

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Animal Enterprises

- Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
121	Management of Range Resources	8%		15%	
302	Nutrient Utilization in Animals	10%		20%	
303	Genetic Improvement of Animals	8%		10%	
304	Animal Genome	0%		10%	
305	Animal Physiological Processes	7%		10%	
306	Environmental Stress in Animals	12%		10%	
307	Animal Management Systems	19%		10%	
308	Improved Animal Products (Before Harvest)	12%		5%	
311	Animal Diseases	13%		5%	
315	Animal Welfare/Well-Being and Protection	11%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	20.0	0.0	14.0	0.0
Actual Paid	27.0	0.0	9.2	0.0
Actual Volunteer	2.7	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
250000	0	457117	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
250000	0	457117	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
3175200	0	2265607	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct fundamental and applied research
- Construct research facilities
- Write extramural grant proposals
- Conduct workshops and other educational meetings and conferences
- Provide in-service trainings
- Provide one-on-one consultation
- Develop and maintain numerous newsletters, web sites, press releases, Sun Up programs, and other mass media resources

2. Brief description of the target audience

Managers, owners and employees of farms, ranches and agribusinesses, research scientists, extension personnel, beef cattle producers, meat goat producers, consumers, and policy makers.

3. How was eXtension used?

Active participation in the Horse CoP. We are collaborating to develop an online curriculum for an introductory horse management university credit course through Michigan State University. The curriculum will be repurposed as an e-course book for use by universities, community colleges and high schools and as the core content for a massively open online course (MOOC) targeting general horse enthusiasts. In addition, we are working with the National Beef Cattle Evaluation Consortium extension team to cooperatively develop additional beef genetics extension materials so that a more uniform source of genetics materials is available across the US. As a part of these efforts, we are working to re-vamp and revitalize the genetics portion of the beef cattle CoP. We are currently developing new content with the goal of launching the new content in 2015, with a large roll-out coinciding with the Beef Improvement Federation Annual Meeting in June.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	154010	3365078	19500	750000

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	2	31	33

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational meetings, class guest lectures, conferences, in-service trainings held

Year	Actual
2014	196

Output #2

Output Measure

- Number of fact sheets, proceedings publications, newsletters, popular press articles and other non-peer reviewed extension publications produced

Year	Actual
2014	40

Output #3

Output Measure

- Number of Animal Enterprise television and radio spots or segments produced

Year	Actual
2014	66

Output #4

Output Measure

- Number of web sites maintained

Year	Actual
2014	4

Output #5

Output Measure

- Number of decision making tools developed

Year	Actual
2014	2

Output #6

Output Measure

- Number of peer reviewed manuscripts published

Year	Actual
2014	34

Output #7

Output Measure

- Number of beef and pork quality assurance program participants

Year	Actual
2014	103

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of cattle enrolled in value enhancement programs
2	Number of producers participating in beef cattle value enhancement programs
3	Percent of participants gaining knowledge in methods to decrease the incidence and severity of bovine viral diarrhea virus and bovine respiratory disease
4	Percent of producers gaining knowledge in pasture and rangeland management, forage use efficiency and pasture and rangeland recovery
5	Percent of producers and educators with access to resources regarding adaptation solutions for climate change
6	Frothy Bloat Control
7	Stocker Production System on Estimated Greenhouse Gas Emissions
8	Beef and Dairy Cattle Sustainability
9	Cattle and Forages: Reproduction
10	Cattle Receiving and Feeding: Behavior and Well-Being
11	Cattle Receiving and Feeding: Environmental Stress
12	Cattle Receiving and Feeding: Immunology
13	Food Safety and Meat Science
14	Meat Science: Dark Cutting Beef

Outcome #1

1. Outcome Measures

Number of cattle enrolled in value enhancement programs

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	46454

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Cattle sickness costs the beef cattle industry millions of dollars each year. These losses negatively impact producer profitability and they impact each and every level of the beef production chain. Negative impacts are felt at the producer level through decreased performance, death loss, increased costs associated with treating sick animals, increased labor expenses and additional expenses for equipment, to name a few. At times, these losses extend beyond the cow-calf producer to each of the other sectors of the beef economy. Chronically ill cattle place a huge financial burden on the entire industry as the cost of carrying such cattle replicates itself throughout the life of the calf. Unfortunately the cost burdens associated with cattle sickness do not stop once the cattle are harvested. There are a number of well-documented studies including the 1995, 2000 and 2005 Beef Quality Audits that clearly illustrate that sickness in cattle, at even an early age, can have dramatic impacts on carcass quality, tenderness, and in some extreme cases the condemnation of entire carcasses.

What has been done

In order to facilitate the adoption of best management practices that should result in reduced sickness and associated adverse effects, a number of value enhancement programs continue to enroll cattle with this goal in mind. A leading program in the state of Oklahoma is the Oklahoma Quality Beef Network (OQBN), which was initially developed in 2001 and redefined in 2009. The objective is to add value to Oklahoma's calf crop and capture at least part of the added value. OQBN held 8 sales for verified cattle in Oklahoma throughout 2014. 6,454 calves were enrolled representing 103 producers which is an increase of 16% in total cattle enrolled from 2013. Analysis of data collected at the 8 auctions shows \$19.99/cwt increase in price over non-weaned cattle that sold the same day.

Results

The average price premium (on average for a 600 lb calf) was \$119.94/animal. The added weight gain over the 45 day preconditioning period on average was 90 lb, and that added gain was worth \$117.00/animal with a value of gain \$1.30/lb this fall, for a gross increase in revenue of \$236.94/animal. A seasonal price increase of \$2.25/cwt from weaning to marketing added \$13.50/animal. If the price of preconditioning is estimated at \$79.45/animal, net profit to producers is \$170.99/animal or \$1,103,569 in net revenue total for all OQBN producers in the state of Oklahoma. Other value enhancement programs included in the number of cattle reported above have similar requirements and goals, such as Angus Source, Superior Livestock Auction Vac 45,

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
315	Animal Welfare/Well-Being and Protection

Outcome #2

1. Outcome Measures

Number of producers participating in beef cattle value enhancement programs

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	325

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Cattle sickness costs the beef cattle industry millions of dollars each year. These losses negatively impact producer profitability and they impact each and every level of the beef production chain. Negative impacts are felt at the producer level through decreased performance, death loss, increased costs associated with treating sick animals, increased labor expenses and additional expenses for equipment, to name a few. At times, these losses extend beyond the cow-calf producer to each of the other sectors of the beef economy. Chronically ill cattle place a huge financial burden on the entire industry as the cost of carrying such cattle replicates itself throughout the life of the calf. Unfortunately the cost burdens associated with cattle sickness do not stop once the cattle are harvested. There are a number of well-documented

studies including the 1995, 2000 and 2005 Beef Quality Audits that clearly illustrate that sickness in cattle, at even an early age, can have dramatic impacts on carcass quality, tenderness, and in some extreme cases the condemnation of entire carcasses.

What has been done

To identify programs in which Oklahoma producers were involved in 2007 and 2012, various marketing programs were contacted to measure producer participation and the number of cattle marketed through value-added efforts. Contacts were made with source and age verification companies approved through USDA, breed associations, feedyards, pharmaceutical companies, and livestock markets as reported by the USDA Agriculture marketing Service (AMSA). Companies reported the total number of Oklahoma producers who participated in the value-enhancement program and total number of calves enrolled. In 2007, 85,575 Oklahoma calves were enrolled in a value-added marketing program which is 4.3 percent of possible calves available annually of Oklahoma cattle numbers. Revisiting this in 2012, 127,759 calves were enrolled in a value added marketing opportunity; this is 7.28% of the 1,754,000 calves available for market in 2012 and an overall increase of 33% of cattle enrolled over the 5 year period.

Results

In 2014, 103 Oklahoma beef producers enrolled 6,454 calves in the OQBN program, a 16% increase in enrollment over 2013. Eight regional OQBN Vac-45 calf sales were conducted in seven livestock markets where 4,704 calves were marketed. 1,750 animals were sold at other verified sales or private treaty. OQBN steer cattle received a premium of \$19.99/cwt, based on the weighted average price of all lots, over non-preconditioned cattle. The weighted average premium does not adjust for any price differences attributable to lot size, weight, breed, hide color, sex, fleshiness, and muscling. The average price premium (based on a 600 lb average calf) was an additional \$119.94 per head, while the added value of weight gain (average of 90 pounds gain at \$1.30/lb) during the preconditioning period averaged \$117.00 per head for a gross increase in revenue of \$236.94 per calf. At a \$19.99/cwt premium for OQBN calves, Oklahoma producers realized \$774,092.00 in added revenue from premiums. From the result of the additional gain during the preconditioning phase added to the premium, there is additional \$755,118.00 gross revenue (no cost subtracted out) to OQBN participants. From the weaning deadline to the OQBN sale dates, the cattle market increased on average of \$2 to \$5/cwt. At \$2.25/cwt, increase in the value of cattle from the market trend resulted in an additional \$13.50 per head for a total of \$72,913. The total increased gross revenue to Oklahoma OQBN Vac-45 participants in 2014 was an additional \$1,602,123 which takes into account the increase in the market prices from weaning to marketing, the additional weight gain, and the price premium.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #3

1. Outcome Measures

Percent of participants gaining knowledge in methods to decrease the incidence and severity of bovine viral diarrhea virus and bovine respiratory disease

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	103

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Bovine respiratory disease (BRD) is the most common disease among feedlot cattle in the United States, accounting for approximately 75 percent of feedlot morbidity and 50 percent to 70 percent of all feedlot deaths. BRD causes between \$800 million to \$900 million annually in economic losses from death, decreased performance, and antimicrobial treatment costs. Despite improved vaccines and antimicrobials, BRD rates have been increasing during recent years. Feedlot cattle that received 1, 2, or 3 treatments for BRD returned \$40.64, \$58.35, and \$291.93 less, respectively, than untreated animals. A substantial portion (79%) of lost return is due to decreased carcass weight and lower quality grade rather than treatment costs. Immune response and morbidity issues relative to cattle growth and carcass quality affect every level of the beef industry, from the producer to the packer, all the way to the consumer as end-user. Few studies have documented the economic effect of BRD from incidence of the disease through harvest, and especially the impact of BRD on acceptability of the final product as determined by consumers.

What has been done

OSU researchers evaluated the effects of BRD incidence during the receiving period on subsequent finishing performance, efficiency, carcass characteristics, and lung scores of feedlot steers. During the receiving period, crossbred steer calves were monitored daily for clinical signs of BRD. After the receiving period, calves were grouped by previous number of times treated for BRD and allocated to finishing pens. The BRD experimental groups included: never treated for BRD (0X), treated 1 time (1X), 2 times (2X), or 3 or 4 times (3/4X) for BRD.

Results

As the number of antimicrobial treatments for BRD increases, average daily gain in the backgrounding phase decreases, cost-per-unit increases, and net returns decline. Days on feed needed to reach a common 12th rib fat thickness increased by 7 days for every increase in number of antimicrobial treatment required. Increased days on feed, lower final body weight and lower carcass value resulted in a 2.3%, 10.2%, and 14.0% decrease in the total value of calves at harvest for calves treated once, twice, and 3 or 4 times for BRD, respectively. Decreasing the average number of times an animal is treated for BRD by one treatment would result in a nearly \$9 million savings to Oklahoma feedlot cattle producers. In addition, marbling scores, color stability and overall acceptance of the final beef product by consumers decreases as the number of antimicrobial treatments increases.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #4

1. Outcome Measures

Percent of producers gaining knowledge in pasture and rangeland management, forage use efficiency and pasture and rangeland recovery

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Grazing management is critical to the sustainability of livestock enterprises in Oklahoma. The majority of the state's land is managed by ranchers for the primary purpose of providing grazing

for beef cattle. These grazing lands are a vital part of the natural and economic resources of the state, and provide many diverse benefits to landowners and society. In a sense, grazing management affects all citizens of Oklahoma. Challenges such as drought, climate change, and feed/energy costs increase rancher's reliance on good management to make efficient use of their grazing resources over the long run.

What has been done

A Master Cattleman Summit was held in Stillwater during the fall of 2014 with an emphasis on grazing management, forage use efficiency and rangeland recovery. Approximately 125 beef producers participated in the 2-day workshop. In addition Area Specialists and County Educators hosted two Cow Boot Camps with special emphasis on grazing management. Approximately 80 producers participated in these 3-day intensive workshops.

Results

Producer knowledge and awareness related to improved grazing management practices, forage use efficiency and rangeland recovery was greatly enhanced according to program evaluations. Most participants indicated a high degree of satisfaction with the educational opportunity and a high rate of adoption of best management practices related to better grazing resource utilization and management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
302	Nutrient Utilization in Animals
306	Environmental Stress in Animals
307	Animal Management Systems

Outcome #5

1. Outcome Measures

Percent of producers and educators with access to resources regarding adaptation solutions for climate change

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2014

450

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Climate variability has had a large impact on the entire United States over the past several years, and has impacted Oklahoma beef producers in the western part of the state most severely. During these times, natural resource usage is critically important, and issues over water rights and availability are paramount.

What has been done

OSU researchers have obtained funding and are currently collecting data for a study to examine abiotic stresses on beef cattle production, including efficiency of water usage (direct consumption) in beef cattle. Over the next five years, we will collect and analyze data that encompasses genomics, bioinformatics, and metagenomics to explore how producers can select for animals better suited to adverse environmental conditions. Similarly, our extension group continues to emphasize "matching cows to forage" resources as an educational thrust as the industry continues to over-adopt traits that compromise cattle's ability to deal with harsh environmental conditions. Examples include increased aggressive selection for milk, growth and muscle as well as a decline in crossbreeding overall.

Results

This research information will be integrated and disseminated through the cooperative extension service and will provide producers with several new decision support tools that will help them better manage their cattle and natural resources. Currently, 3 MS, 2 Ph.D. and 2 undergraduate research scholars are being trained in animal genomics, genetics, data curation and management, and data analysis.

Results of the extension program, in concert with increased awareness by breed associations seem to be taking hold. While it is too early to tell, the genetic selection for traits that increase maintenance requirements of beef cows and their general "lack of fit" seems to be slowing while the industry appears to gradually be going back to more planned crossbreeding programs. We hope to have solid data to demonstrate these changes in 2015.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
302	Nutrient Utilization in Animals
306	Environmental Stress in Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #6

1. Outcome Measures

Frothy Bloat Control

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Frothy bloat of growing cattle grazing wheat pasture is a major herd health problem. While not a true bloat-preventive compound, monensin has been shown to decrease the incidence and severity of bloat of wheat pasture cattle in very intensive studies with small numbers of cattle.

What has been done

OSU researchers have conducted a 2-year study relative to the effect of monensin on the incidence and severity of bloat in large scale grazing trials with about 200 cattle/year. Method of delivery of monensin was different between years, and monensin consumption averaged 200 and 81 mg/animal/day.

Results

Despite the large difference in monensin consumption between years the incidence and severity of bloat was decreased both years by provision of monensin. Provision of monensin to growing cattle on wheat pasture is an efficacious means of decreasing cattle death losses due to bloat, and has huge potential to increase profitability of the approximately 4.5 million stocker cattle that are grown each year on wheat pasture in the southern Great Plains.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #7

1. Outcome Measures

Stocker Production System on Estimated Greenhouse Gas Emissions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The two primary greenhouse gases from livestock production are methane and nitrous oxide which come from enteric fermentation, and fertilizer and manure application to soil.

What has been done

OSU researchers have conducted a three-year study to evaluate the effect of stocker cattle production systems that alter rumen fermentation and replace fertilizer with feed supplements on greenhouse gas emissions. Summer grazing systems on old world bluestem pastures included: (1) non-fertilized, low stocked pastures (CONT); (2) N fertilized, high stocked pastures (NFERT); (3) N and phosphorus (P) fertilized, high stocked pastures (NPFERT); and (4) non-fertilized, high stocked pastures plus supplementation of dried distillers grains with solubles (DDGS). Greenhouse gas emissions were computed for each pasture using life cycle assessment methods. Total greenhouse gas emissions (direct + indirect) were greater for NFERT, NPFERT, and DDGS than CONT (average 23,475 vs. 8367 kg CO₂e). However, when adjusted for shrunk body weight gain, total emissions were similar between DDGS and CON with NFERT and NPFERT having greater total emissions per kg BW gain.

Results

These data suggest that DDGS can be used to replace nitrogen fertilizer in stocker cattle grazing systems and decrease greenhouse gas emissions to levels similar to low input systems. Use of DDGS in place of fertilizer N could decrease greenhouse gas emissions from the millions of acres of improve pastures used in stocker cattle production systems across the U.S.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #8

1. Outcome Measures

Beef and Dairy Cattle Sustainability

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Enteric methane emissions from beef and dairy cattle represent a loss of feed energy value and methane is a greenhouse gas, 28 times more potent at trapping heat than carbon dioxide.

What has been done

A brand new ventilated hood system that has the capability of measuring enteric methane emissions from confined beef and dairy cattle has been constructed in the Department, which is a first of its kind for Oklahoma State. The system will be validated in the winter and spring of 2015.

Results

The system will provide the capability to provide baseline data for Oklahoma enteric methane emissions from both beef and dairy cattle. Additionally, this system provides the capability to conduct studies on mitigating enteric methane emissions, which can lead to ways to improve the nutrient use efficiency of Oklahoma cattle producers. Furthermore, graduate students will be trained in a novel research area that is lacking trained professionals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #9

1. Outcome Measures

Cattle and Forages: Reproduction

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Reproduction in the southern states is dramatically lower than in states further north. Improvements in reproductive capacity of the cowherd would have a very dramatic impact on profitability and sustainability of beef cattle operations in Oklahoma and the southern United States.

What has been done

In 2014, the Applied Reproductive Strategies in Beef Cattle Annual Meeting was held in Stillwater, OK, and was planned and organized in conjunction with the Beef Reproduction Task Force. Together, we raised approximately \$20,000 in sponsorships from industry partners to host the event, along with a \$5,000 USDA-NIFA-AFRI grant to support speaker travel and graduate student travel scholarships. The meeting was held October 8-9, 2014 and attracted over 200 beef producers, beef industry professionals, academics, extension professionals, and veterinarians from 15 different states (TX, CO, AR, OK, CA, IA, MO, KS, NE, LA, ID, SC, OR, GA, AZ), including many attendees from Oklahoma and the southern US.

Results

Attendee surveys highlighted the value they obtained from the conference (rated a 4.4 out of 5 overall) and 92% (69 out of 75 respondents including producers, veterinarians, extension educators, and industry consultants) indicated that they intended to make or recommend changes based on the information from the conference and that they expected these changes to affect over 340,000 head of cattle and be worth approximately \$2.9 million to the industry (# head * increased profit/head estimated by the attendee).

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
307	Animal Management Systems

Outcome #10

1. Outcome Measures

Cattle Receiving and Feeding: Behavior and Well-Being

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is need to develop behavioral scoring systems and provide welfare scoring services for research in growth-promoting technologies, which are currently associated with beef cattle industry-wide and societal concerns in cattle welfare and mobility.

What has been done

Oklahoma State University evaluated the effects of growth-promoting technologies (i.e., antimicrobials, antibiotics, growth-promoting implants, beta-adrenergic agonists) typically used in conventionally raised beef cattle to determine how modern technologies affect cattle behavior and health when compared to cattle raised in an all-natural system (i.e., no growth-promoting technologies administered to cattle). Cattle were evaluated individually and as groups for a wide variety of behaviors. Cattle health records and blood samples were collected to monitor the overall health status of cattle. There were no negative impacts of technologies on cattle disposition, activity, condition of mobility, or health.

Results

Cattle health and behavior studies at Oklahoma State University have evaluated the welfare impacts of growth-promoting technologies in the beef industry. A novel scoring system of cattle mobility was tested and new information about cattle well-being and modern technologies in beef production have been determined. Research indicates there were no negative impacts of technologies on cattle disposition, activity, condition of mobility, or health. Adopting the new mobility scoring system may help determine if other factors (i.e. varying transportation duration, weather conditions, cattle genetics, handling conditions, etc.) in combination with the use of modern technologies may alter the health, behavior and well-being of cattle. The development and evaluation of a novel scoring system of cattle mobility and an evaluation of the welfare implications of using growth-promoting technologies in feedlot cattle.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #11

1. Outcome Measures

Cattle Receiving and Feeding: Environmental Stress

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Environmental stress of confined cattle has begun to receive societal concern and also remains an economical concern of cattle producers. Effects of cold have been realized in recent severe winter storms of the north central United States while extreme heat periods of recent summers have intensified the focus. For confined feeding operations, hard dirt pen surfaces, animal density, animals with heavier condition, and shade area availability increase potential for sustained heat events to cause stress to cattle. The extent of the stress, impact on cattle well-

being, and effectiveness of mitigation strategies is not clearly defined.

What has been done

Core body temperatures of finishing cattle under conventional and natural management programs have been monitored during confined feeding. Methods for managing heat load include balancing dietary adjustments, air flow, shade consumption, and evaporative cooling. The impact of shaded provided from pens with barn feeding areas has been compared to outdoor feeding pens. Within outdoor pens, evaporative cooling relief by wetting with sprinklers during extreme heat days was evaluated. Data is being compared to Mesonet Cattle Comfort Advisor data to determine benchmarks that are appropriate for implementing heat load mitigation management strategies.

Results

Results, to date, suggest the differences in tolerance and response to heat loads can differ between conventionally and naturally managed cattle. Large barns feeding areas providing shade results in decreased heat accumulation by cattle. Sprinkling appears to provide minimal relief on single day heat events, but does result in measurable relief periods during multiple high heat load days. Development and evaluation of tools and management techniques to identify and mitigate heat loads that cause stress in confined cattle can lead to improved animal well-being and improved efficiencies of production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #12

1. Outcome Measures

Cattle Receiving and Feeding: Immunology

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Food Drug Administration (FDA) just implemented a new policy in December 2013 to phase out the use of medically important antibiotics in healthy animals in three years. Alternatives to antibiotics are urgently needed.

What has been done

We have systematically screened the genomic sequences of cattle and identified the entire repertoire of the bovine beta-defensin and cathelicidin gene families. We are in the process of evaluating the potential of these antimicrobial peptides as candidate alternatives to antibiotics. Simultaneously, we have also discovered several dietary compounds and their combinations with a strong capacity to enhance the synthesis of host defense molecules, animal immunity, and disease resistance.

Results

Identification and characterization of novel host defense molecules and immune boosting compounds could potentially lead to the development of new effective alternatives to antibiotics to ensure animal health, productivity, and food safety and security with no reliance on in-feed antibiotics. Currently, 5 PhD, 1 MS, and 3 undergraduate research scholars are being trained in animal genomics, immunology, cell and molecular biology, and bioinformatics. Development of effective alternatives to antibiotics could potentially impact the global livestock industry.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
304	Animal Genome
311	Animal Diseases

Outcome #13

1. Outcome Measures

Food Safety and Meat Science

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

According to the recent CDC estimates, foodborne illnesses affect 48 million people, resulting in 128,000 hospitalizations, and 3,000 deaths annually in the US. Shigatoxin producing E. coli (STEC), Salmonella, and Listeria have been a major issue in the food industry, resulting in continued recalls and foodborne outbreaks.

What has been done

(1) Development of best management practices (BMPs) for cow-calf operations to reduce foodborne pathogens such as Shiga-toxigenic E. coli and Salmonella; (2) Evaluating the food safety of mobile slaughter units for pastured poultry growers in the Southeast; (3) Molecular basis of adherence of food pathogens on food and food contact surfaces using molecular proteomics; (4) Improving the safety of organic leafy greens using good agricultural/production practices; (5) Assessment of plant-derived antimicrobials for reduction of foodborne pathogens during food processing and storage; (6) Development of bacteriophage and bacteriocins that can be used as a bio-preservative against E coli, Salmonella, and Listeria; (7) A Farm Health for Public Health Conference was held to educate livestock producers and Agri-event managers about Shigatoxin producing E. coli.

Results

Farm food safety assessment studies and development of good agricultural and management practices will lead to adoption of food safety principles by the livestock, poultry and fresh produce farmers. Reduction of foodborne pathogens in the food animals and farm environment, as a result, will enhance farmer competitiveness, leading to increased profitability. New knowledge in Listeria pathogenesis will help to develop novel control strategies. Assessment and intervention studies at food processing level will increase knowledge of food industry professionals; improve intervention strategies; and decrease cross contamination, making food supply safer. These studies will eventually result in decreased incidences of foodborne illnesses and improved consumer health. In 2014, 89 agricultural linked individuals received basic information about prevalence and on farm control of E. coli and critical control points for Agri-events to control pathogen transfer.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

Outcome #14

1. Outcome Measures

Meat Science: Dark Cutting Beef

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

According to the 2011 National Beef Quality Audit 3.2% of the carcasses assessed were dark cutters. The US Beef industry loses approximately \$165 - \$170 million dollars due to discounted price in beef carcasses.

What has been done

Extended aging, modified atmospheric packaging, and enhancement techniques were used to improve the surface color in dark cutting beef. Follow-up studies are currently determining the sensory attributes of dark cutting beef.

Results

Developed aging and modified atmospheric packaging based techniques to improve the surface color of dark cutting beef. 7 Master students and 8 undergraduates are being trained in both applied and basic meat science research. To help the beef packers to use postharvest techniques to enhance the value of dark cutting beef. Techniques will have a national and international scope.

4. Associated Knowledge Areas

KA Code	Knowledge Area
308	Improved Animal Products (Before Harvest)

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Both the QQBN and VAC-45 programs used market data to evaluate the monetary results of producers using information and technology suggested by the programs. See state defined outcomes

Master Cattleman Summit used post conference questionnaire of participants to evaluate quality and value of education. See State Defined Outcomes

Key Items of Evaluation