

**V(A). Planned Program (Summary)**

**Program # 5**

**1. Name of the Planned Program**

Animal Production and Protection

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
301	Reproductive Performance of Animals	10%		10%	
302	Nutrient Utilization in Animals	10%		13%	
303	Genetic Improvement of Animals	0%		10%	
304	Animal Genome	0%		10%	
305	Animal Physiological Processes	0%		10%	
307	Animal Management Systems	45%		13%	
308	Improved Animal Products (Before Harvest)	0%		1%	
311	Animal Diseases	10%		15%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		2%	
315	Animal Welfare/Well-Being and Protection	5%		11%	
605	Natural Resource and Environmental Economics	10%		5%	
806	Youth Development	10%		0%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2014	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	15.1	0.0	9.5	0.0
<b>Actual Paid</b>	17.0	0.0	9.6	0.0
<b>Actual Volunteer</b>	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
780695	0	930076	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
780695	0	941199	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	3379877	0

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

Research programs to:

- Understand the processes that control/influence reproduction at the molecular and genetic level.
- Develop and test new cropping, grazing and feeding strategies for food animals.
- Develop and evaluate management/training strategies for race horses to reduce injuries.
- Add to the understanding of various food animal genomes by improving and integrating genetic maps.
- Understanding of the genetic and molecular processes that control/influence the immune system in food animals to create new disease detection and tracking technologies.
  - Develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.
  - Understanding of the environmental fate and biological effects of vaccines, steroids and other drugs fed to animals.

Extension activities to:

- Assist beef producers with implementing the mandatory electronic identification system and demonstrate methods to use the system to sharpen management skills.
  - Provide livestock producers with knowledge and skills to develop and maintain herd-health systems.
  - Provide animal industry with up-to-date animal health information.
  - Improve farm-specific environmental stewardship related to manure management, including developing whole-farm nutrient management plans, manure value, land use and neighbor relations.

### 2. Brief description of the target audience

Michigan animal producers, agriculture and natural resources industry representatives, animal pharmaceutical industry, animal welfare organizations, state agency representatives, state and local elected officials and the interested public.

### 3. How was eXtension used?

All MSUE field educators and specialists are encourage to be involved in eXtension through both the Ask an Expert and Communities of Practice (CoP). A total 3.59 fte's were involved in this area of animal production with 2.58 fte's funded through 3bc funds.

An example in this area is:

**Title of Question:** Toxicity of Sweet Pea to Equines

**Question:** I purchased grass hay that contains a small amount of sweet pea vines, flowers, and seed pods. I understand the pods are toxic to equines if eaten in large quantity but is there a problem with a small amount of dried sweet pea pods in horse hay?

**Response:** Hello,

I have not heard of cases where small amounts have caused problems for horses in dry hay. In researching a bit further, I came across the following link: <http://www.petpoisonhelpline.com/poison/sweet-pea/>

If you can easily see and remove them that might be best, not knowing what defining as small amounts, but a couple of pods likely won't hurt most horses.

Another example:

**Title of Question:** CL vaccine/test/treatment for goats

**Question:** I have recently put a goat down as she was infected with the CL bacterium. This has caused an intense bout of reading up on treatments and vaccines leading to three questions. Question one: in your opinion is there a vaccine you would recommend for goats (I am specifically looking at one offered on the Jeffers website that is specifically for goats)? Question two: is there any treatment whatsoever for CL? I am seeing some talk about using formalin (formaldehyde) injected into the abscess....(while this does not cure the infection it is supposed to prevent its spread). Question three: is there a reliable test that I can have done on the rest of my herd to determine who is/is not infected?

**Response:** CL is very contagious. Once an abscess is open the organism can be spread. Abscesses not only open through the skin, but can open in the lungs and mammary system as well. The organism is thought to survive for years in organic material. If the animal that you had "popped" an abscess on your farm it is highly likely that it was spread in your herd.

There are vaccines available for CL. It often comes with a CD-T vaccine. There is good evidence that these vaccines work well in sheep and goats (it is the same organism that causes the disease and can spread between sheep and goats). The key to elimination of the disease is to vaccinate the young animals before they become infected. Once infected an animal will be infected for life. Also vaccination must be done annually for several years after the last abscess is seen as the organism can live for years in the environment. Kids should be raised in heat treated colostrum and pasteurized milk as the abscess can also form in the udder and be passed on that way.

As far as I know injecting the abscess with formalin is not a legal treatment for CL and this should be discussed with your herd veterinarian.

There are blood tests that can be done to test animals for CL. Just remember that once an animal is vaccinated it will test positive for CL.

An evaluation of Horses Community of Practice 101 Purchasing and Owning on-line course found from analyzing 169 surveys that:

- 96% of the participants stated the course gave them a better understanding of purchasing and owning horses?
- 64% of the participants rated the course excellent
- 88% of the participants would recommend the course

A comment stated: "Thank you for offering this online course. The information provided was very informative. Made me realize how much I did not know!"

For more information about the course, go to: <http://www.extension.org/pages/9611/my-horse-university#.VRWJzi4qTP0>

## **V(E). Planned Program (Outputs)**

### **1. Standard output measures**

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	2775	8325	58860	117720

**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
<b>Actual</b>	2	38	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of research programs on animal production and protection.

Year	Actual
2014	36

**Output #2**

**Output Measure**

- Number of adult participants trained in animal management systems.

Year	Actual
2014	2775

**Output #3**

**Output Measure**

- Number of youth participants trained in animal management systems.

<b>Year</b>	<b>Actual</b>
2014	58860

**Output #4**

**Output Measure**

- Number of adult participants trained in animal diseases.  
Not reporting on this Output for this Annual Report

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Number of adult participants with increased knowledge about animal management systems.
2	Number of youth participants with increased knowledge about animal management systems.
3	Number of adult participants with increased knowledge of animal diseases.
4	Number of research programs to understand the processes that control/influence reproduction at the molecular and genetic level.
5	Number of research programs to add to the understanding of various food animal genomes by improving and integrating genetic maps.
6	Number of research programs to develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.
7	Number of research programs to understand the environmental fate and biological effects of vaccines, steroids and other substances fed to animals.
8	Number of research programs to develop and evaluate management/training strategies for horses to reduce injuries.
9	Number of research programs to add to the understanding of animal behavior and welfare.
10	Number of research programs to test new cropping, grazing and feeding strategies for food animals.

## **Outcome #1**

### **1. Outcome Measures**

Number of adult participants with increased knowledge about animal management systems.

### **2. Associated Institution Types**

- 1862 Extension

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	2702

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

One example in this area, a major customer to the local Turkey Producers Co-operative informed them that although they were currently supplying them with Antibiotic Free/No Animal By-product (ABF/NAB) turkey meat for their stores, unless they could achieve Step 1 Certification for Animal Welfare through Global Animal Partnership on each of the six farms that supply birds to them, they would no longer be a supplier. This would leave the Co-operative with ABF/NAB product available for sale without a secure customer. Certainly the product could be boxed and stored in frozen cold storage, but the value of the product would go down with the extra handling and expense of boxing as well as the cost of outside cold storage and transportation of the product.

#### **What has been done**

Working with 3 farm families, each owning 2 farms requiring the audit, I went through each line on the audit (187 individual line items). Where programs were necessary, I worked with each farm to write a program. Where training documents or forms were necessary, I worked with each farm to create them. Based on the flow of the audit, a manual with all of the necessary information in it was developed for each farm.

Prior to the audit a visit was made to each farm to conduct a 'mock audit' for the day. I assumed the role of the auditor as a practice for each farm to feel comfortable with where the information the auditor was looking for was located within their program. We also toured the farms to look at the things the auditor would be looking for during the audit and assess the overall readiness of the farm for the audit.

On the day of the audit, I was either present for the entire audit (including load-out of birds on one farm through the night) or I was available on the phone for questions that came up during the audit.

As audit results were available, I worked with each farm to make necessary corrective actions and submit them for review prior to certification.

**Results**

Each of the six farms received their Animal Welfare Certification. The result to the farms is as follows:

Allegan County - 2 farms

Montcalm County - 2 farms

Oceana County - 2 farms

Total of 15 finisher barns, each barn capable of 3 turns per year ( $15 \times 3 = 45$  flocks)

Each flock has 10,000 poult placed ( $45 \times 10,000 = 450,000$  poult annually)

Target 85% livability ( $450,000 \times .85 = 382,500$  finished birds annually)

Average finished weight per bird is 40 pounds ( $450,000 \times 40 = 15,300,000$  pounds annually)

ABF/NAB GAP Certified flocks are paid 0.07¢ more per pound than traditional flocks ( $15,300,000 \times 0.07 = \$1,071,000.00$  increase to Michigan Agriculture annually)

What difference did it make - public value?

Society has an ethical concern about the quality of life experienced by farm animals - consumers want to know where their food comes from, how it is grown, and what practices are employed. It is a current trend that customers are requiring farms to become audited - not just for marketing the compliance of animal welfare standards on their packaging. Reputable third party audits help both the producer and their customer in the eyes of the consumer. Helping Michigan farmers obtain animal welfare certification keeps Michigan Agriculture on the forefront of change in animal agriculture. Becoming compliant with third party Animal Welfare standards can in some cases help farms become more profitable as was the case above.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
307	Animal Management Systems
311	Animal Diseases



## **Outcome #2**

### **1. Outcome Measures**

Number of youth participants with increased knowledge about animal management systems.

### **2. Associated Institution Types**

- 1862 Extension

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	56101

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Youth are needing experiences that give them a real life understanding of supply and demand principles and a greater capacity to succeed in business in the future.

#### **What has been done**

One example to address this need, youth participated in a MSUE 4-H livestock auction where programming increased significantly that impacted those in the marketing projects. With new members, came new buyers and greater community understanding of MSUE 4-H programming. The kids worked to market their animals with area businesses and served on the committee to make decisions.

#### **Results**

The 2014 4-H Market Livestock sales topped \$190K. 105 animals were sold at the auction. A new record was set for price/pound for a lamb at \$16.50/lb. The news of the record sale made the cover of the weekly local newspaper and increased program visibility. Oceana County 4-H youth recognized the importance of a successful marketing plan and how competition can drive the prices higher.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
307	Animal Management Systems
311	Animal Diseases
806	Youth Development

### **Outcome #3**

#### **1. Outcome Measures**

Number of adult participants with increased knowledge of animal diseases.

Not Reporting on this Outcome Measure

### **Outcome #4**

#### **1. Outcome Measures**

Number of research programs to understand the processes that control/influence reproduction at the molecular and genetic level.

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Condition Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	7

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

Unless you are a strict vegetarian or lactose intolerant, chances are that dairy and beef products make up half of your diet. According to the U.S. Department of Agriculture, almost 40 percent of the average American diet is dairy, and beef makes up 10 percent. This makes these products an integral part of our lifestyle and our economy, this sustained productivity and animal health are critical issues to the cattle industry.

##### **What has been done**

Research to: understand the impact of animal agriculture on the modern society; develop new methods to improve fertility and reproductive efficiency in livestock; investigate potential effects of exposure to environmental contaminants in humans and animals, with an emphasis on reproductive performance; develop a local/regional pasture-based beef production system encompassing the entire beef production chain; and to assess the impact of Ovsynch on conception rates of lactating dairy cows.

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### **Results**

Researchers have identified genes in mice that appear to be important to egg quality and discovered that oocytes may edit the paternal contribution to progeny characteristics. They are also studying environmental stressors on the early molecular development of mammal embryos and ties to conditions such as attention deficient disorder, Type 2 diabetes, obesity and asthma later in life.

Researchers have been developing a cost effective tool to analyze specific elements, called single-nucleotide polymorphisms (SNPs), within a pig's genetic code. They insert a sample of genetic material, such as blood or hair, into the device, called a SNP chip. Probes then target each SNP with fluorescence technology. The probes glow different colors, denoting which SNPs are present, so the user can fully characterize an individual pig's entire genotype. Applying the SNP chip to an entire population of pigs, such as a farm herd, enables breeders to predict the genetic value ? the number of desirable traits ? of the pigs and dramatically increase breeding efficiency.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
304	Animal Genome
305	Animal Physiological Processes
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

#### Outcome #5

##### 1. Outcome Measures

Number of research programs to add to the understanding of various food animal genomes by improving and integrating genetic maps.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2014	3

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Genetic maps are an integral part of several statistical models that are commonly used to find disease genes. A better understanding of these maps will allow for the development of increasingly accurate models that will provide researchers and producers with reliable estimates in a practical amount of time and will greatly enhance disease prevention and treatment efforts.

#### What has been done

Research to: develop methods for producers and consultants to evaluate dairy herd performance and assess trends for herd life and culling rates; develop a new set of tools and reagents to study autologous cell therapy using a new large animal model; and to develop and adapt statistical and computational methods to link phenotypic variation to genomic variation.

#### Results

We have made significant progress towards achieving our goals by providing a basic understanding on how the genes Sox2 and Cdx2 regulate early differentiation in the bovine embryo. Specifically for the gene Sox2 we determine its spatial and temporal localization of the SOX2 protein, revealing that its expression starts at the 16-cell stage and then becomes restricted to the ICMs of blastocysts. To study the role of SOX2 during the early development of bovine embryos, we designed siRNA to target SOX2. We began by injecting this siRNA into zygotes; the rate at which blastocysts developed declined compared to ioninjected or scrambleinjected controls. When only one blastomere of a two-cell embryo was injected with SOX2 siRNA, we observed development

rates similar to those of controls. Daughter cells of the injected blastomere were tracked by TRITC fluorescence and found to contribute to the ICM, as select cells also lacked SOX2. Gene expression analysis revealed a decrease in SOX2 and NANOG gene expression in siRNA-injected embryos, but OCT4 expression remained unchanged. We conclude that SOX2 localizes exclusively in the ICM of bovine blastocysts, and its downregulation negatively impacts preimplantation development; however, it is still unclear as to why downregulation of SOX2 in one cell of a two-cell embryo does not affect the composition of the ICM.

For the gene Cdx2, we found that the protein was present only at the blastocyst stage. To further understand the roles of CDX2 during bovine development, we depleted CDX2 mRNA and despite a significant loss of detectable protein, embryos were able to form blastocysts at the same rate as controls. Embryos lacking CDX2 did not show abnormalities in the number of trophectoderm, and inner cell mass cells, or total cells in the blastocyst.

Expression of the developmentally important genes SOX2, POU5F1, and NANOG, or TE markers such as IFN-T and KRT18 were not affected by the reduction in CDX2 levels, nor was the localization of SOX2 and POU5F1 protein. Using a functional barrier assay, we observed that the TE epithelial layer of embryos lacking CDX2 had lost its integrity.

Our results thus indicate that CDX2 is not required for TE formation during bovine development; nevertheless, it is necessary for maintaining TE integrity.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
305	Animal Physiological Processes

## **Outcome #6**

### **1. Outcome Measures**

Number of research programs to develop and evaluate new tools and strategies to detect, prevent and control emerging and reemerging livestock and poultry diseases.

### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	7

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Animal disease in the United States could seriously damage the livestock and poultry industries. For example, eradication of avian influenza in the United States following an outbreak in the mid-1980's resulted in the destruction of 17 million birds and cost taxpayers nearly \$65 million. The collective effort and vigilance of researchers, livestock producers, veterinarians and state and local government officials is needed to ensure adequate disease surveillance and to provide the needed resources to prevent, respond and/or eliminate disease outbreaks.

Keeping livestock free from infectious disease has been a concern since the first sheep and goats were domesticated in Mesopotamia almost 10,000 years ago. Sick animals produce less food, pose a risk to humans that consume their meat and milk, and threaten the health of the entire herd by spreading the contagion. After struggling to fight infection by quarantine and natural remedies, livestock producers began using antibiotics in the last century to combat disease with unprecedented efficiency. Antibiotic resistance is threatening to undermine the past 70 years of progress.

#### **What has been done**

Research to: develop new interventions to reduce antimicrobial resistance when treating animals with antimicrobial drugs and to develop a new non-antibiotic treatment for mastitis in dairy cows; determine the contribution of T2SS to biofilm formation in gram-negative human and plant pathogens' better understand parasitic and mutualistic interactions in a bacteria-nematode insect association; collect and screen for bacterial strains with antagonistic properties for food borne pathogens and test their efficacy; and improve immune recognition in order to protect against or

eliminate viruses and diseases such as Johne's disease.

### Results

Researchers found that regularly using antibiotic-medicated milk replacers on calves plays a role in resistance levels. Milk replacers are commercial substitutes for whole milk that are commonly used to feed calves on farms because they are typically less expensive and have less risk of contamination than whole milk. Taking a sample of Michigan dairy farms, all of whom initially fed calves with antibiotic-medicated milk replacers, researchers divided them into two groups. One group continued to use the medicated replacers, and the other switched to replacers without antibiotics. They then took samples from the animals and environments of each farm over the course of one year and found that, in the group without antibiotics, resistance had decreased.

Though the initial results looked promising, that soon changed. Those farms eventually began to experience a resurgence of resistance. Simply eliminating the use of antibiotics was not enough? new techniques would be needed. Currently, researchers are in the beginning stages of research to investigate new treatments for gastrointestinal disease in cattle that do not involve antibiotics.

## 4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

## Outcome #7

### 1. Outcome Measures

Number of research programs to understand the environmental fate and biological effects of vaccines, steroids and other substances fed to animals.

### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Condition Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2014	2

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Michiganders are an exceptionally vulnerable population due to their chronic exposure to complex mixtures of endocrine disruptors, which include legacy environmental contaminants (e.g., dioxin, PCBs, DDT) within the Great Lakes basin. A comprehensive molecular and physiological understanding of the interactions that may occur is critical to human health. Also, vaccines, steroids, antibiotics and other substances are added to animal feed to improve growth rates by controlling parasitic and bacterial diseases. With the recent major expansion in concentrated animal feedlot operations, the potential risks from these operations must be assessed.

Much of the Western world appears on a mission to keep bacteria at bay. The increased use of antibacterial soaps and cleaning solutions has resulted in a billion-dollar industry that encourages consumers to destroy the microscopic foes inhabiting homes and workspaces to prevent the spread of illness and disease. What often goes unmentioned is the fact that the human body is home to roughly 100 trillion microbes living on the skin and in the mouth, nose and intestines ? and not all of them are bad.

#### **What has been done**

Research to: achieve a better understanding of the impact of animal agriculture on society by integrating the risks and benefits related to economics, environmental protection and human health; develop multistage hierarchical models to facilitate greater efficiency of inference in general mixed model microarray experiments; and to identify the environmental transformations undergone by animal feed additives and determine their environmental fate.

#### **Results**

*C. jejuni* infections are the most common cause of bacterial gastroenteritis in Michigan and are most often acquired when people consume raw or undercooked poultry, unpasteurized milk or contaminated water. Like *C. difficile*, *C. jejuni* colonizes the gastrointestinal tract and causes intestinal inflammation resulting in vomiting and diarrhea, and, for some, the long-term complications associated with GBS. A percentage of patients experience paralysis only in their limbs; in others, the paralysis advances until they can no longer breathe on their own, forcing reliance on an iron lung or respirator for support.

MSU Researchers were the first to use a mouse model to show that *C.jejuni* employs this molecular mimicry. Their goal was to learn more about the factors that facilitate the intestinal inflammation and destructive autoimmune response caused by the bacterium.

They also uncovered a second important insight about *C. jejuni*: the bacterium can evolve inside its host in real time.

It's widely understood that pathogens adapt to their environment by changing the genes they express through the evolutionary processes of mutation and selection, which preserve favorable genetic changes that help organisms survive. However, very little is known about how bacteria adapt during infection.

The lab made progress in exploring this area of microbiology by demonstrating that *C. jejuni* rapidly changes from one heritable genetic state to another in its host.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
307	Animal Management Systems
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
315	Animal Welfare/Well-Being and Protection

## **Outcome #8**

### **1. Outcome Measures**

Number of research programs to develop and evaluate management/training strategies for horses to reduce injuries.

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	2

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Due to improvements in nutrition, management and health care, horses are living longer, more useful lives. It's not uncommon to find horses and ponies living well into their 20s and 30s. Although genetics play a determining role in longevity, providing proper care and nutrition plays a key role in horses' health, performance and overall well-being.

#### **What has been done**

Research to: investigate ways to manipulate bone density and strength through mechanical loading to help prevent injuries to performance horses and increase the longevity of livestock; identify ways to manipulate the equine diet to optimize skeletal health and improve the overall welfare of horses; and to define the role that EHV-5 plays in the development of spontaneous equine multinodular pulmonary fibrosis.

#### **Results**

Oral supplementation of omega-3 (n-3) fatty acids (FA) may have anti-inflammatory benefits, which could improve health and performance of exercising horses. However, the effects of various sources and amounts of n-3 FA in healthy mature exercising horses have not been well documented. Thus, the objective of this study was to determine the effect of the supplementation



of differing sources of dietary long-chain polyunsaturated n-3 FA on health and performance parameters of horses. The increases in the amount of omega-3 fatty acids in plasma was also accompanied by a longer stride length after supplementation and hence appeared to ease problems associated with osteoarthritis. In further work, horses received one of three diets that differed in n-3 fatty acid profiles. The results of this study indicate that mature exercising horses free from osteoarthritis do not exhibit physiological anti-inflammatory benefits when supplemented with a low dose of omega-3 fatty acids over a 21-d period. This study suggests a higher dose of DHA may need to be offered. Alternatively, if feeding DHA at an amount lower than 30 to 35 g/d, supplementation longer than 21-d may be required to observe potential differences in plasma FA concentrations. To our knowledge, this is the first study to supplement n-3 FA in the form of DHA-rich microalgae (DRM) to exercising horses. As nothing is known about potential differences in bioavailability of a DRM source of DHA in the horse, additional research is needed with an amount greater than 28.4 g/d for a 21-d period of DHA to validate the effects of a DRM DHA source on metabolic effects of DHA in the horse.

#### 4. Associated Knowledge Areas

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

#### Outcome #9

##### 1. Outcome Measures

Number of research programs to add to the understanding of animal behavior and welfare.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2014	4

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Our society has placed increased emphasis on the welfare of research and exhibit animals. U.S. law now requires attending to exercise requirements for dogs and the psychological well-being of non-human primates. Animal welfare without knowledge is impossible. Animal behavior

researchers look at the behavior and well-being of animals in lab and field. Good animal welfare requires solid science that informs and directs policies and practices related to disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter.

#### **What has been done**

Research to: maintain and improve skeletal health in livestock and companion animals; identify management practices and environmental conditions, particularly for young animals, that allow expression of positive natural behaviors while improving animal welfare in the context of environmentally sustainable production systems; and to examine ethical issues in agriculture.

#### **Results**

research focuses on mastitis, a bacteria-caused inflammation of the cow's udder and the most common disease to afflict dairy cattle in the United States. According to the U.S. Department of Agriculture, mastitis affects 15 to 20 percent of Michigan dairy cows annually. For an average-size dairy farm of 187 cows, the disease can result in the annual loss of about 25,000 pounds of milk and an annual cost of up to \$10,000 in medical treatment. Severe cases can result in even greater losses along with long-term impacts on the health, welfare and fertility of the affected animals.

Part of this research is determining when antibiotic therapy is an appropriate tactic. Mastitis is caused by a wide range of bacterial pathogens, not all of which are susceptible to antibiotics. The most common agents of mastitis, streptococci and staphylococci, respond very well to antibiotics if caught in time. Other causes, however, do not. Establishing and following protocols for the daily operations of a dairy farm, from milking procedures to administering antibiotics to preparing feedstocks, is paramount to a healthy herd.

On the basis of a survey of the concerns and practices of more than 600 producers in Michigan, Florida and Pennsylvania, the team crafted an evaluation system to develop protocols and educational materials to help veterinarians educate farm employees.

#### **4. Associated Knowledge Areas**

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

#### **Outcome #10**

##### **1. Outcome Measures**

Number of research programs to test new cropping, grazing and feeding strategies for food animals.

##### **2. Associated Institution Types**

- 1862 Research

### 3a. Outcome Type:

Change in Condition Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2014	11

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

As production costs rise, environmental concerns increase and consumer expectations become higher, those involved in the agrifood industry are looking for ways to maximize reproductive and performance efficiencies in a way that is economically and environmentally sustainable, and that protects human and animal health.

#### What has been done

Research to: develop a local/regional pasture-based beef production system encompassing the entire beef production chain; investigate strategies to maximize milk production output and ecosystem functions in grazing dairy systems; mitigate the environmental footprint of animal systems; develop a local/regional pasture-based beef production system encompassing the entire beef production chain; investigate strategies to maximize production output (milk) and ecosystem functions (processes and services) in grazing systems managed under various scenarios for the optimization of automatic milking and pasture systems; better understand the mineral needs of the pig; and to evaluate the effectiveness of mannaniligosaccharides on egg production, egg weight and bird livability of laying hens.

#### Results

We evaluated the effects of propionic acid and glycerol that have similar metabolisable energy but different routes of metabolism on feeding behavior and dry matter intake of cows in the postpartum period.

We evaluated the effects of glucose precursors with different routes of metabolism as potential treatments for ketosis with cows in the postpartum period. We completed an experiment to evaluate the relationship between feed intake and the change in hepatic acetyl CoA content. We conducted an experiment to evaluate supplementation of chromium proportionate for the first 120 days of lactation. We completed an experiment to evaluate the effect of time of chromium supplementation on production and metabolic responses of cows in early lactation. Results have been disseminated to the scientific community at professional meetings, to nutritionists and veterinarians at nutrition and management conferences, and to dairy producers at meetings.

The development of improved grazing dairy systems for Michigan and the

upper Midwest requires the investigation of alternative strategies to refine milk production systems that are profitable and ecologically sustainable. In the context of grazing dairies utilizing AMS, this can be achieved by the collective implementation of forage (pasture/forage systems, irrigation), feeding (supplementation), animal (genotype, lactation) and grazing (stocking rates, allocation) strategies that optimize the labor, use of the land base, milk production and ecosystem functions and services. This project proposes the investigation of these strategies for the optimization of dairy systems utilizing AMS in concert with grazing. Breed had marked effects on the milk performance, feed efficiency and use of robotic milking in pasture-based farms. In turn, proper stocking rate management in concert with accurate supplementation with mixed ration was critical to managing pasture growth rate, forage utilization and occupancy and revenue of robotic milking stalls.

#### 4. Associated Knowledge Areas

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

During the 2013-2014 fiscal year, ABR and MSUE was able to start rebuilding some of its resources after several years of either flat or funding cuts at both the state and federal levels. ABR was able to **fill voids in its research and support teams by hiring quality, skilled people for a variety of positions ranging from farm managers and grant coordinators to faculty and research technicians. Much needed equipment and infrastructure updates were also conducted at many on-campus and outlying research facilities**, helping to keep operations to full capacity. In 2014, ABR and Project GREEN funds helped bridge operating budget gaps at five of the 13 outlying research centers, enabling the repairs of equipment and several buildings. Together, the organizations look to re-invigorate the MSUE presence at the 13 outlying research centers throughout the

state.

The **ongoing economic challenges** faced by Michigan continue to affect this planned program area. Consequences have included fewer new hires, delaying the award of new financial obligations, reducing levels of continued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants. Specifically, a 15 percent decrease in state funding FY2011-2012 coupled with a flat federal funding line for the following two years resulted in the elimination of 72 Extension educator positions across 83 counties, 22 academic and faculty positions on campus and 15 support staff. Administrative positions were reduced from 45 to 19 FTEs. Impacts on ABR came largely in the form of reductions in research infrastructure support. Investments in facility maintenance and equipment were postponed in an effort to avoid eliminating more than 45 research positions (faculty, support staff and graduate assistants) and one research facility had to be closed in light of the reductions. There were also fewer funds to seed research on emerging issues.

Recent **extreme weather events** also caused extensive hardship to the agriculture industry. The spring 2012 ranks among the most destructive weather periods in Michigan fruit production history, with crop losses valued at more than \$500 million. Peach production suffered a 95 percent loss; tart cherry, a 90 percent crop loss; apple production, an 88 percent loss; and grapes, an 85 percent loss. The summer 2012 brought the worst drought in Michigan since 1988 with many crops suffering substantial losses.

And the winter of 2013-14 brought a series of bitterly cold air masses rolled down from the Arctic, through Canada and into Michigan. The period between November 2013 and February 2014 was the coldest in Michigan since 1911 and among the five coldest periods on record in the state.

Together, MSUE and ABR continue to serve as the primary research and development arm for the agriculture and food industries in Michigan, valued at more than \$100 billion annually.

## V(I). Planned Program (Evaluation Studies)

### Evaluation Results

#### Research

As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of the research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and whether continuation funding and/or new dollars are appropriate and necessary as funds are available.

#### Extension

Another example of evaluation in this area included:

**Issue:** Youth need to learn about basic information regarding dairy cattle that will help them in critical thinking, problem solving and caring for animals.

**What was done:** 4-H Exploration Days educated young people ages 11-19 and involves about 2,500 participants from all parts of Michigan. This session was designed to: teach youth about parts of the mammal eye; provide hands-on learning activities for youth through the dissection of a cow eye; and allow students to tour the MSU Dairy Teaching and Research Center to apply their knowledge of dairy cattle.

**Results:** Evaluation results found: 100% of the participants agreed or strongly agreed that they were more knowledgeable about animal science; 88% felt more knowledgeable about entrepreneurship and career opportunities in animal science-related fields; and 92% planned on applying the meat science knowledge and skills from the session.

## Key Items of Evaluation

### Research

Keeping livestock free from infectious disease has been a concern since the first sheep and goats were domesticated in Mesopotamia almost 10,000 years ago. Sick animals produce less food, pose a risk to humans that consume their meat and milk, and threaten the health of the entire herd by spreading the contagion. After struggling to fight infection by quarantine and natural remedies, livestock producers began using antibiotics in the last century to combat disease with unprecedented efficiency.

However, with antibiotic resistance threatening to undermine the past 70 years of progress, another novel set of tactics is needed to ensure food security and safety. Michigan State University (MSU) AgBioResearch scientists from the College of Veterinary Medicine are working to develop new techniques aside from conventional antibiotics to fight and prevent diseases on the farm.

MSU associate professor of large animal clinical sciences **Bo Norby** has been studying antibiotic resistance on and off since graduate school. He began as a Ph.D. student at MSU measuring the impact of antibiotic elimination of resistance levels of bacteria in pigs raised on organic farms versus those raised on conventional farms.

**John Kaneene**, director of the MSU Center for Comparative Epidemiology studies the epidemiology and mechanisms of antibiotic resistance in both livestock and humans. One focus is on identifying the factors that cause resistance to form.

"By understanding the mechanisms and dynamics of antibiotic resistance, we can get a sense of the magnitude of the problem," said the MSU professor of epidemiology.

Kaneene has conducted research that found that regularly using antibiotic-medicated milk replacers on calves plays a role in resistance levels. Milk replacers are commercial substitutes for whole milk that are commonly used to feed calves on farms because they are typically less expensive and have less risk of contamination than whole milk. Taking a sample of Michigan dairy farms, all of whom initially fed calves with antibiotic-medicated milk replacers, Kaneene divided them into two groups. One group continued to use the medicated replacers, and the other switched to replacers without antibiotics. Kaneene and his team took samples from the animals and environments of each farm over the course of one year and found that, in the group without antibiotics, resistance had decreased.

### Extension

MSUE utilizes the Institute Work Teams for planning, evaluating and reporting. Work Teams in this area found:

#### Institute of Agriculture and Agri-Business

- 35,001 animal units adopting practices that manage risks
- 707 farms adopting practices that manage risks
- 139 farms adopting technology or tools to manage risks

- 200 farms adopting practices to increase yield, improve quality, or decrease inputs
- 7,084 farms adopting tools or technology to increase yield, improve quality, or decrease inputs