

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Food Safety

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			10%	
301	Reproductive Performance of Animals			5%	
302	Nutrient Utilization in Animals			10%	
303	Genetic Improvement of Animals			7%	
305	Animal Physiological Processes			5%	
306	Environmental Stress in Animals			5%	
307	Animal Management Systems			11%	
308	Improved Animal Products (Before Harvest)			5%	
311	Animal Diseases			15%	
315	Animal Welfare/Well-Being and Protection			7%	
503	Quality Maintenance in Storing and Marketing Food Products			5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			5%	
902	Administration of Projects and Programs			5%	
903	Communication, Education, and Information Delivery			5%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	49.4	0.0
Actual Paid	0.0	0.0	49.5	0.0
Actual Volunteer	0.0	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
0	0	521349	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	2744755	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2547517	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Food Safety, in its most basic nature, aligns with national priorities to ensure the safety of the nation's food supply. This program area includes the investigation and incidence reduction of food-borne illnesses and assisting producers in providing a safer and more robust food supply, in all respects.

Protection of the health and security of food products spans the entirety of the food safety field; beginning with molecular studies, and ending with the application of sound market trends in a global food- trade market for Montana products. MAES and COA researchers are committed to ensuring, supporting and examining food safety production and processes in all levels of this program area. (*For a detailed review and reporting achievements as it relates to pre-harvest animal health research, see GFS: Animal Health, Production and Products.)

The global market is driving changes to the agricultural industry with constraints on grain and animal products. The organic market is quickly becoming one of the nation's fastest growing, as American consumers are demanding safer foods free of harmful chemicals and pesticides. Agricultural producers and agribusinesses are continually affected by supply, demand, technology, market integration, risk management and international trade dynamics. While the program area of food safety does represent traditional 'safety' measures such as food-borne illness and animal health diseases, it also incorporates and additional 'safety' measures to protect family-owned agribusinesses as well as economic policy research as it relates to the nation's food supply.

Animal health is economically essential to livestock producers who work diligently producing high quality, high profit stock. Promoting and maintaining animal health has led to advances in genetics and reproductive science and improved animal performance. Investigators with MAES and COA are studying animal health and its impact on food safety through numerous studies exploring all aspects of livestock management from genetics research projects, disease identification and prevention, to animal breeding practices, reproductive sciences, and nutrition. Studying infectious diseases is important to Montana researchers because of both the economic losses for producers and food safety concerns (the college's Department of Microbiology and Immunology focuses a great deal of research infectious diseases and animal health, and particularly infectious cattle diseases, reported in the Animal Health Planned Program in this report). This department and the college's Department of Animal and Range Science have several joint research projects developing and testing new drugs, vaccines, and diagnostic tools for fighting infectious diseases of livestock, humans, and wildlife, as well as zoonotic diseases.

Montana prides itself on being home to some of the greatest cattle and sheep operations in the United States, and also as a state that boasts an abundant wildlife population. This brings about unique research

opportunities as scientists balance health concerns of livestock, wildlife, consumers and the urban-wildland interface as it relates to safety concerns in agricultural production. The goal of MAES/COA faculty scientists is to provide objective, research-based animal health and food economics information (impacts of changes in market policy and conditions of the food and fiber sector) to the public. MAES/COA faculty and personnel in at MSU continue to be a main vein of information and research for the state's agricultural sector.

Promoting and maintaining animal health (cattle, sheep, horses, and wildlife) has led to advances in genetics and reproductive science and improved animal performance. By understanding immune systems and parasite development in livestock, and by developing novel genes and new biochemical routes of activity for drugs and vaccines, ranchers can better manage economically important diseases like coccidiosis, shipping fever, and brucellosis. Montana developed an integrated network to track calves from Montana ranches to feedlots and packing plants in other states. Tracking will provide both source and process verification for easy trace-back in case there is a disease outbreak.

Cattle research focuses on disease control, reproductive enhancement, and animal productivity. Scientists will continue investigating vaccines for rotavirus, strangles, respiratory diseases, and mastitis in cattle. Researchers are using feed studies with barley, camelina meal, and supplements to evaluate varying rations for calves and cows, and to continue producing superior feeder stock to markets outside of Montana. Scientists are devising research to understand the cause and development of immunity to bovine shipping fever and to develop novel strategies for the prevention and control of this disease complex.

Researchers in the sheep industry continued studying targeted grazing strategies to increase the competitiveness of Montana's lamb and wool in the world market. They also studied the impact of sheep grazing in weed management programs. Scientists are initiating studies about Blue Tongue and Cache Valley Virus, which are both critical diseases for lamb and sheep populations.

The new undergraduate major in Sustainable Food and Bioenergy Systems (SFBS) adds new education and research opportunities to students and faculty through the interdisciplinary degree program which promotes sustainable production, distribution, and consumption of nutritious food and bioenergy by growing a new generation of leaders through collaborative learning and hands-on experience. SFBS students explored various aspects of food and bioenergy systems as well as career opportunities in the sustainable food systems, agro-ecology, and sustainable crop and livestock production options. The SFBS program combines classroom learning, research opportunities, and meaningful field experiences to prepare students for careers that will impact the future of food and energy production.

Create databases accessible to researchers and producers to share research results readily available

- Distribute papers and research results at state nutrition conferences, field days, county meetings, and state conventions
- Prepare research articles, fact sheets, and news releases for scientists and state media
- Hold strategic planning meetings with state agricultural groups
- Develop systems that ensure food safety and agricultural security
- Integrate, where possible, best practices for beef quality assurance in programs
- Further knowledge and management of insects affecting animals and humans
- Develop effective livestock disease control methods
- Identify and mitigate the transmission of diseases between livestock and wildlife
- Increase wool and lamb competitiveness
- Implement targeted grazing strategies as weed control
- Nutritional impact of grazing on sheep and cattle

- Improve traceability of livestock

2. Brief description of the target audience

- State agencies, animal health companies, and state commodity groups
- Ranchers, seedstock industry, colleagues, and related stakeholders
- Crop and livestock producers in Montana
- National Park Service, Montana Fish, Wildlife and Parks
- Food safety workforce sector
- Montana food producers

3. How was eXtension used?

COA and MAES researchers worked closely with county extension agents and outreach coordinators to disseminate timely and accurate information regarding the evaluation and procurement of food safety.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	10000	5000	1500	500

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	0	150	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research citations

Year	Actual
2014	150

Output #2

Output Measure

- Number of publications on infectious disease and food safety research

Year	Actual
2014	200

Output #3

Output Measure

- Number of presentations on infectious disease research

Year	Actual
2014	150

Output #4

Output Measure

- Number of undergraduate and graduate students trained in animal science and biotechnology

Year	Actual
2014	3000

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Identify critical infection and resistance processes
2	Number of improvements to vaccines developed
3	Meetings that maintain or enhance Montana's presence in the production of quality meat products
4	Number of ranches using beef quality assurance practices to manage animal health and well-being issues

Outcome #1

1. Outcome Measures

Identify critical infection and resistance processes

2. Associated Institution Types

- 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)

Identifying critical infection and resistance processes is immensely important to Montana's food producers. Providing detection, treatment and resistance for a variety of illnesses and diseases ensures that Montana's food exports are safe and meet standards for the global market, while assuring producers and patrons of a healthy and economically viable food source. Infection and resistance studies also provide a deeper understanding of human illness and their correlation and behavior with that of animal diseases.

What has been done

Identified virulence factors and protective antigens among the cell surface proteins of horse pathogen Streptococcus, and identified new virulence factors among 13 uncharacterized cell wall proteins. Determined whether virulence factors identified in the primary objective are protective antigens, and the study expects to identify new projective antigens that can be included in a vaccine formulation for the development of an effective and safe strangles subunit vaccine

Results

2013 research objectives included cloning DNA fragments on three target genes for inactivation of the target genes, successfully obtaining Streptococcus equi mutants for two of the three target genes, and have generated mutants for 12 of 13 target genes. The project compared virulence of four mutants with the parent strain using a mouse model of intranasal S. equi infection, and one of the mutant was significantly attenuated in virulence. Studying animal losses allows MAES/COA scientists to continue a deeper and active understanding of food safety.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #2

1. Outcome Measures

Number of improvements to vaccines developed

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Animal losses due to environmental stresses, disease, and death create the need for an improved understanding of factors affecting Montana livestock. Infectious disease continues to cause considerable losses to livestock producers by reducing production and by reduced sales because of food safety concerns. Disease outbreaks are closely monitored in Montana to ensure quality and disease-free animals are shipped to other states.

What has been done

Research was conducted on bovine gamma/delta T cells using functional, biochemical and molecular approaches, which clarified the general understanding of the bovine immune system and how it is similar and dissimilar to the immune system in rodents and humans. This information facilitates the development of new approaches to treat infectious diseases of cattle.

Results

The direct impact of this work is a general understanding of animal immune systems and their responsive health to new improvements to vaccine development. This discovery and research affects the fields of food animal production and food safety. Several producers expressed appreciation for the alert and pro-active action taken by MSU and the state livestock department.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Meetings that maintain or enhance Montana's presence in the production of quality meat products

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Quality meat production is critical for producers, processors, and consumers. Educational programs geared toward specific audiences enhance food safety awareness and increases the quality of meat products produced and processed in Montana.

What has been done

An MSU professor and beef cattle specialist administered the Steer of Merit program, providing feedback on youth beef cattle projects for youth, parents, beef cattle producers, and county agents. The state Steer of Merit Committee meets annually to set industry-reflective standards for the following fair season.

Results

MSU researchers and Montana Department of Livestock researchers formed a taskforce to address this concern and develop strategies for vector mitigation. Through a series of conference calls, they developed recommendations and shared the information with Montana public. Two professors redesigned a university course in the Animal and Range Sciences Department to include social and video media. They incorporated agriculture and range science advocacy training into the course, which has allowed a broad audience to have access to advocacy materials. Several meetings were held across the state with regional, local, county and state livestock, farm and ranch boards concerning livestock health.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection
902	Administration of Projects and Programs

Outcome #4

1. Outcome Measures

Number of ranches using beef quality assurance practices to manage animal health and well-being issues

2. Associated Institution Types

- 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)

Consumers are increasingly demanding more information about their food products. Producers are therefore working to track their livestock from conception to consumption. Producers are focusing on genetics, disease identification and prevention, and better feed management systems. MSU studies help ensure Montana producers raise safe beef while improving the quality.

What has been done

COA/MAES scientists and research programs allowed producers to document best management practices for raising and marketing calves. The program provides quality assurance certification, implements and documents bio-security plans on ranches, and provides informational outreach. Sheep and wool producers continued using targeted grazing to increase the competitiveness of Montana lamb and wool in the world market.

Results

During legislative testimony producers repeatedly shared the impact COA/MAES research had on their operations and how new technologies were saving money and increasing agricultural product quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

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 Programmatic Challenges

Brief Explanation

- Inadequate funding and technical support from partnering institutions and cooperators
- Inadequate moisture (rainfall, irrigation, snowpack) for crops to be produced, creating excessive variability
- Lack of full-time staff and part-time assistants
- Major interruptions in program development
- Reduced support from Montana crop and animal agricultural groups, conservation and wildlife groups, private industry, private donations, and other agencies

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Montana has 2.5 times more cattle than people providing the foundation for the number one industry in the State - agriculture. It is in this context that researchers design, implement,

and conduct research projects within the COA/MAES. Research in the Animal Health Program is critical to the industry in Montana and producers and consumers alike who count on the investigators to promote a healthy industry through their consistent research. Highlights for 2014 were:

- Advancements in knowledge of Staphylococcus Aureus in humans and livestock

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2013 Montana State University Research Annual Report of Accomplishments and Results

- Hired new faculty members, two of which are core users of new molecular tools
- Evaluated 256 animals through the GrowSafe system and added new equipment to MSU research center doubling the capacity of researchers to evaluate residual feed intake
- Conducted webinars, workshops, and seminars to share up-to-date information on animal health and quality assurance reaching audiences in excess of 2,500

MSU researchers evaluated electronic identification tags and are now emphasizing DNA tracking in the sheep and cattle industry. MSU hired two faculty members in 2012 to enhance DNA and genetics management and a rumen micro-biologist. At the Northern Agricultural Research Center researchers evaluated 276 replacement heifers and developing bulls through the GrowSafe System. Reproduction, longevity and RFI are evaluated and the data will be used for long-term tracking and monitoring of the livestock.

Through the use of EID tags producers are receiving carcass information and sometimes even feedlot information, allowing them to identify production characteristics for their herd and for individual bloodlines beyond typical ranch production traits. This information allows producers to position their production for the future and identify specific markets that fit their product.

Key Items of Evaluation

The Animal Bioscience Building combined with state-of-the-art laboratory equipment assisted in the successful recruitment and hiring of three new faculty members in the Animal and Range Sciences Department for the College of Agriculture. The new faculty include a beef geneticist, a range ecologist, and a rumen microbiologist. The College also purchased an Illumina MiSeq and is using it to help members of the Crow Indian Reservation identify sources of antibacterial resistant E. coli. A collection of biting flies (mosquitos and midges) have been collected for disease collection specifically for livestock producers. A model product was produced used for estimating environmental concentrations of insecticides used for adult mosquito management.

Educational aids and curricula were produced on adding value to beef cattle, these materials were presented 23 times to a total of 1,261 constituents in the North West region of the United States. Presentations for this program included state and agricultural extension agents, financial advisors, local business leaders and beef cattle and forage producers. Finally, data and research material was produced on a study regarding the commonality of *S. aureus* in the anterior nares of horses. MSU COA and MAES experienced significant faculty movement impacting this planned program, and several programs with remaining research goals have migrated with the principal investigators and their respective projects, outlined in the 2015 and 2016 Plans of Work.