

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

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
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		10%	
204	Plant Product Quality and Utility (Preharvest)	10%		5%	
205	Plant Management Systems	10%		10%	
206	Basic Plant Biology	5%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%		5%	
212	Pathogens and Nematodes Affecting Plants	5%		5%	
213	Weeds Affecting Plants	5%		5%	
216	Integrated Pest Management Systems	5%		5%	
301	Reproductive Performance of Animals	5%		5%	
302	Nutrient Utilization in Animals	8%		5%	
304	Animal Genome	2%		5%	
305	Animal Physiological Processes	5%		5%	
306	Environmental Stress in Animals	2%		5%	
307	Animal Management Systems	15%		10%	
311	Animal Diseases	10%		10%	
315	Animal Welfare/Well-Being and Protection	3%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	39.7	0.0	126.0	0.0

Actual Paid Professional	26.3	0.0	169.4	0.0
Actual Volunteer	0.7	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
798097	0	2933547	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2212757	0	13102626	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
812604	0	17821760	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supported research in 2013 provided new information and strategies to support the major crop and animal production systems in Minnesota, as well as supporting smaller but growing operations, such as organic dairy. Research provided better understanding of new disease threats to both crop and animal producers. Building on previous genomic research breakthroughs, researchers used these tools to help provide the necessary basic and applied research to support the health of the global food supply. Along with ongoing and long-term research efforts, new technologies, such as robotics, remote sensing and precision agriculture were investigated for their potential uses in agriculture. Some specific examples of research results in 2013 include:

- MAES supported research has developed a technique for editing the genes of livestock. Researchers were able to produce a living cow that has 10-to-50 percent more muscle mass than its ancestors.
- Research on the potential of aquatic plants as a protein source for animal feed has opened the door for production of feed protein in countries that cannot produce sustainable amounts of conventional animal protein due to land and water constraints.
- Other research evaluated the use of near infrared reflectance to increase the precision of on-farm feed preparation.
- MAES researchers hosted the first U.S. Precision Dairy conference in 2013, which included national and international experts in the field, and panels of producers who are using robotic milking sensors and automated calf feeders.
- Soybean molecular breeding work has been extended to develop genomic selection prediction models for soybean cyst nematode resistance, along with other agronomic and disease resistant phenotypes. The work demonstrated that association mapping can be an effective tool for identifying resistance genes in diverse germplasm. This previously unexplored variation in SCN resistance will be valuable in breeding new and better soybean varieties.
- MAES supported researchers made a breakthrough in 2013 in the fight against porcine epidemic diarrhea virus. They developed a swine herd surveillance test, the first PEDV swine herd surveillance test in the U.S.
- Air sanitation devices are being used in the swine industry to decrease the risk of exposure to

influenza infections. A study to see whether commercially available sanitation devices were effective showed that they could decrease the number of airborne viral particles in swine housing systems by half, and therefore should be considered as part of strategies to mitigate influenza transmission in pandemic preparedness plans.

- Animal science researchers developed new feeding strategies for nursery calves raised in Minnesota winters, resulting in recommendations for increased feeding frequency and increased energy feeding. Research also determined that particle size of corn silage may be as important as the chemical composition of fiber fed to high producing dairy cows.

- Selection for increased milk yield has increased production per cow and altered many metabolic and physiological characteristics of the dairy cow. The U of M line of Holsteins, which has been unselected since 1964, produces about 4,500 kg less milk per lactation than contemporary Holsteins. For many years they have provided researchers with a model to assess impacts of selection on metabolism. Research in 2013 showed that our unselected versus contemporary Holstein animal model is a valuable tool to identify factors that regulate efficient conversion of nutrients to milk.

- Surveys and farmer focus groups revealed that weeds are the most critical management problem facing organic farmers who limit their use of herbicides. Past years MAES supported research developed cover crop systems, cultivation methods, and natural product herbicides to manage weeds. Research in 2013 found that fall-seeded radish cover crops can also be a tool for weed management in organic field crop systems.

- The brown marmorated stink bug is a new invasive pest to Minnesota. Little is known about the ecology and potential impacts of the bugs in soybean. In 2013 researchers conducted a caged field study that identified the scope of the potential danger of this pest, which had not been studied previously.

- In other agronomic disease research, scientists made progress in understanding resistance to sudden death syndrome in soybean cultivars and characterizing resistance to SDS in breeding lines and varieties.

- In our work to address significant disease problems of major crops in Minnesota, we have increased our effort on Goss's wilt of corn, a disease that is relatively new and is now spread across most of the corn producing regions of Minnesota. Researchers are studying survival in fields, hybrid resistance to this disease, and the diversity and characteristics of populations of this pathogen.

- One advanced experimental wheat line with high grain protein content, MN06028, was released as "Linkert" in 2013. Linkert is a mid-maturity hard red spring wheat with excellent straw strength and competitive grain yields.

- From July 2011 through June of 2013, the Mycotoxin Diagnostic Lab supported by MAES analyzed about 70,000 samples submitted by 45 scab research groups from 21 states. By analyzing mycotoxins, the project provided support to barley and wheat breeding programs to develop resistant scab resistant varieties, and to researchers to study disease mechanisms and to develop effective chemical and biological disease controls. Mycotoxin data provided gave researchers a means to evaluate the effectiveness of their efforts in fighting Fusarium Head Blight.

- Research on precision dairy systems showed the potential benefits to mid-sized dairies in Minnesota. Researchers analyzed a year's worth of data gathered from 52 Minnesota and Wisconsin dairy farms using robotic milking technology.

- MAES supported integrated pest management research has led to major advancement in crop scouting techniques. In 2013 researchers investigated the potential of using remote sensing in IPM. They found the technology offers a number of benefits in mapping the regional and within field distribution of insect pests. Researchers used sensors such as near-infrared cameras mounted on drones to take images of fields. Using drones to pinpoint specific locations of aphid-infested soybeans, for example, could lead to more effective and efficient scouting. In turn, farmers will be able to target pest treatments more precisely

- Newcastle disease is world-wide in distribution and a major cause of death in poultry. Two Newcastle disease variants are considered a substantial threat to commercial turkeys. Also of concern is the potential for either of these viruses to infect the increasing numbers of free range and backyard poultry. In 2013, researchers conducted serological analysis for Newcastle antibodies on predatory birds, including bald eagles, great horned owls, peregrine falcons and red-tailed hawks. Results led to

researchers to predict a higher disease infection rate in 2014, allowing for fair warning and preparation.

Extension. Educational forums designed and delivered by Extension's crops and livestock team in 2013 updated producers on research that maximizes profits, decreases environmental harm and addresses market concerns. Topics of special concern in 2013 included the following:

- An exceedingly wet and cold spring;
- Shortages and price spikes for forage that feeds cattle, horses and swine;
- Ongoing concerns about reducing nitrogen in order to protect ground water;
- Extreme weather conditions.

Crop production and livestock Extension education uses educational forums, one-on-one consultation, industry collaboration and web-based information to deliver content. Increasingly, the ag team reaches its audiences to address timely topics using social media and web content. Multi-disciplinary efforts combine the efforts of programming for youth, families and food systems across Minnesota.

2. Brief description of the target audience

The primary audiences are producers of livestock, commodity crops and small farms. Additional audiences are industry representatives who can assist in dissemination of valuable information. Collaborative relationships with state departments, local government jurisdictions and regulating agencies support and inform those who influence crop and livestock producers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	25251	109364	1529	0

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

Patent Applications Submitted

Year: 2013
 Actual: 4

Patents listed

- 8,399,187--Identifying Virally Infected and Vaccinated Organisms (new swine disease test)
- 1 Oat variety--Deon (high yields and crown rust resistance)
- 1 Wheat variety--Linkert (spring wheat with high protein and yield)
- 1 Soybean variety--MN0083 (conventional soybean with white mold tolerance)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	56	179	235

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Extension publications and presentations.
Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of Extension learning opportunities.

Year	Actual
2013	640

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants of Extension livestock and crop program workshops/classes and conferences will achieve significant learning gains regarding research-based knowledge and skills. (Target expressed as the percentage of participants who achieved significant learning gains as a result of attending Extension program workshops/classes and conferences.)
2	Participants of workshops/classes and conference sessions related to livestock and crop production will significantly improve their production practices as a result of attending the program. (Target expressed as a percentage of participants that significantly changed one or more of their practices as a result of attending workshops/classes and conference sessions intended to improve participant practices.)
3	Interventions will result in changes in conditions related to profitability, crop and livestock health or environmental conditions. (Target expressed as number of changes in condition reported each year.)
4	Research will support a more sustainable, diverse and resilient food system (Measure: number of new or improved innovations developed for food enterprises. Measure: number of new diagnostic systems analyzing plant and animal pests and diseases)
5	Wheat acreage planted in crops resistant to Fusarium Head Blight will become a significant percentage of wheat acreage. (Target is the percentage of wheat acreage.)
6	Research will provide information to help swine producers improve sow comfort and welfare.

Outcome #1

1. Outcome Measures

Participants of Extension livestock and crop program workshops/classes and conferences will achieve significant learning gains regarding research-based knowledge and skills. (Target expressed as the percentage of participants who achieved significant learning gains as a result of attending Extension program workshops/classes and conferences.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	83

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

As producers and land managers seek to maximize profits, increase efficiencies, stay safe and protect natural resources, science-based education supports decision-making. One example is Extension's pesticide safety program. Certification or recertification is required for all applicators of restricted use pesticides. Pesticide safety training supports this certification for commercial, noncommercial, and structural pesticide applicators, as well as private pesticide users.

What has been done

The Pesticide Safety program trains Minnesota farmers and other agricultural commodity producers. Program goals are to: 1) enhance public health and environmental quality; 2) improve the health and safety of pesticide application workers and their families; 3) encourage efforts among producers, industry, government, natural resource managers and the public to adopt economically and environmentally sound pest and pesticide management practices; and, 4) facilitate public discussion of pesticide-related issues.

Results

The quantitative outcome above reflects outcomes of all Livestock and Crops workshops at Extension. The following data was collected from the 2013 Private Pesticide Applicator Recertification Workshops through use of post-workshop surveys. Percentages were gathered from at least 29 or more workshops: 1) 79 percent said they know the steps they need to take and resources available if they should have a pesticide spill. 2) 84 percent of participants reported they were somewhat likely or very likely to continue or increase use of crop rotation for Corn Root Worm Management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
304	Animal Genome
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #2

1. Outcome Measures

Participants of workshops/classes and conference sessions related to livestock and crop production will significantly improve their production practices as a result of attending the program. (Target expressed as a percentage of participants that significantly changed one or more of their practices as a result of attending workshops/classes and conference sessions intended to improve participant practices.)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Interventions will result in changes in conditions related to profitability, crop and livestock health or environmental conditions. (Target expressed as number of changes in condition reported each year.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In a highly scientific industry, producers need the newest information about crop and livestock production. One example is the need to examine and manage nitrogen content using recommended fertilizer nitrogen rates.

With increasing costs for corn production and greater concern over environmental quality, it is critical that corn growers make sound decisions on purchased inputs. The most frequent and extreme cases of over-application of N in corn often occur in first and second year corn after alfalfa.

What has been done

MAES researchers conducted a statistical analysis using 259 site years of data from the literature and recent research conducted in Minnesota. They surveyed alfalfa-corn growers in Minnesota to quantify the extent to which they have adopted alfalfa nitrogen credits. During 2013, follow up educational presentations on alfalfa nitrogen credits to corn were given at five Extension workshops and at a program sponsored by a commercial soil testing laboratory. These presentations were given to producers and agricultural professionals managing over 1.9 million acres of land.

Results

According to participant evaluations, 55 percent of respondents said that they would modify future fertilizer nitrogen management for first year corn after alfalfa by much or very much. Assuming they reduce their applied or recommended fertilizer nitrogen rate by 40 pounds of fertilizer nitrogen per acre, and that first-year corn after alfalfa represents five percent of the cropland they manage or provide recommendations for, the educational presentation at these programs will cause growers to reduce fertilizer nitrogen use by 2.09 million pounds per year without reducing corn yield. This is an annual savings of \$1.15 million at \$0.55 per pound of fertilizer nitrogen. With this reduction in fertilizer nitrogen use, energy input to corn production will be reduced by 45.8 million megajoules per year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

213	Weeds Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
304	Animal Genome
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

Research will support a more sustainable, diverse and resilient food system (Measure: number of new or improved innovations developed for food enterprises. Measure: number of new diagnostic systems analyzing plant and animal pests and diseases)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A unique modern technology may have promise to improve the sustainability of Minnesota dairy farms. Precision dairy systems have grown steadily in the state.

What has been done

Researchers analyzed a year's worth of data gathered from 52 individual Minnesota and Wisconsin dairy farms using robotic milking technology. They found that individual dairy's robots may work a little differently, depending on the size of the herd, the age of the barn and other factors like the type of housing used. But researchers have found that precision dairy has kept some of the farms, especially in the 120-to-140 cow size, in business.

Results

Entry costs are steep, but it's possible that the technology's long run savings may end up preserving a bedrock piece of rural Minnesota, the mid-sized dairy farm. Along with providing vast quantities of information about the cows, useful for maintaining a healthy herd, the robotic systems free the dairy farmers from the tyranny of the milking schedule. Farmers who convert to robotic milking say they most appreciate the improved quality of life.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
307	Animal Management Systems

Outcome #5

1. Outcome Measures

Wheat acreage planted in crops resistant to Fusarium Head Blight will become a significant percentage of wheat acreage. (Target is the percentage of wheat acreage.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	60

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Wheat varieties in the region have been vulnerable to Fusarium Head Blight, a destructive disease of wheat and barley that puts crops, and thus food supplies, at risk. Gains can only be reached if access to improved genetics is matched with other inputs including the judicious use of fungicides and fertilizer inputs. This requires education and consultation with producers.

What has been done

Major efforts of MAES-supported wheat breeders over the past several years have focused on developing FHB resistant wheat varieties. For the past decade, Extension in Minnesota has used a multi-faceted approach to educate farmers and the crops industry to shift wheat production to varieties that are moderately resistant. Educational efforts have ranged from individual consultations to educational events.

Results

Varieties resistant to FHB now account for more than 60 percent of wheat acreage in Minnesota; varieties rated susceptible account for less than 20 percent. This region of the U.S. has the highest rate of adoption of FHB-resistant varieties, and Minnesota has the highest rate of adoption in the region. This result was lauded at national conferences. Yields continue to climb, with three of the highest state averages in three of the last five years. On average, grain yields increased nearly 1.5 bushels per year in the past 15 years. Yield resulted in largely the same grain quality. Protein content decreased less than 0.05 percent per year while test weight increased by just over 0.2 lbs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #6

1. Outcome Measures

Research will provide information to help swine producers improve sow comfort and welfare.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Gestation housing is one of the most important welfare issues in the swine industry. with the rapid development in regulation on sow housing, information on management strategies for group-housed gestation sows is in urgent demand. Group housing of gestating sows improves sow welfare by providing freedom of movement, but also induces aggression among the sows.

What has been done

In 2013 a study was conducted on a large-scale commercial farm to investigate the performance and well-being of gestating sows in pens which were retrofitted from stalls. The results suggested that performance and well-being of sows were compromised in pens, as indicated by decreased

farrowing rates and increased sow removal rates. The researchers concluded the limited floor space allowance and the competitive floor feeding system could be the problem. New management strategies were tested and found that smaller static groups of sows of 35-40 performed better than larger dynamic groups of 105-120 sows.

Results

Next, researchers investigated whether providing open stalls would be useful to low ranking sows as hiding spaces during mixing. Sows were video-recorded and results showed that sows in pens with open stalls fought less frequently and had fewer injuries than sows in pens without stalls. The results of this animal welfare research have been distributed nationally. Animal scientists, swine producers and extension educators are using the management strategies developed to improve sow well-being and production efficiency.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Crop and livestock production programs conduct in-depth evaluations for yearly events that have a broad impact and that will be repeated every year. The goal of these evaluations is to measure whether programs achieve educational goals, and to determine whether programs can be improved in regard to marketing, target audience, logistics, content, teaching or structure.

Generally, end-of-workshop surveys assess outcomes for crops and livestock educational opportunities. Pre-post questions determine the degree of learning gains achieved, and participants are asked to indicate the likelihood they will change their behavior. Sometimes, intentions can be extrapolated into the potential impact of the program. Questions also ask for participants' logistical preferences regarding workshop offerings in an effort to better reach target audiences with future programming. Demographic information is gathered to better understand who attends workshops and events.

Key Items of Evaluation

Behavior change that resulted from new knowledge influenced almost 348,000 acres

of farmland in 2013, and influenced 450,000 beef cattle.