The survey found that the majority (48%) of the types of cattle raised were cow-calf. The survey also found that the majority (43%) age of the principal operator was 51 to 60, and 62.3% of the principal operators had been beef producers for 30 or more years (Dahlen et al., 2014).

South Dakota. A survey conducted in 1982 evaluated South Dakota beef cattle production. The survey was mailed to 1,901 people selected from breed registries and the South Dakota Beef Cattle Improvement Association. Operators from 320 spring calving herds made up the sample for the survey. The survey determined the average herd size was 163 cattle, and the average weaning weight was 213 kg. Eighty-one percent of respondents provided extra winter feed for open heifers and 54% provided extra winter feed for bred heifers (Dooley et al., 1982).

Oklahoma. In 2006, a survey was conducted by Oklahoma State University to evaluate beef cattle production and management practices. The data set for the survey was comprised of 335 producer surveys, which were divided into 2 groups. The first group was made up of small producers with 1-99 breeding females, and group 2 consisted of larger producers with more than 100 breeding females. The survey found that a large portion of smaller producers (42%) never used forage tests to estimate supplemental feed requirements during the winter months, while 19% almost always did. In contrast, 25% of larger producers almost always used forage testing, and only 14% rarely used forage testing (Vestal et al., 2006).

With regards to harvested foraged produced on the ranch, 43% of smaller producers rarely tested their own forage, and only 9% nearly always tested it. Thirty-two percent of larger producers rarely tested forage produced on the ranch, and 16% nearly

always tested it. With purchased forage, over 50% of both groups rarely used forage testing, but nearly twice as many large producers (14%) tested purchased forage as small producers (8%). When asked to provide the typical length of their hay-feeding season, approximately 70% of both groups reported feeding hay for 90 days or more annually (Vestal et al., 2006).

In addition, cowherd management practices that affected profitability were also evaluated. One of these factors was pregnancy examination performed on owned mature cows as well as replacement heifers. Only 14% of smaller producers nearly always used pregnancy checks, while 48% rarely did. For the larger producers, 33% nearly always did pregnancy checks, while only 31% rarely did. The researchers theorized the groups differed because the smaller producers were not as dependent on the beef operation as a sole source of income as the larger producers were. The survey also determined that larger producers were more likely to pay a higher price for bulls than smaller producers ($p<0.05$). The average purchase price of bulls for small producers was $1,600.88, while the large producers paid an average price of $1,955.06. Seventy percent of large producers had a set breeding season, while 47% of small producers left bulls with their cows year round. For the producers in both groups that had a targeted breeding season, about half indicated it was between 60 and 90 days (Vestal et al., 2006).

National. In 2001, a nationwide survey was developed for the Pasture-Based Beef Systems for Appalachia to determine production and marketing practices of pasture-finished beef. The original survey sample was comprised of about 300 beef cattle producers, and with a response rate of almost 50%, 149 respondents were used for analysis. The surveys were mostly sent out and returned by traditional mail, with a few

respondents completing the survey online. Many of the respondents indicated that they were relatively new to producing pasture-finished beef with an average of only 5 years in the business. The majority (54%) of producers described themselves as small producers in comparison with other producers in the area, while 39% were medium and 8% were large in size. The criteria for large, medium, and small were not defined in the survey. The survey also found that only 8% of the producers were certified organic. Thirty-nine percent of producers considered themselves organic but not certified organic, and 42% considered themselves not quite organic but close (Lozier et al., 2003).

Producers of pasture-finished beef were asked questions about the type and breed of animals they produce. The majority of the respondents produced steers and heifers (87% and 74%, respectively), and about 33% also produced bulls. The most common breeds mentioned were Angus and Hereford, or a cross of these 2 breeds. Eighty-five percent of producers produced animals from their own cows, but about half also purchased animals for production. A drastic difference was also found between calving seasons, with 74% of producers calving in the spring and only 10% calving in the fall. The remaining 16% produced calves year-round (Lozier et al., 2003).

When asked about their grazing systems, the average month producers stated for the beginning of grazing was March, and November was given as the beginning of winter feeding. The observers also estimated that about one third of respondents kept their animal on pasture all year, with or without some form of supplemental feeding. Respondents were asked to describe their grazing systems as either continuous, rotational, or intensive rotational. The vast majority (94%) described their grazing

systems as some form of rotational, and only 6% stated that they were continuous grazers.

Producers also stated that legumes were an integral source of nitrogen fertility in both pastures and hay fields, and they rated a cool-season grass-clover mix as the most important forage combination, followed by perennial warm-season grasses. Interestingly, nitrogen-fertilized cool season grass ranked seventh on the list, and stockpiled tall fescue ranked eighth (Lozier et al., 2003). One reason that tall fescue was ranked so close to the bottom of the list could be that this survey compiled data from 46 different US states, as well as Canada. If the survey was confined to Missouri, Tall fescue would likely rank towards the top, as it is the dominant forage produced in the state.

MATERIALS AND METHODS

Population and Sample

The population of this study is cattle producers in Missouri. In an attempt to obtain a sufficient representation of Missouri cattle producers, the Missouri Cattleman's Association was used as the sample. According to the 2012 Census, there were 53,401 farms located in Missouri that raised cattle or calves or both. The Missouri Cattleman's Association distributed the survey to all of its members with an email address. Researchers had no access to information regarding participant physical or email address, so I relied on the Missouri Cattlemen's Association to distribute the questionnaires and reminder emails on my behalf. Out of the total of 1,898 producers comprising the final email list, 179 responded to the survey. Once inapplicable responses and responses from those who declined to participate in the survey were removed, 112 responses were used, which gave a final response rate of 5.9 percent. Although the response rate was low, the survey was distributed throughout Missouri, covering all 7 districts of the Missouri Cattlemen's Association, which increased my confidence that the sample was representative of the state. I acknowledge that an email only survey may have potentially excluded producers in the older demographic and those without access to the internet; however, time and resources did not allow for the distribution of questionnaires by mail.

Procedures

All research was approved in accordance with the rules established by the Institutional Review Board at Missouri State University (Appendix A). The questionnaire

(Appendix B) was developed by Missouri State University through the examination of previous published studies (Dahlen et al., 2014; Dooley et al., 1982, Loizer et al., 2003; Vestal et al., 2006; UW-Madison College of Agriculture and Life Sciences, 2008), as well as previous research conducted at Missouri State University (Cole et al., 2014). A new survey was created, primarily due to a lack of specificity in other studies as it related to my research objectives. The final version of the survey consisted of 52 quantitative (closed ended) questions. The survey was sent to a panel of experts within the field consisting of university professors, extension personnel, and experienced cattle producers for review. Survey questions could be answered using a typical Likert scale (never, rarely, sometimes, often, always), multiple-choice (select one or check all that apply), or fill in the blank. Producers provided information with regards to personal demographics, farm characteristics, farm management practices, and production methods.

The questionnaire was emailed to Missouri cattle producers by the Missouri Cattlemen's Association in October 2014 via Survey Monkey© online questionnaire. Reminder emails were sent to all participants approximately 2 and 4 weeks after the initial survey was sent. Returned questionnaires were dated and assigned a "Subject ID number". Data was stored in a computer with secured passwords for later analysis. All participants were made aware that participation was voluntary and information obtained from the survey would be kept confidential in accordance with Institutional Review Board requirements. The first question on the survey asked producers to give their consent to participate in the survey. If they did not consent, they were automatically redirected to exit the survey. The survey required approximately 20 minutes of the participants' to complete.

Descriptive Statistics

All questions in the survey collected information about the owner of the farm. Personal variables included age, county of operation in Missouri, length of time involved with cattle, level of education completed, and whether or not the owner had attended a grazing school. Production variables included gross farm income and expenses, number of hectares owned and rented, number of cattle owned, type of cattle production (cow-calf, stocker, backgrounder, heifer development, bull production, bottle calves, or finishers), and other agricultural operations on the farm. Farm management variables included pasture and forage management, pasture improvements, forage and soil nutrient analysis, feeding practices, and weaning practices. Independent variables (Table 3) included age, level of education completed, grazing school attendance, profitability, cattle herd size, reason for raising cattle, and location north or south of I44. Dependent variables (Table 4) included winter stockpiling, rotational grazing, use of polywire, pasture improvements, forages grazed, and mature cow weight.

Data Analysis

Data were analyzed using SPSS (Version 21.0; SPSS, Chicago, IL) to perform frequency counts, descriptive statistics, correlations, and bivariate cross tabulation analysis. Data obtained with regards to age, education level, farm size, grazing school attendance, and grazing management practices were analyzed using chi-square tests with the alpha level set at 0.05 to determine significant differences.

Table 3. Summary of Independent Variables

Variable	Definition
Age	1 = 18-30 2 = 31-55 3 = 56-70 4 = Over 70
Grazing School Attendance	1 = Yes 2 = No
Level of Education Completed	1 = Less than high school 2 = High school or GED 3 = Vocational or technical diploma 4 = Associate's Degree 5 = Bachelor's Degree 6 = Graduate Degree
Profitability	Calculated using (gross income - gross expenses)
Cattle Herd Size	1 = 0-74 cattle 2 = 75 or more cattle
Reason for Raising Cattle	1 = Source of income 2 = Personal consumption of meat/milk 3 = Family tradition (always had livestock) 4 = Fun/hobby 5 = Showing, competition, 4-H or club 6 = Tax deduction purpose 7= Other
Location north or south of I44	0 = South 1 = North

Table 4. Summary of Dependent Variables

Variable	Definition
Winter Stockpiling	1 = Yes 2 = No
Rotational Grazing During Growing Season	1 = Yes 2 = No
Use of Polywire	1 = Yes 2 = No
Pasture Improvements	1= Lime and fertilizer 2 = Fencing Improvements 3 = Water source improvements 4 =Overseeding or planting pastures 5 = Mowing/brushhoging 6 = Herbicide treatments 7 = Pesticide treatments 8 = None 9 = Other
Forages Grazed	1 = Tall fescue (KY31 endophyte infected) 2 = Tall fescue (novel or endophyte free) 3 = Cool season (other than tall fescue) 4 = Legumes 5 = Forbs (broadleaf other than legumes) 6 = Non-native warm season grasses 7 = Native warm season grasses 8 = Crop stubble
Mature Cow Weight	Measured in kilograms

RESULTS AND DISCUSSION

General Information

All respondents did not answer every question in the survey which resulted in unanswered questions. Valid percentages were calculated with unknown and unanswered questions not included.

County Information

Sixty-five (n=112) of the 114 counties in Missouri were represented in this study, representing 57% coverage of the state. Table 5 shows the number of respondents in each county, with the most responses from the counties of Greene (6), Lawrence (6), Callaway (5), Howell (5), and Polk (5). When Interstate 44 was used as a divider between the northern and southern halves of the state, 36.7% (n=40) of respondents were located south of I-44, and 63.3% (n=69) were located north of I-44.

Demographic Data

The majority of cattle producers (47.3%) are between 31 and 55 (n=53) years of age, and 33.9% are between 56 and 70 (n=38) years of age. This is consistent with 2012 Census information that 61% of principal farm operators are between the ages of 35 and 54 (USDA, 2013).

In regards to level of education, approximately one-third of producers (36.0%) who completed the survey have a Bachelor's degree (n=40).

Table 5. Cattle Producer Farm Location in Missouri by County (n=112)

County	Freq.	Percent	County	Freq.	Percent
Andrew	1	0.9	Linn	1	0.9
Bates	5	4.5	Livingston	1	0.9
Benton	2	1.8	Macon	2	1.8
Boone	3	2.7	Maries	1	0.9
Caldwell	3	2.7	McDonald	2	1.8
Callaway	5	4.5	Moniteau	2	1.8
Carroll	1	0.9	Monroe	1	0.9
Carter	1	0.9	Morgan	2	1.8
Cass	2	1.8	Newton	3	2.7
Christian	2	1.8	Osage	3	2.7
Clay	1	0.9	Ozark	2	1.8
Clinton	4	3.6	Pettis	4	3.6
Cole	1	0.9	Phelps	1	0.9
Cooper	1	0.9	Polk	5	4.5
Crawford	1	0.9	Pulaski	1	0.9
Dade	3	2.7	Putnam	1	0.9
Dallas	4	3.6	Randolph	1	0.9
DeKalb	1	0.9	Ray	1	0.9
Dent	2	1.8	Saline	2	1.8
Douglas	2	1.8	St. Charles	1	0.9
Franklin	3	2.7	St. Clair	1	0.9
Gentry	3	2.7	St. Francois	2	1.8
Greene	6	5.4	St. Louis	1	0.9
Henry	3	2.7	Ste. Genevieve	1	0.9
Howell	5	4.5	Stone	1	0.9
Jackson	1	0.9	Sullivan	1	0.9
Jasper	1	0.9	Texas	4	3.6
Jefferson	1	0.9	Vernon	3	2.7
Johnson	4	3.6	Warren	1	0.9
Knox	1	0.9	Webster	1	0.9
Lafayette	3	2.7	Worth	1	0.9
Lawrence	6	5.4	Wright	3	2.7
Lewis	1	0.9			

Twenty-seven percent of producers have a Graduate degree (n=30), indicating that many of the producers who responded to the survey have an upper level of education. Percentages of producers with an Associate's degree, high school or GED, and vocational or technical certificate are 9.0%, 19.8%, and 8.1%, respectively. Table 6 shows the demographic characteristics of respondents.

Farm gross income and total expenses are highly variable as seen in Table 7. Gross income (n=84) ranged from $1,000.00 to $1,870,000.00, with a mean of $105,054.59. Total expenses (n=82) ranged from $500.00 to $1,100,000.00, with a mean of $80,906.13. Net profit (n=80) was calculated by subtracting total expenses from gross income, with a mean of $25,713.44.

A correlation test was performed to determine if there is a significant relationship between net profit, number of mature cattle, and amount of rented land (Table 8). The results found that all 3 variables are positively correlated with a significance level of $p<0.01$. Net profit is positively correlated with the number of mature cattle and the amount of rented land with correlation coefficients of 0.792 and 0.870, respectively. The number of mature cattle is positively correlated with the amount of rented land with a correlation coefficient of 0.677. These results indicate that producers with larger numbers of cattle tend to be more profitable than producers with fewer cattle.

Farm Type

Respondents reported the percentage of each type of cattle production method they used. Choices were cow-calf, stocker, backgrounder, heifer development, bull production, bottle calves, finishers (grain fed), and finishers (grass fed).

Table 6. Demographic Characteristics of Cattle Producers in Missouri

Variable	Description	Frequency	Percent
Age (n=112)	18-30	9	8
	31-55	53	47.3
	56-70	38	33.9
	Over 70	12	10.7
Education (n=111)	High School or GED	22	19.8
	Vocational/Technical Certificate	9	8.1
	Associate's Degree	10	9.0
	Bachelor's Degree	40	36.0
	Graduate Degree	30	27.0

Table 7. Income, Expenses, and Net Profit of Cattle Producers in Missouri

Variable	Min.	Max	Mean	Std. Deviation
Gross Income (n=84)	$1,000.00	$1,870,000.00	$105,054.59	$241,304.90
Total Expenses (n=82)	$500.00	$1,100,000.00	$80,906.13	$161,904.35
Net Profit (n=80)	-$94,000.00	$770,000.00	$25,731.44	$94,115.71

Table 8. Correlation Between Net Profit, Number of Mature Cattle, Owning Land, and Renting Land for Cattle Producers in Missouri

		Net Profit	Cattle	Own Land	Rent Land
Net Profit	Pearson correlation	1	0.792**	0.000	0.870**
	Sig. (2-tailed)		0.000	0.998	0.000
	N	80	80	78	78
Cattle	Pearson correlation	0.792**	1	0.346**	0.677**
	Sig. (2-tailed)	0.000		0.00	0.00
	N	80	112	104	104
Own Land	Pearson correlation	0.000	0.346**	1	-0.012
	Sig. (2-tailed)	0.998	0.000		0.900
	N	78	104	104	104
Rent Land	Pearson correlation	0.870**	0.677**	-0.012	1
	Sig. (2-tailed)	0.000	0.000	0.900	
	N	78	104	104	104

** Correlation is significant at the 0.01 level (2-tailed)

Most producers (76.63%) indicated that cow-calf made up the majority of their operation (Table 9), corresponding with Missouri's second place ranking in total beef cow farms (NASS, 2011). An independent samples t-test was used to determine if percentage of cow-calf operations differed based on location north or south of I-44, however, there is not a significant difference ($p=0.45$). Forty-nine respondents indicated they raised more than one type (production method) of cattle.

Reasons for Raising Cattle

Participants indicated their reasons for raising cattle in a "check all that apply" question. The options included source of income, personal consumption, family tradition, fun/hobby, showing/competition/4-H, or tax deduction purposes. The majority of producers (91.1%) indicated that a source of income was a reason for raising cattle, 56.3% indicated family tradition, 40.2% indicated personal consumption, 31.3% indicated fun/hobby, 20.5 indicated tax deduction purposes, and 18.8% indicated showing/competition/4-H. Table 10 shows farm characteristics including reason for raising cattle.

Years of Involvement with Cattle

Cattle producers indicated they had been involved with cattle since the age of 18 for an average of 27.78 years ($n=111$), with responses ranging from 1 to 70 years of involvement. Corresponding with information from the 2012 Census that the average age of principal farm operators is between 35 and 54 years (USDA, 2013), an average of 27.78 years in the cattle business since age 18 would put producers at age 45.78 or older.

Table 9. Percentage of Production Methods of Beef Cattle Producers in Missouri (n=91)

Variable	Min.	Max	Mean	Std. Deviation
Cow-calf	0%	100%	76.63%	27.35
Stocker	0%	100%	4.63%	15.67
Backgrounder	0%	100%	5.08%	17.56
Heifer development	0%	100%	9.02%	15.54
Bull production	0%	35%	2.53%	6.98
Bottle calves	0%	2%	0.03%	0.233
Finishers (grain fed)	0%	50%	1.18%	8.046
Finishers (grass fed)	0%	9%	0.27%	1.30

Table 10. Cattle Producer Reason for Raising Cattle in Missouri (n=112)

Variable	Frequency	Percent
Source of income	102	91.1
Personal consumption of meat/milk/products	45	40.2
Family tradition (always had livestock)	63	56.3
Fun/hobby	35	31.3
Showing, competition, 4-H or club	21	18.8
Tax deduction purposes	23	20.5

Farm Size

To determine farm size, participants provided the number of hectares they owned and rented (Table 11). Producers in this survey (n=104) own an average of 137.27 hectares and rent an average of 84.18 hectares. The average of 137.27 hectares found here corresponds with the 115.3 hectare average farm size in Missouri reported by the National Agricultural Statistics Service in 2013 (NASS, 2013). Participants (n=95) stated an average of 14.65 permanently fenced pastures. With the average 137.27 hectares owned, this provides an average pasture size of 9.37 hectares. Similar results were found with a study of dairy farmers in Pennsylvania that determined the average pasture size to be 12 hectares (Hanson, 1995). The average herd size (n=112) for this study was 109.2 mature cattle, with responses ranging from 0 to 1,155.

Producers (n=104) also indicated how many hectares of their land (both owned and rented) is used with regards to forage and crop production. An average of 135.27 hectares is used for grazing, 43.54 hectares is used for hay production, 25.33 hectares is used for crop production, and 2.90 hectares is used for silage production. In regards to types of forage production, producers estimated the percentage of various forage types (Table 11) used to graze cattle. Respondents indicated that the majority (61.93%) of their forage for grazing cattle is tall fescue (KY-31 endophyte infected), and 11.76% is legumes.

An independent samples t-test was used to determine differences in forages used for grazing cattle with regards to location. Counties north of I-44 were more likely ($p<0.05$) to graze crop stubble, and somewhat more likely ($p=0.06$) to graze cool season grasses other than tall fescue.

Table 11. Farm Size and Forage Production of Beef Cattle Producers in Missouri

Variable	Description	Min.	Max	Mean	Std. Deviation
Farm size (n=104) (hectares)	Owned land	0	849.84	137.27	165.90
	Rented land	0	1,861.55	84.18	212.77
Land use (n=104) (hectares)	Grazing	0	1,537.81	135.27	189.56
	Hay production	0	364.22	43.54	57.34
	Silage production	0	80.94	2.90	11.49
	Crop production	0	728.43	25.33	88.32
Forage production (n=94) (percentage)	Tall fescue (KY-31 endophyte infected)	0	100	61.93	29.39
	Tall fescue (novel or endophyte free)	0	100	8.57	22.59
	Cool season grasses (other than tall fescue)	0	50	8.28	11.53
	Legumes	0	50	11.76	12.82
	Forbs (broadleaf other than legumes)	0	20	1.15	3.34
	Non-native warm season grasses	0	25	1.10	4.33
	Native warm season grasses	0	50	3.37	8.52
	Crop stubble	0	86	3.35	11.64
Cattle (n=112)	Mature cattle	0	1,155	109.2	167.51

Pasture Rental

Producers who rented pasture reported the amount they paid for rented pasture per hectare per month as a fill-in-the-blank question. Responses range widely was from $0.00 per hectare per month to $3,706.58 per hectare per month, with an average of $67.58 per hectare per month or $810.96 per hectare per year. According to the University of Missouri, the average rent per hectare of good pasture per year in 2008 was $74.01 (Plain and White, 2009). Therefore, I believe the information obtained from this survey with regards to price paid for rented pasture is inaccurate.

Some of the variation in responses could be from producers who stated price paid per year instead of price paid per month. Another possibility is that some producers provided the price paid for an entire parcel of rented land instead of price paid per hectare. Finally, some producers might have provided price paid per hectare of cropland instead of pastureland. Rental rates for cropland (irrigated corn) in Missouri averaged $365.69 per hectare per year in 2008 (Plain and White, 2009), which is substantially higher than the price for rented pastureland. For these reasons, the data obtained for price paid for rented pasture was considered inaccurate and not used in any further analysis.

Pasture Management

The survey asked participants several questions with regards to pasture management practices. In order to determine planting practices, producers ranked the frequency of inter-seeding practices (Table 12) on pastures (n=97) and hay fields (n=82) using a Likert scale. The largest group (32%) indicated that they inter-seeded pastures every 2 to 3 years, with only 14.4% indicating inter-seeding every year. Inter-seeding

every 4 to 5 years accounted for 18.6% of respondents, and 16.5% stated that they never inter-seeded pastures. In regards to hay fields, 9.8% inter-seeded every year, 35.4% inter-seeded every 2 to 3 years, 19.5% inter-seeded every 4 to 5 years, 9.8% inter-seeded less often than every 5 years, and 18.8% never inter-seeded hay fields.

Producers were asked the same question on re-seeding. With pastures, 8.4% reported re-seeding every 2 to 3 years, 8.4% re-seeded every 4 to 5 years, 22.1% re-seeded less often than every 5 years, and 61.1% never re-seeded pastures. Distribution of producers re-seeding hay fields is similar with 1.2% re-seeding every year, 9.8% every 2 to 3 years, 11.0% every 4 to 5 years, 22.0% less often than every 5 years, and 56.1% never re-seeding hay fields.

Respondents also reported how often (Likert scale) they produced stored forage (n=99), purchased stored forage (n=98), and tested their soil (n=98). The majority of respondents (33.3%) never tested produced forage, and only 14.1% always did. Only 10.2% of producers always tested purchased forages, 17.3% rarely did, and 30.6% did not purchase stored forages. Previous research (Vestal et al., 2006) found that large producers with herds of more than 100 or more breeding females were more likely to use forage testing; however, no significant differences ($p>0.05$) could be found within this sample, due in part to the limited sample size. Soil testing is more prevalent in this study than forage testing with 43.9% of producers indicating they sometimes tested soil, 29.6% often tested soil, and only 9.2% never tested soil. Table 12 shows pasture management practices including inter-seeding, re-seeding, and Table 13 shows soil and forage testing.

Producers (n=105) indicated whether or not they made a variety of pasture improvements to either owned or rented land (Table 14).

Table 12. Prevalence of Inter-Seeding and Re-Seeding Practices of Cattle Producers in Missouri

Variable	Description	Frequency	Percent
Inter-seeding pastures (n=97)	More than once per year	1	1.0
	Every year	14	14.4
	Every 2 to 3 years	31	32.0
	Every 4 to 5 years	18	18.6
	Less than every 5 years	17	17.5
	Never	16	16.5
Inter-seeding hayfields (n=82)	More than once per year	0	0.0
	Every year	8	9.8
	Every 2 to 3 years	29	35.4
	Every 4 to 5 years	16	19.5
	Less than every 5 years	8	9.8
	Never	21	25.6
Re-seeding pastures (n=95)	More than once per year	0	0.0
	Every year	0	0.0
	Every 2 to 3 years	8	8.4
	Every 4 to 5 years	8	8.4
	Less than every 5 years	21	22.1
	Never	58	61.1
Re-seeding hay fields (n=82)	More than once per year	0	0.0
	Every year	1	1.2
	Every 2 to 3 years	8	9.8
	Every 4 to 5 years	9	11.0
	Less than every 5 years	18	22.0
	Never	46	56.1

Table 13. Prevalence of Forage and Soil Testing by Cattle Producers in Missouri

Variable	Description	Frequency	Percent
Test produced stored forage (n=99)	Never	33	33.3
	Rarely	15	15.2
	Sometimes	21	21.2
	Often	16	16.2
	Always	14	14.1
Test purchased stored forage (n=98)	Never	13	13.3
	Rarely	17	17.3
	Sometimes	13	13.3
	Often	15	15.3
	Always	10	10.2
	Do no purchase stored forage	30	30.6
Test soil (n=98)	Never	9	9.2
	Rarely	9	9.2
	Sometimes	43	43.9
	Often	29	29.6
	Always	8	8.2

Pasture improvement categories consisted of lime and fertilizer applications, fencing improvements, water source improvements, over-seeding or planting pastures, mowing/brushhoging, herbicide treatments, and pesticide treatments.

With all pasture improvements, more than twice as many producers made improvements to owned lad compared to rented land. Lime and fertilizer applications were performed by 81.9% of producers on owned land and 33.3% on rented land. The majority (87.6%) of producers made fencing improvements on owned land and 38.1% made fencing improvements on rented land. The majority (73.3%) of producers made water source improvements to owned land and 20.0% made improvements to rented land.

Over-seeding or planting pastures was done by 75.2% of producers on owned land and 21.9% of producers on rented land. Mowing or brushhoging or both was performed by 85.7% of producers on owned land and 41.0% of producers on rented land. On owned land, 60.0% of producers performed herbicide treatments and 10.5% performed pesticide treatments, while only 24.4% applied herbicide and 10.5% applied pesticide to rented land.

An independent-sample t-test was used to determine if herd size had any effect on pasture improvements. The results show larger producers (75 or more mature cattle) are more likely to make fertilizer and lime improvements ($p<0.05$), fencing improvements ($p<0.01$), water source improvements ($p<0.05$), over-seeding or planting improvements ($p<0.05$), and mowing or brushhoging treatments ($p<0.05$) to rented land. Larger producers were somewhat more likely ($p=0.076$) to make herbicide treatments to rented land, and no significant differences ($p=0.729$) were found with regards to size of operation and pesticide improvements.

Table 14. Prevalence of Pasture Improvements on Owned and Rented Land by Cattle Producers in Missouri (n=105)

Variable	Description	Frequency	Percent
Lime and fertilizer	Owned land	86	81.9
	Rented land	35	33.3
Fencing improvements	Owned land	92	87.6
	Rented land	40	38.1
Water source improvements	Owned land	77	73.3
	Rented land	21	20.0
Over-seeding or planting pastures	Owned land	79	75.2
	Rented land	23	21.9
Mowing/brushhoging	Owned land	90	85.7
	Rented land	43	41.0
Herbicide treatments	Owned land	63	60.0
	Rented land	26	24.8
Pesticide treatments	Owned land	11	10.5
	Rented land	3	2.9

One reason size of operation and pesticide treatments are not related could be because pesticide treatment is usually performed on crops, and the amount of crop land a producer owns or rents is not necessarily related to the amount of cattle he or she owns. There are also no significant differences ($p>0.05$) with regards to producer size and any of the previously mentioned pasture improvements on owned land. With a larger sample size, significant differences might have been observed.

Grazing Management Practices

Determining grazing management practices, particularly rotational grazing, was considered an important aspect of this study. Producers' reports (n=111) about grazing school attendance indicated that 50.5% had never attended and 49.5% had attended. The majority (62.2%) of producers (n=98) stated that they used temporary electric fencing to subdivide pastures for rotational grazing during the growing season and 41.8% subdivided pastures for rotational grazing during the winter months (Table 15).

With regards to rotating cattle to a new pasture, 1.0% of producers (n=97) rotated multiple times per day, 5.2% rotated daily, 24.7% rotated 2 to 3 times per week, 24.7% rotated every 1 to 2 weeks, 21.6% rotated every 3 to 4 weeks, 3.1% rotated every 1 to 2 months, 10.3% rotated every 3 to 4 months, and only 9.3% indicated that they continuously grazed pastures (Table 15). Previous research (Lozier et al., 2003) indicated in a national survey that only 6.0% of producers classified themselves as continuous grazers.

Producers provided an average of 41.4 days of rest for pastures between grazing events with a range of 6 to 180 days (Table 16).

Table 15. Rotational Grazing Practices of Cattle Producers in Missouri

Variable	Description	Frequency	Percent
Grazing school attendance (n=111)	Yes	56	50.5
	No	55	49.5
Rotational grazing during growing season (n=98)	Yes	61	62.2
	No	37	37.8
Rotational grazing during winter months(n=98)	Yes	41	41.8
	No	57	58.2
Frequency of pasture rotation (n=97)	Multiple times per day	1	1.0
	Daily	5	5.2
	2 to 3 times per week	24	24.7
	Every 1 to 2 weeks	24	24.7
	Every 3 to 4 weeks	21	21.6
	Every 1 to 2 months	3	3.1
	Every 3 to 4 months	10	10.3
	Never (continuously grazed pastures)	9	9.3
Pastures purposefully stockpiled for winter grazing (n=96)	Yes	72	75.0
	No	24	25.0

Table 16. Forage Utilization of Cattle Producers in Missouri Using Rotational Grazing Practices

Variable	Min.	Max	Mean	Std. Deviation
Days of rest between grazing events (n=77)	6	180	41.4	28.54
Days of allotment per rotation (n=59)	1	90	23.75	21.24
Months of stockpiled forage use (n=98)	0	6	2.36	1.69

The majority (75.0%) of producers (n=96) also indicated that they purposefully stockpiled pastures for winter grazing, provided and average of 23.75 days allotment (Table 16) when rotating cattle through stockpiled pastures, and were able to utilize stockpiled winter forage for an average of 2.36 months.

A cross-tabulation (Pearson Chi-Square) was used to determine if attending grazing school had an effect on rotational grazing practices. Results showed that producers who attended grazing school (n=97) were more likely to use temporary electric fencing to rotate cattle during the winter months ($p<0.001$) and during the growing season ($p<0.05$) compared to producers that did not attend grazing school.

Producers who attended grazing school (n=95) are also more likely ($p<0.01$) to purposefully stockpile forage for winter grazing. With regards to frequency of rotation of cattle through pastures, producers who attended grazing school (n=96) were more likely to move cattle more frequently (every 1 to 2 weeks or less) than producers that did not attend grazing school ($p<0.01$).

An independent-samples t-test was used to determine if attending grazing school affected the amount of stockpiled forage producers utilized. Producers that attended grazing school (n=97) utilized stockpiled winter forage for an average of 3.09 months, compared to 1.76 months for producers that did not attend grazing school ($p<0.001$). Grazing school attendance did not significantly affect the number of days of rest for pastures ($p=0.42$) or the number of days allotment to cattle when rotating pastures ($p=0.079$). With a larger sample size, the number of days of allotment might have become significant in relation to grazing school attendance.

Cattle Characteristics

Participants responded to a series of questions that determined the number (Table 17) and weight (Table 18) of cattle at various production stages on their operation. Producers have an average number of mature cattle age 3 years and older (n=92) of 90.59 cattle, with an average weight (n=86) of 562.64kg. Mature bulls (3 years of age and older; n=73) ranged in size from 544.31kg to 1,088.62kg, with an average weight of 833.09kg. Producers (n=92) have an average of 2.92 mature bulls. An average of 78.89 immature cattle (less than 3 years of age; n=91) was found for producers in this sample.

Calving and Weaning

Producers weaned their calves at an average of 6.85 months of age (n=84), with an average weaning weight (n=83) of 240.98kg. The majority of producers (n=87) calved in either March (20.18%) or September (22.17%), with less than 1.00% calving in July or December. Table 19 shows the data for calf weaning age and weight, and Table 20 shows calving season characteristics for survey participants.

A correlation test was performed to determine if there was a relationship between weaning weight, net profit, and calving month, however the results showed no significant relationship ($P>0.05$). A correlation test (Table 21) did find that mature cow weight and calf weaning weight are positively correlated ($p<0.05$) with a correlation coefficient of 0.275.

Producers (n=87) ranked the importance of factors affecting the time at which calves are weaned. Choices included time availability, forage availability, weather, and market price. Respondents stated that the most important factor affecting calf weaning is time availability (38.4%) followed by forage availability (32.2%).

Table 17. Characteristics of Cattle Herd Size in Missouri

Variable	Min.	Max	Mean	Std. Deviation
Number of mature cows (3 years and older) (n=92)	0.00	900.00	90.59	122.43
Number of mature bulls (3 years and older) (n=92)	0.00	40.00	2.92	4.86
Number of cattle less than 3 years of age (n=91)	0.00	1,525.00	78.89	217.16

Table 18. Mature Cow and Mature Bull Weights in Missouri

Variable	Min.	Max	Mean	Std. Deviation
Mature cow weight (3 years and older) (n=86)	408.23kg	816.47kg	562.46kg	68.18
Mature bull weight (3 years and older) (n=73)	544.31kg	1,088.62kg	833.09kg	110.14

Table 19. Weaning Weight and Weaning Age of Calves in Missouri

Variable	Min.	Max	Mean	Std. Deviation
Calf weaning age (months) (n=84)	4.00	9.00	6.85	1.09
Calf weaning weight (kg) (n=83)	158.76	317.52	240.98	74.15

Table 20. Characteristics of Calving Months Used by Cattle Producers in Missouri

Variable	Description	Min.	Max	Mean	Std. Deviation
Calving month	January	0	80.00	2.80	10.00
(n=87)	February	0	85.00	9.02	16.06
	March	0	100.00	20.18	21.66
	April	0	100.00	14.47	19.58
	May	0	50.00	5.20	10.28
	June	0	25.00	1.56	4.28
	July	0	17.00	0.70	2.70
	August	0	50.00	4.97	10.89
	September	0	80.00	22.17	22.10
	October	0	50.00	12.28	14.20
	November	0	100.00	3.72	11.49
	December	0	15.00	0.62	2.28

Table 21. Correlation Between Calf Weaning Weight and Mature Cow Weight of Cattle in Missouri

		Weaning weight	Mature cow weight
Weaning weight	Pearson correlation	1	0.275*
	Sig. (2-tailed)		0.012
	N	83	83
Mature cow weight	Pearson correlation	0.275*	1
	Sig. (2-tailed)	0.012	
	N	83	86

* Correlation is significant at the 0.05 level (2-tailed)

The least important factor affecting weaning is market price with only 12.6% of producers rating it as a priority and 17.2% of producers ranked weather as the most important factor affecting weaning.

Cattle Feeding

Producers in this survey fed cattle strictly on hay (n=91) for an average of 65.38 days per year, with some producers feeding cattle on hay for as many as 340 days per year (Table 22). A Wisconsin study found cattle were fed hay for an average of 150 to 180 days (UW-Madison College of Agriculture and Life Sciences, 2008). Differences in findings between Wisconsin and Missouri could be due to the longer growing seasons and milder winters found in Missouri. In addition, producers (n=91) fed grain for an average of 98.87 days per year and supplemented grazing with hay for an average of 67.08 days per year. When asked about total hay consumption, producers fed an average of 1,150.22kg of hay per cow per year.

Table 22. Hay and Grain Feeding by Cattle Producers in Missouri

Variable	Min.	Max	Mean	Std. Deviation
Days cattle are fed strictly hay (n=91)	0.00	340.00	65.38	59.80
Days grazing is supplemented with hay (n=91)	0.00	180.00	67.08	46.22
Kilograms of hay per cow per year (n=84)	0.00kg	5,443.11kg	1,150.22kg	1,059.05
Days cattle are fed grain (n=84)	0.00	365.00	98.87	127.06

CONCLUSIONS

Results of my project indicated significant differences with regards to rotational grazing practices. Producers who attended a grazing school are more likely to use temporary electric fencing as a method of rotational grazing during both the winter months and the growing season compared to producers that did not attend grazing school. Those who attended a grazing school are also more likely to purposefully stockpile forage for winter grazing and rotate cattle between pastures more frequently than those who did not attend. Producers who attended a grazing school are able to utilize stockpiled winter forage for an average of 3.09 months compared to 1.76 months for those who did not attend. However, attending a grazing school did not have a significant effect on the amount of time pastures are allowed to rest or the number of day's allotment of forage cattle are given at a time.

Significant differences between producers exist with regards to net profit, number of mature cattle, and amount of rented land. Results indicated that the number of mature cattle is positively correlated with net profit, suggesting that larger herds are more profitable than smaller herds. The amount of land producers rented is also positively correlated with net profit, which suggests that who rent more land tend to be more profitable.

Results of my study found significant differences with regards to pasture improvements made on rented land. Larger producers with 75 or more mature cattle are more likely to make improvements to rented pasture such as making fertilizer and lime or both, fencing improvements, water source improvements, over-seeding or planting

improvements, and mowing or brushhoging. There are no significant differences with regards to herd size and pasture improvements on owned land.

No significant differences were found with regards to producer level of education and net profit, rotational grazing, pasture improvements, or weaning practices. Producer age and reasons for raising cattle did not significantly affect any of the previously mentioned variables.

My results suggest that educators and extension personnel should continue to use grazing schools as a tool to teach rotational grazing management practices to producers. Only half of the producers in this study attended grazing school, and those who did are more likely to employ a variety of rotational grazing practices on their operation. Several previous studies (Bertelsen et al., 1993; Poore and Drewnoski, 2010; Hanson, 1995; Gerrish, 2000) have demonstrated the benefits of rotational grazing with regards to profitability, forage yields, and cattle productivity.

IMPLICATIONS

Knowledge of the current state of the beef cattle industry in Missouri may provide educators, extension personnel, and industry professionals a better understanding of the needs and concerns of cattle producers. Understanding theses needs and concerns are important factors for determining educational programs for both the short and long term.

University educators may be able to use this understanding of the Missouri beef cattle industry to develop effective training and resources for producers seeking information on cattle production. Knowing that the information producers obtain from grazing school helps them to implement better grazing management practices may help extension personnel increase the awareness of grazing school or make the same information readily available through other sources.

The development of new training programs could allow educators, extension personnel, and private industry collaborators to educate beef cattle producers on management practices to make their operations more profitable and productive, leading to a more sustainable industry. Understanding the relationship between renting pasture and profitability could assist extension personnel in developing programs to benefit both the cattle producer and the landowner. Educators and extension personnel might also be able to help cattle producers determine which types of pasture improvements are economically feasible on rented land and which practices are not.

As Missouri continues to play a dominant role in the U.S. beef cattle industry, a greater understanding of the Missouri beef cattle industry by educational and government organizations could lead to more sustainable and profitable production practices.

LIMITATIONS OF STUDY

The current study was affected by several factors that limit the applicability of this data to the state of Missouri as a whole. Although the sample represented several counties throughout the state, the overall response rate (5.9%) was low. One reason for this low response rate could be that I had to rely on the Missouri Cattlemen's Association to deliver the survey and reminders for me. At no point did I have access to the email addresses of producers who were sent the survey. I also had no way of knowing which producers had already completed the survey and which ones had not, so there was no way for me to target reminder emails to only those who had yet to complete the survey.

Another limitation of this study was the fact that my sample was only made up of members of the Missouri Cattlemen's Association. Although the survey was delivered to 1,898 recipients, it did not include cattle producers who were not members of the Missouri Cattlemen's Association, or members without an email address. Had the sample been expanded to include breed registries and various other organizations, a better response rate might have been obtained.

Data obtained from this survey was intended to be preliminary research and lead the way for further research on the topic by Missouri State University or other educational institutions.

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APPENDICES

Appendix A. Human Subjects IRB Approval

To: Elizabeth Walker
Agriculture - SPFD
Karls 207 901 S. National Avenue Springfield MO 65897

From: MSU IRB

Date: 9/26/2014

RE: Notice of IRB Exemption
Exemption Category: 2.Survey, interview, public observation
Study #: 15-0115

Study Title: Cattle Production in Southwest Missouri: A Survey of Management Practices

This submission has been reviewed by the Missouri State University IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes.

CC:

Jordan Kinder

Appendix B. Survey Questionnaire

Please see attached document.

Instructions & Consent

Thank you for completing this survey being conducted by Missouri State University to better understand the needs and concerns of the cattle producers in Missouri.

The results will be used to help educators develop educational programs to meet the short and long term needs of cattle producers.

The survey should take about 20 minutes to complete. All information obtained from this survey is anonymous and your participation is completely voluntary. In addition, all procedures have been approved by the Missouri State University Institutional Review Board.

Scroll down to answer the questions on each page, then click the "next" button at the bottom of the page to continue with the survey.

Because we are not tracking specific individual's responses, you need to complete the entire survey in one session.

This survey has been designed to better understand the management practices, demographics, productivity, and profitability of cattle producers in Missouri.

All of the following questions refer to the owner of the cattle.

If you have any questions, please contact Dr. Beth Walker 417-836-5638 or via email EWalker@Missouristate.edu.

Thank you again.
Dr. Beth Walker Associate Professor
Mr. Jordan Kinder, MSU Graduate Assistant

***1. Do you consent to participate in this survey?**

◯ Yes (to continue the survey)

◯ No (to exit the survey)

Demographics

In this section we use the general terms "beef operations" specifically related to the owner of the beef operation, rather than the "owner of the farm" because we recognize that some or all of the farmland may be rented. We are focusing on who owns the cattle, regardless of land/farm ownership.

2. Which of the following best describes your status?

- ◯ Beef operation owner
- ◯ Beef operation manager (not the owner)
- ◯ Other (please specify)

3. Please list all the counties (in Missouri) the owner has beef operations in.

4. What is the age of the owner of the beef operation?

- ◯ 18-30
- ◯ 31-55
- ◯ 56-70
- ◯ Over 70

5. What is the highest level of education the owner of the beef operation has completed?

- ◯ Less than High School
- ◯ High School or GED
- ◯ Vocational or technical diploma/certificate
- ◯ Associate Degree
- ◯ Bachelor's Degree
- ◯ Graduate Degree

6. Has the owner of the beef operation ever been to a grazing school? If yes, please specify where and what year.

- ◯ No
- ◯ Yes

If yes, please specify

7. How many reproductively mature cattle does the beef operation have?

Head of cattle:

8. Since the age of 18, how many years has the owner of the beef operation owned cattle?

Years

9. What is the owner of the beef operation's reason(s) for raising cattle? (Check all that apply).

- [ ] Source of Income
- [ ] Personal consumption of milk/meat/products
- [ ] Family tradition (always had livestock)
- [ ] Fun/Hobby
- [ ] Showing, competition, 4-H or club
- [ ] Tax deduction purpose
- [ ] Other (please specify)

10. One of the main goals of this survey is to determine profitability of beef farms in Missouri. Therefore, we need accurate information regarding your beef farm income and expenses. Please keep in mind that this is an anonymous survey. No information is being collected that will allow the researchers to identify survey participants. Therefore, we would greatly appreciate accurate income and expense information for 2013.

To the best of your ability, what were the expenses and the GROSS income for the beef operation in the year 2013?

Expenses

GROSS Income

11. What is the work status of each of the following people who may be associated with the beef operation?

	Only work is farm-related	Work on the farm full-time	Work on the farm part-time and have another non-farm related job	Only work is non-farm-related	No one of this status)
Owner	○	○	○	○	○
Owner's Spouse/Partner	○	○	○	○	○
Owner's business partner (other than spouse)	○	○	○	○	○
Manager (non-owner)	○	○	○	○	○

12. How many of the owner's family members (besides spouse/partner) are employed with the beef operation full-time and part-time? (Enter '0' if none).

Full-time

Part-time

13. How many non-family members are employed with the beef operation full-time and part-time? (Enter '0' if none).

Full-time

Part-time

Land Management

In this section "beef operations" refers to the land area used for raising the cattle -- whether rented or owned by the owner of the cattle.

14. How many acres of owned and rented land does the beef operation include? (Enter '0' if none).

Own

Rent

15. How many acres of total land are used for grazing, hay production, silage production, and crop production for the beef operation? (Enter '0' if none).

Grazing

Hay production

Silage production

Crop production

16. If travel is required, on average, approximately how many miles are traveled weekly by owner/manager/farm help to manage pastures/check on livestock? (Enter '0' if none).

Miles:

17. If travel to and from the farm/farms is required, what are the estimated, average, total weekly travel expenses (fuel, labor, etc.)?

Dollars:

Forages and Land Management

18. How much, on average, is paid per acre for rented pasture per month? (Enter '0' if none).

Dollars:

19. What are the estimated percentages of the following types of forage the cattle graze (both owned and rented land)? (Enter '0' if none).

Tall Fescue (KY 31 endophyte infected)	
Tall Fescue (novel endophyte or endophyte free)	
Cool season grasses (other than tall fescue)	
Legumes	
Forbs (broadleaf other than legumes)	
Non-native warm season grasses	
Native warm season grasses	
Crop stubble	

20. Regarding land use for cattle production, which of the following types of pasture improvements have been made to owned and/or rented land? (Check all that apply).

	Owned land	Rented land
Lime and fertilizer	☐	☐
Fencing improvements	☐	☐
Water source improvements	☐	☐
Overseeding or planting pastures	☐	☐
Mowing/brushhoging	☐	☐
Herbicide treatments	☐	☐
Pesticide treatments	☐	☐
None	☐	☐
Other	☐	☐

If Other, please specify

21. How much money is spent per acre per year on lime, fertilizer and/or herbicide/pesticide? (Enter '0' if none).

Lime	
Fertilizer	
Herbicides	
Pesticides	

22. How often have pastures and hay fields been inter-seeded?

	More than once per year	Every year	Every 2 to 3 years	Every 4 to 5 years	Less than every 5 years	Never
Pastures	◯	◯	◯	◯	◯	◯
Hay fields	◯	◯	◯	◯	◯	◯

23. How often have pastures and hay fields been re-seeded?

	More than once per year	Every year	Every 2 to 3 years	Every 4 to 5 years	Less than every 5 years	Never
Pastures	◯	◯	◯	◯	◯	◯
Hay fields	◯	◯	◯	◯	◯	◯

24. What percentage of pastures and hay fields are inter-seeded or re-seeded on an annual basis? (Please enter "0" if none)

Pastures inter-seeded	
Pastured re-seeded	
Hay fields inter-seeded	
Hay fields re-seeded	

25. How often are the following done on lands used for the beef operation?

	Never	Rarely	Sometimes	Often	Always
Produced stored forage is tested to evaluate nutrients	◯	◯	◯	◯	◯
Soil is tested to evaluate nutrients	◯	◯	◯	◯	◯

26. How often do you purchase stored forages without a nutrient test?

- ◯ Never
- ◯ Rarely
- ◯ Sometimes
- ◯ Often
- ◯ Always
- ◯ Do not purchase stored forages

Fencing

27. What is the total size, in acres, and number of permanently fenced pastures on land used to raise cattle?

Total Size

Number of pastures

28. How many permanently fenced pastures does the beef operation have?

29. Is temporary electric fencing (e.g. polywire) used to subdivide permanent pastures for the purpose of any form of rotational grazing during the growing season?

- ◯ Yes
- ◯ No

30. Is temporary electric fencing (e.g. polywire) used to subdivide permanent pastures for the purpose of any form of strip grazing during the winter months?

- ◯ Yes
- ◯ No

31. Is any farm where cattle are raised equipped to use electric polywire fences to divide permanent pastures for the purpose of rotational or strip grazing?

- ◯ Yes
- ◯ No

Grazing

32. How often are cattle rotated to a "new" pasture during the growing season?

- ◯ Multiple times per day
- ◯ Daily
- ◯ 2-3 times per week
- ◯ Every 1-2 weeks
- ◯ Every 3-4 weeks
- ◯ Every 1-2 months
- ◯ Every 3-4 months
- ◯ Never (continuously grazed pastures)

33. On average, how many days of rest does each pasture (whether temporary or permanent) receive between grazing events? (Enter 'N/A' if rotational grazing is not used).

Days of rest _____

34. Are pastures purposefully stockpiled for winter grazing?

- ◯ Yes
- ◯ No

35. How many days allotment is provided to cattle when rotating pastures of stockpiled forage?

Days of allotment _____

Do not use pasture stockpiled forage _____

36. Which months does the beef operation attempt to utilize pasture stockpiled forage (check all that apply).

- ☐ January
- ☐ February
- ☐ March
- ☐ April
- ☐ November
- ☐ December
- ☐ Do not use stockpiled forage

Cattle Production and Stocking Rates

The questions in this section are about the number and type of cattle owned by the beef operation.

37. Please indicate the number of each of the following types of cattle. (Enter '0' if none).

Commercial Beef

Purebred / Registered Beef

38. What percentage of the cattle fit into the following categories? (Enter '0' if none).

Cow-calf

Stocker

Backgrounder

Heifer development

Bull Production

Bottle Calves

Finishers (grain fed)

Finishers (grass fed)

39. How many mature (3 years or older) cows does the operation have? (Enter 0' if none).

Mature cows:

40. What is the average weight of mature (3 years or older) cows? (Enter 'N/A' if no mature cows).

Weight of mature cows:

41. How many mature (3 years or older) bulls does the operation have? (Enter '0' if none).

Bulls:

42. What is the average weight of mature (3 years or older) bulls? (Enter 'N/A' if no mature bulls).

Weight of bulls:

43. How many cattle, less than three years, old does the operation have? (Enter '0' if none).

Less than 3 year old cattle:

Feeding

44. On average, how many days per year do cattle get their feed strictly from hay? (Enter '0' if none).

Days:

45. On average, how many days per year is hay fed as a supplement to grazing? (Enter '0' if none).

Days:

46. If the beef operation feeds grain, on average how many days per year is it fed? (Enter '0' if none).

Days:

47. On average, how many pounds of hay are fed per cow per year? (Enter '0' if none).

Pounds of hay:

Calving and Weaning

48. To what extent are each of the following breeding methods used in the beef operation? (Please enter a percentage, or "0" if none)

Artificial Insemination	
Embryo Transfer	
Natural, by operation's bulls	
Natural, by another operation's bulls	

49. What is the estimated percentage of calves born during each month? (Enter '0' if none).

January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

50. At what age (in months) are calves weaned?

Age:

51. What is the average weaning weight of calves on the farm?

Weaning weight:

52. Please rank the following factors that effect the time calves are weaned. (1 being the most important reason and 4 being the least important) (Note: after you select a ranking for each item, the survey program will reorder the list).

	Time availability
	Forage availability
	Weather
	Market price