2014 University of Minnesota Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

This report highlights accomplishments of the University of Minnesota's Agricultural Experiment Station (MAES) and Extension in 2014. Fifteen programs provide the organizing structure for reporting both MAES and Extension outcomes and to address NIFA priorities. Extension reports on both programs and initiatives as defined by structured program areas and NIFA priorities. MAES describes research conducted within the five U of M colleges that receive MAES funding. In many cases, research is interdisciplinary and integrated with Extension outreach efforts, and increasingly, involves partners from other states and stakeholder groups. Only one program in this joint Extension and MAES report, Youth Development, has no MAES components.

MAES: Summary of 2014 Activities

This report summarizes the effort and results of over 300 MAES-funded research projects conducted by over 250 faculty at five University of Minnesota colleges: College of Food, Agricultural and Natural Resource Sciences, College of Biological Sciences, College of Veterinary Medicine, College of Education and Human Development, and the College of Design. While the research efforts have been reported under program areas, the majority of this research is broad-based and interdisciplinary and has impacts under multiple programs areas.

This year saw the completion of several long-term MAES-supported research projects and researchers branching out into new territory based on previous discoveries or new interests. It also saw key leadership shifts with Brian Buhr officially named the new Dean of the College of Food, Agriculture and Natural Resource Sciences (CFANS), and thus the new Director of MAES, and Greg Cuomo stepping in as the deputy director of MAES. Significantly, a new position was established within CFANS with Phil Pardey becoming the first director of global research strategy- this position encourages the development of international partnerships and use of interdisciplinary problem solving.

New University-Wide Strategic Plan

In 2014, University President Kaler unveiled a new strategic plan for the University that focuses on solving "grand challenges in a diverse and changing world." Within the broader plan is a research specific initiative that identifies three initial research grand challenges, they are:

1. Sustainable, Healthy, Secure Food
2. Advancing Industry While Conserving the Environment and Addressing Climate Change
3. Building Vibrant Communities that Enhance Human Potential and Collective Well-Being in a Diverse and Changing Society

Significantly, all three of these areas have already been identified as high priority research areas by MAES. President Kaler also challenged each department to develop their own strategic plan which, in the case of MAES, is reflected in the POW and will affect future research priorities and reporting.

Broad-based Interdisciplinary Research

The University of Minnesota prides itself on the breadth and depth of the faculty and research taking place on our campus. As mentioned, much of the research funded by MAES impacts several program

areas and often requires collaboration between departments, and even colleges, at the University.

In particular, MAES research on climate change often involves researchers focused on everything from forestry and natural resources to crop management systems and crop breeding. Our newest Research and Outreach Center (ROC), The Hubachek Center became operational in 2014 and will allow for increased research on climate change and how it affects Minnesota's forests and natural resources. The Center is a 350 acre, well preserved forest bordering two lakes in the Boundary Waters Canoe Area.

MnDRIVE, as reported in previous years, is one way the University is leveraging research funding provided by the MN Legislature to encourage interdisciplinary solutions to problems facing Minnesota industries. The $18 million in annual funding goes to research focused on four broad categories in order to encourage collaboration they are: robotics sensors, and advanced manufacturing, global food ventures, advancing industry conserving our environments, and discoveries and treatments for brain conditions. 2014 was officially the first year of MnDRIVE research being conducted and saw 354 researchers collaborating on 120 funded projects.

In 2014, the MN Legislature approved funding for several research initiatives including $4.8 million to establish the Minnesota Invasive Terrestrial Plants and Pests Center on the St. Paul campus. Similar to the Minnesota Aquatic Invasive Species Research Center established in 2012, the new center will pursue research and educational programs in collaboration with government, nongovernmental agencies, the private sector, Extension, and other colleges and Universities. The mission of the Center will be to offer science-based solutions to pest invasions that ensure the protection of the state's healthy prairies, forests, wetlands, and agricultural resources.

Increased use of Technology

University researchers are also finding new ways to use technology for everything from plant breeding and pest management to developing safe clothing for first responders. Increased investments in technology at the University and finding ways to adapt existing technologies to provide new solutions for industries is an important component of MAES-supported research.

The need to be smart and efficient with research investments while continuing to build beneficial relationships between producers, private industry, and education is critical and has influenced technology and research facility investments at the University.

Research Focuses and Highlights for 2014

- U of M researchers are committed to exploring the issue of global food security, climate change, and agriculture on an international level. Several research projects are devoted to developing new varieties of crops that will be more resilient and adaptive to changing conditions.
- Alternative energy continues to be an important concern for researchers with projects committed to developing new sustainable energy from algae and other projects analyzing the trade-offs involved with current sustainable energy sources.
- As our nation's parents continue to adapt and use technology, social science researchers are exploring how new technologies are changing the ways families communicate.
- Invasive species are a growing concern in Minnesota with new pests threatening our state's waters, forests, and crops. University researchers are working closely with policymakers and conservation groups to limit the impact of emerging pests including the emerald ash borer.
- To address the effect of climate change on Minnesota plants, researchers are utilizing phenology and over 120 years of data to identify species that are vulnerable to climate change and develop mitigation strategies for the future.
- To satisfy needs for nutritious, appealing food, scientists are collaborating with plant breeders to use the plant genome to incorporate nutrition and flavor considerations in the wheat breeding process to develop wheat breads that maintain their quality and flavor with less salt and sugar.
- University economists are providing government officials with needed insights to protect Minnesota from the effect of future economic downturns.

• Research continues to increase its focus on underserved audiences including seniors, minorities, and low-income individuals. In 2014, 25 projects had components tied to underserved groups in Minnesota and internationally.

Extension: Summary of 2014 Activities

Service levels: In 2014, Extension program teams delivered programming to almost 600,000 Minnesotans. This includes programs funded by federal, state, local and grant funding, as well as nutrition education (EFNEP and SNAP-Ed) and Farmer Lender Mediation programs. Indirect contacts are defined differently by each program area. They often refer to unique visits to educational web sites, social media sites, listserves, or educational outreach. **Note: Extension's outputs reports for adults and youth served are typically unduplicated counts, and indicate program contact.**

In 2014, Extension continued to enhance the use of technology to reach constituents, as called for in the 2012 strategic plan. Online education, social media and mobile "apps" are supplementing content in each of the fifteen planned programs, and in many cases very traditional, long-standing program offerings are being moved online to expand reach or enrich experiences. As of 3/9/2015, U of M Extension is the first site listed in a search for "Extension Service" on DuckDuckGo.com, which does not tailor engine results to the location of the searcher.

Extension mobilizes volunteers across Minnesota, giving them the capacity to serve and protect Minnesota's land, water, children, families and communities. Extension volunteers provided at least 1,158,986 hours of service in 2014, the equivalent of 557.2 full-time staff. According to the Independent Sector, this service is valued at $28,174,950. This includes volunteerism leveraged by the Master Gardener program, the Master Naturalist program, 4-H programs, the Regional Sustainable Development Partnerships, and other Extension programs.

Outreach to underserved audiences:

While Minnesota is not as racially diverse as the nation as a whole, it is becoming more so. More than 18 percent of our state's residents are now persons of color, compared to only about 1 percent in 1960 (www.mncompass.org). Four of Minnesota's 15 planned programs have adapted programming and outreach to engage diverse populations, achieving participation near or above 18 percent being persons of color:

1. 54 percent of participants in 4H urban youth development programs are youth of color. Moreover, 16 percent of youth in 4H clubs statewide are youth of color. By attracting volunteers and partners from new communities, and offering a variety of youth development activities, 4H is impacting a wide variety of youth populations.
2. 49 percent of Building Healthy, Strong Families participants (family development and financial literacy programs) are Minnesotans of color. As described in reported impacts, specialized partnerships are replicating programs within trusted community organizations for various cultures across the state.
3. 46 percent of the adults and 44 percent of the youth in nutrition education programs are Minnesotans of color. Community-based outreach offer cooking, gardening and nutrition programming to SNAP-ED recipients, and are achieving impacts for low-income communities across the state.
4. A leadership and civic engagement educator has been assigned to work specifically in tribal communities to facilitate, educate, and improve community planning. As a result of this effort, as well as programming to integrate immigrants into civic life in southwest Minnesota, 25 percent of leadership and civic engagement programming reaches Minnesotans of color.
5. With support, coordination and funding from the Dean if Extension, the Native American Task Force supports local and regional educators who are engaging Minnesota's Native American Communities, . Because program offerings can only be offered after people in Indian communities trust the people and the programs being offered, the Native American Task Force convenes educators and specialists across program areas to nurture relationships on behalf of all of Extension. As reported in the past, this effort has resulted in specialized grants and educator positions to conduct work in Indian country. In 2014, 19

program offerings were convened directly with Indian communities as a result of past outreach. The educational efforts addressed financial literacy, STEM education, water quality, food systems, biofuels and biochar Master Gardening, health and nutrition, entrepreneurship, youth development, and community and economic development. In addition, 18 projects are beginning to develop relationships and engage Native American communities to learn about community program needs and adaptations that will grow the reach of future Extension programming.

Multi-state engagement: All of Minnesota's planned programs are engaged in projects, initiatives, evaluations or educational gatherings with other land grant institutions. For example, the water resource programs are collaborating with neighboring states that share water boundaries. Community economics educators have used funds from the North Central Region to share and borrow from economic development research in other states, and collaborative evaluation projects are being done by youth development and family development programs. Moreover, Minnesota is the current educational provider for the North Central Extension Leadership Development Program, which trains emerging and existing Extension leaders in land grant institutions in the North Central part of the U.S.

Strategic plan: The 2012 strategic plan called for greater attention to interdisciplinary work on priority issues. Extension identified three priority issues: Food Systems, Educational Disparities and Clean Energy. These three issues have direct ties to larger University of Minnesota initiatives, or Grand Challenges. In 2014, four projects received small grants to address these issue areas. These issue area investments have brought in diverse faculty from across the University as well as partners in communities that work with Extension staff on research and outreach projects. The projects funded in 2014 related to the priority issues were: 1) Healthy Bodies, Healthy Minds, Healthy Learners; 2) Economic Impact and Enterprise Benchmarking of Local Foods Enterprises; 3) Saving Native Pollinators; and, 4) The Fresh Connect Learning Laboratory.

Staff expertise: In 2014, 133 (132.5 FTE) highly specialized Extension educators delivered planned programs described in this report. In county offices, 31 local educators (28.5 FTE) and 163 (132.5 FTE) program coordinators deliver programs.

Merit review: Since 2008, an academic promotion process has been in place to monitor and reward educators' performance and scholarship. In 2014, ten regional educators and three local educators were promoted after rigorous peer review of their scholarship, teaching, and program leadership, as described in "Merit Review Processes."

Academic and scholarship ties: Partnerships with six academic affiliations assure funding or partial funding for 82 faculty, supporting 33.79 FTEs with Extension funding. Efforts over the years to improve the scholarship of Extension's program and staff have been successful. For the third year in a row, the number of peer reviewed publications published by Extension staff increased. This year, it increased by 11.1 percent.

County positions: Extension offers contracts to each of Minnesota's 87 counties so that local educators can develop, deliver, and evaluate county-based program delivery in alignment with local priorities. This county system works alongside Extension's regional system in Minnesota, and benefits from research and program planning of statewide specialists and educators. The degree to which counties invest in these positions demonstrates local endorsement of the value of Extension's work, especially as county governments make difficult budget decisions. While contract prices rose by 1.5 percent in 2014, investment in Extension programs for 2014 increased by 4.9 percent, with 68 of Minnesota's 87 counties (78 percent) increasing their county's allocation to Extension. With these new investments, the number of Extension FTEs assigned to counties increased from 116.45 to 118.57 for programming in 2014.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	303.9	0.0	388.8	0.0
Actual	305.7	0.0	457.5	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review

2. Brief Explanation

MAES. The merit review of research faculty supported by MAES funding occurs within each of the five partner colleges. The process follows standards established by the University for promotion and tenure, and explicitly includes an evaluation of research quality and impact. In 2014, 11 MAES-supported researchers in the College of Food, Agricultural and Natural Resource Sciences were granted promotion. Five were promoted from assistant professor to associate professor with tenure, and six were promoted from associate professor to professor.

The merit review process by which research projects are selected for MAES funding is also under the direction of the deans of the five MAES partner colleges, as members of the MAES deans council. The process varies somewhat by college. In the College of Education and Human Development, for example, in the Department of Family Social Science, all tenured and tenure-track faculty are offered the opportunity to prepare a proposal for MAES funding. The total amount of AES funding for research projects is divided equally between all approved MAES projects, which must undergo peer review.

In the College of Veterinary Medicine, MAES-related research projects are peer-reviewed by members of the CVM research committee, signature program steering committee members and ad hoc reviewers, selected based on their expertise in proposal subject matter. In 2014, the MAES-related funding was distributed across two signature programs: Research in Emerging and Zoonotic Disease, and Population Systems. The competition awarding these funds was open to all CVM faculty with MAES-related research. The College of Biological Sciences has a similar review process to select research projects for MAES funding.

Extension: In 2014, U of M Extension continued to manage its academic promotion process for all educators working in local and regional offices and specialists working in the Extension college. In all, ten Extension educators were promoted in 2014, and three local Extension educators were promoted after a rigorous review of education, scholarship, and outreach. Efforts to assist staff through the promotion process include peer learning groups and mentors who have successfully navigated the promotion process.

There are seven criteria reviewed for promotion within Extension's merit review system: 1) program leadership, 2) Extension teaching, 3) program management, 4) scholarship, 5) technical assistance, 6)

engagement, and 7) service. These seven criteria are weighted differently for Extension educators with rank (regional educators) and Extension educators without rank (local or county educators). Candidates choose which criteria will be the primary emphasis of their promotion dossier. Candidate dossiers are reviewed by peers in Minnesota and from colleagues in other states. Responsibility for the Extension promotion decision rests with the Dean of Extension, based on recommendations from a promotion review committee, Center Associate Deans, and Extension's Senior Associate Dean.

Promotion is neither automatic nor routine, and the decision is made without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status or sexual orientation. Promotion is awarded to recognize the level of the academic professional's contributions to the mission of Extension and the University, as well as to their professional field. Although tenure is not granted in U of M Extension, there are clear expectations that academic professionals will move onward in rank and will be recognized for attaining a higher academic rank.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Other (One-on-one interactions)

Brief explanation.

MAES. The research that MAES supports is defined by the five colleges that receive MAES funding. Those decisions are guided by stakeholders' input gathered through each college's research advisory committees. Feedback is also gathered from stakeholder groups on specific research areas. Besides the formal processes in place to identify stakeholders and gather input, other strategies are in place to elicit input for research decisions, such as the requirements for stakeholder input to be included in each proposal for Rapid Agricultural Response research project funding, and for Small Grains Initiative research project funds. Both those funds are managed by MAES. Other research-related committees bring stakeholders to the table for input and decision-making, such as the Agronomic and Horticultural Variety Review Committees and the Plant Licensing Task Force, which meet yearly under the leadership of the MAES director.

Each Research and Outreach Center across the state, supported by MAES funding, has an advisory committee which reflects the composition and interests of the local area. Also at the Research and Outreach Centers there are other specific stakeholder groups advising on particular programs. For example, the Southwest Research and Outreach Center has a program that is guided by an Advisory Committee of conventional and organic farmers, researchers and educators. Research advisory boards also exist in several academic departments in the College of Food, Agricultural, and Natural Resources Sciences, (CFANS).

The College of Education and Human Development maintains a formal Dean's Advisory Council, as well as an innovations Council focusing on issues of research, discovery, and application. The college strives to mirror its commitment to diversity in these groups, which draws from a number of community groups.

The nature of research requires that MAES maintain contact with stakeholder groups, and use their input to shape their research agenda. Many researchers volunteer to serve on national review panels so they can better understand issues and priorities at the national level.

Extension: This year, stakeholder engagement involved seeking input for the creation of new

county Memorandums of Agreement (MOA). The last MOA was a three-year agreement that ends in 2015. Counties currently invest $8,100,000 and another $5,949,828 in county support dollars for a total of $14,083,304. This is 20 percent of Extension's entire budget. To engage county stakeholders in the MOA decision, Extension utilized the ongoing Extension Advisory Committee coordinated by the Association of Minnesota Counties. A subcommittee was selected to understand MOA issues and to make a recommendation for future contract prices. In addition, Extension and AMC surveyed Minnesota counties to better understand current norms in county wages and wage increases. This research was done to create more congruence between current county and Extension practices.

Also, Extension's Regional Sustainable Development Partnerships (RSDP) used their ongoing stakeholder relations (described in Minnesota's 2013 report) to connect Greater Minnesota and the University. The Partnership uses governing boards composed of community members (75 percent) and University staff (25 percent) who meet throughout the year in each region. Work groups are also convened to set regional priorities and present ideas. A 2014 initiative used the power of the RSDP network to manage the Extension Reconsidered process. The University of Minnesota is one of 13 land-grant universities that participated in a process to reflect upon and envision cooperative extension's role and relevance across the whole of American higher education. Between May and October 2014, University of Minnesota Extension, in partnership with colleagues from Design Thinking at The UMN College of Design, developed and facilitated a series of six creative events using Design Thinking methods for Minnesota's Extension Reconsidered. The project was led by an organizing team and advised by a statewide leadership team.

Reviewers might also refer to our "Underserved Communities Report" above to see how Extension has collaborated with new Minnesota communities.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Needs Assessments
- Use Surveys

Brief explanation.

MAES maintains ongoing relationships with main agricultural and natural resource stakeholder groups formally by inviting them to be part of advisory groups, and informally, through contact with individual researchers in their research areas. Stakeholders are identified by their connection to the relevant research area.

For Extension Reconsidered, six events were conducted across the state. The events targeted the following participants:
EVENT 1: Twenty-five participants represented community and University interests. Of the four teams at the event, two took on a "University perspective" while the rest took on a "Community perspective" to address questions related to the past, present, and future of Extension.
EVENT 2: Seven participants represented the voice of regional Extension staff. The process included listening to the view from the field on possible future directions for Extension and the Extension Reconsidered project.
EVENT 3 (at the Rural Design Conference): An audience of 100 participants represented Extension staff, University staff and faculty, and community members. Speakers provided issue-specific content and commented on the future of the land grant mission in the next 100 years. A repeat of the Conference hosted 41 participants, including Extension staff, University staff and faculty, and

community members.
EVENT 4 (Interactive Listening Sessions): 33 participants represented citizen and county representatives from across the state who advise Extension in their role as county or program advisory committee members.
EVENT 5 (Statewide Leadership Team): 11 members of the Extension Reconsidered Statewide Leadership Team and Organizing Team represented University and community voices.
EVENT 6 (Extension Conference): 20 participants represented Extension staff from across the state. An additional breakout discussion held 10 participants.
The Extension Advisory Committee selected three county commissioners to review and approve all materials and to negotiate MOA decisions with Extension. These commissioners heard all relevant information needed to negotiate the contracts and consulted with key informants to make their recommendation.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public

Brief explanation.

MAES. While the majority of stakeholder input is collected through advisory committees and informal researcher contacts and events, there are other more formal opportunities for collecting this input including events where industry and stakeholder input is strategically sought.
One such example is the Allen D. Leman Swine Conference, an annual educational event for the global swine industry. Each year hundreds of participants from over 20 countries attend.

The Extension Reconsidered effort collaborated with Design Thinking at the College of Design. These University consultants use principles of design thinking to facilitate processes so that organizations can construct decisions and consider multiple perspectives. Design Thinking developed and facilitated a series of six creative events. The project was led by an organizing team and advised by a statewide leadership team.
EVENT 1 organized teams to consider the "University perspective" while the rest took on a "Community perspective" to address questions related to the past, present and future of Extension.
EVENT 2 used a process that listened to the view from the field. Staff provided feedback to the visiting team regarding the experience of a regional Extension office. Their feedback about the process informed a future event.
EVENT 3: tapped key informants through an Extension Reconsidered Plenary Session at a statewide conference. Participants drew from work in the fields of mental health, community action, corrections, and education, and experiences from the Southeast Regional Sustainable Development Partnership. An additional meeting used a process that integrated steps to empathize, define, ideate and prototype for the future.
EVENT 4: tapped seven teams to add perspective to the purpose of Extension, the promise of Extension; and "What should Extension do to deliver on that purpose and promise for the next 100 years?"

EVENT 5: integrated key learnings from the previous sessions to establish "Short Term Goals" and "Long Term Goals" for the Extension Reconsidered project in Minnesota. The brainstorm session also generated ideas integrating grass-roots community input, arts and humanities.
EVENT 6: used the Kano Model to identify the essential, the delightful, and things to set aside.

The Extension Advisory Committee considering the County MOA used: 1) a review of past pricing strategies and influences as far back as 2005 to consider precedent for future decisions; and 2) a survey of 87 Minnesota counties with regard to common practices in compensating the county staff who are colleagues of Extension educators. With this information, Extension and the committee presented offers for managing the future MOA.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

MAES research has been redirected to high priority areas by stakeholder input in decisions on the use of the Rapid Agricultural Response Fund and the Small Grains Initiative Fund, as well as other areas. Research across the University is being impacted by stakeholder and industry input through research funding programs that partner with Minnesota industries like MnDRIVE.

The Extension Reconsidered process was used to present eight key considerations to the Extension leadership for what Extension should become in the future, as well as recommendations of key priorities for future work and recommendations for next steps.

The Extension Committee process used county surveys to better align Extension salary processes with existing county salary procedures. The process allowed for positive negotiations and general consensus among the Advisory Committee and Extension leadership, establishing a future infrastructure for multi-year memorandums of understanding that will maintain stable Extension programs in counties.

Brief Explanation of what you learned from your Stakeholders

For **MAES.** Stakeholder input has led to an increased focus on interdisciplinary solutions and finding ways for researchers to interact and develop solutions across departments and even colleges. The development of new, as well as, the increased investment research centers that can take a broader interdisciplinary view of key research concerns including invasive pests is a direct result of stakeholder input.

The Extension Reconsidered process revealed the following key considerations for Extension as it charts the future. Participants shared they believe the future should nurture:
1. An Extension accessible to all that is inclusive, addresses equity and builds trust.
2. An Extension that is a go-to place of expertise for high-quality research and services.
3. An Extension that is innovative and flexible in its approach to the future.
4. An Extension that partners and collaborates with the community and across many sectors.

5. An Extension that uses community-based approaches tailored carefully and appropriately to the needs of community, both individual and collective.
6. An Extension that addresses grand challenges.
7. An Extension that addresses its own administrative structure and transforms models with leadership.
8. An Extension that preserves and leverages the past to inform the future.

The Extension Advisory Committee process discovered that Extension's past decision to keep county contributions level during the difficult Great Recession created goodwill that allows for ongoing future partnerships. The Committee also learned, and acted upon, the concern that Extension's salary processes be, to the extent possible, aligned with those county workers who are working alongside Extension staff.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
9005826	0	6406603	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8379698	0	6030262	0
Actual Matching	28401488	0	32183926	0
Actual All Other	26107764	0	45202707	0
Total Actual Expended	62888950	0	83416895	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	0

V. Planned Program Table of Content

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	Diseases and Nematodes Affecting Plants	5%		10%	
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%		3%	
304	Animal Genome	2%		2%	
305	Animal Physiological Processes	5%		2%	
306	Environmental Stress in Animals	2%		2%	
307	Animal Management Systems	15%		11%	
311	Animal Diseases	10%		8%	
315	Animal Welfare/Well-Being and Protection	3%		8%	
604	Marketing and Distribution Practices	0%		2%	
609	Economic Theory and Methods	0%		2%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	37.0	0.0	128.2	0.0

Actual Paid	27.8	0.0	160.8	0.0
Actual Volunteer	0.6	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**
878939	0	2310294	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2346655	0	12421590	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1122998	0	16699207	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supported research in 2014 provided new information and strategies to improve major crop and animal production systems in Minnesota, along with supporting niche agriculture issues like organic dairy. Diseases threatening our crops and animals remain a primary concern for researchers. New opportunities to use breakthrough technologies in agriculture continue to be explored including remote sensing, robotics, and precision agriculture.

A key consideration for livestock researchers at the U is animal welfare in animal production systems. Researchers are discovering how to increase profitability while providing producers with information needed to provide a better environment for the animals.

A key area of research for crop improvement is on uncovering the genotypic and phenotypic diversity within crop types. Modern breeding practices have led to many high yield crops becoming too genetically similar which raises concern for pest management and the effects of climate change. Researchers are responding by searching historical plant databases for key genes to reintroduce and using genomic selection to speed up the breeding process while maintaining genetic diversity.

Research highlights for 2014 include:

- Experiments were conducted to determine yield and quality of commercial field beans and soybeans. Twelve new varieties were tested along with nine top performers from 2012-2013 at five locations. Results will be used to identify varieties adapted to upper Midwest organic systems.
- A research project on Pythium has revealed 31 different species in soybean fields in Minnesota. This number is far larger than has been previously known and reveals, in part, why this pathogen has been so difficult to manage.
- Genetic mapping tools have been successfully utilized to isolate the soybean genes responsible for photosynthesis and trichome development.
- Two new QTLs in soybean PI 567516C were found to be resistant to SCN. Marker-assisted selection will allow these new genes to be used in future breeding.
- A study on seed treatments for wheat found that only one out of eight environments treated resulted in better initial stand compared to untreated controls. Furthermore, preliminary data for fungal isolations shows that while the seed and initial stand may be protected by treatment, mature plants are still susceptible to late-season infections.

• Genomic selection as a means of speeding up development of new wheat cultivars with desirable traits continues to move forward. Phenotype data was collected on lines in training and validation populations, and 90K SNP (single nucleotide polymorphism) genotyping was done.

• A field study was conducted to examine the distribution of soil borne diseases in commercial wheat fields in Minnesota. Fusarium Crown Rot was identified as the most prevalent root disease of wheat in the state.

• Researchers studying genetic markers for crop improvement found that every inbred line of barley crop surveyed contains deleterious mutations, on the order of 2,000 per inbred line.

• A study found that cultivated barley appears to have mosaic ancestry with genetic contributions evident from, and consistent with, adaptive contributions from wild populations.

• Researchers discovered the environmental association approaches being applied by evolutionary biologists are useful for identifying variants associated with precipitation and temperature variables in crop relatives. However, it remains that the most significant variants associated with climate adaptation are associated with chromosomal structural variation.

• A two-year study on fly management on organic dairy farms explored two alternative bedding forms - straw and sawdust compost. Results from sticky traps indicated that the number of adult stable flies in the area were statistically the same in both bedding situations. But the average straw bedding pile yielded 30,000 stable flies during the summer months compared to only 670 yielded from the average sawdust pile. Additional research on development time and survival rate is planned for 2015.

• Researchers investigating the presence of rotavirus H (RVH) in US pigs, identified RVH in 15% of fecal samples from 10 US states, suggesting that RVH has circulated in the United States since 2002, but probably longer.

• A test to develop foaming manure in the lab utilized long-chain fatty acids (LCFA) as surfactants to cause foaming. A high level of LCFA were found in the foam layer in foaming manure pits and tests showed adding and removing them in the lab change the ability for the manure to foam. More research is needed to determine where the higher levels of LCFAs are coming from.

• Research on levels of DDGS in feedstock has found that DDGS has minimal negative effects on pig health and does not cause Mulberry Heart Disease in young pigs.

• Continued research on sow welfare in group-housing systems revealed that producers may benefit from separating sows by age and weight as well as housing low ranking sows in smaller pens away from high ranking sows.

• Research continued on the development of a vaccine for Johne's disease. Researchers were able to isolate, expand, and sort dendritic cells from two cows.

• Efforts to enhance the reproductively efficiency of turkey found evidence that: (1) the premammillary nucleus (PMM) is a site for photoperiodic time measurement that controls the initiation and termination of avian reproductive seasonality, and (2) the GABAergic system has a prominent role in the regulation of light neurotransmission in the PMM. These findings can be used to find methods to increase reproductive efficiency by eliminating photorefractoriness in turkeys.

• In 2013, we mentioned a new partnership with APHIS to collect samples from double-crested cormorants during the 2013 breeding system. This year we can announce that preliminary analysis of the data has allowed the production of an 'atlas' of the cormorant's hypothalamus, and verification of the localization of primary structures, including the PMM, that is specific to the species.

• Researchers studying Newcastle disease collected and tested 359 cormorant eggs of which 304 (85 percent) tested positive. No outbreak of Newcastle disease took place in 2014 (despite historical patterns implying it would). Researchers hypothesize the high level of seropositivity in the eggs in 2013 and 2014 indicate that females were largely antibody positive both years which may have been indicators that no outbreak would occur.

Extension:

Minnesota crop and livestock producers faced challenging conditions in 2014 that Extension programs helped address. The difficult winter of 2013-2014 and a late, wet spring created planting problems. There was significant alfalfa acreage loss across the five state region and Canada, so Extension responded with

education on forage production and use. Minnesota farmers also saw increasing problems with herbicide resistant weeds in their corn and soybean fields. Corn rootworm caused more damage and the soybean cyst nematode spread further and infected more fields. Extension focused on finding and demonstrating new strategies for weed management, and Extension educators and specialists educated about the use of cover crops to improve soil and manage pests.
Climate change caused heavy weather events and some Minnesota fields flooded while others experienced drought. These challenges, along with smaller profit margins, increased farmers' interest in going back to the basics and paying close attention to management practices. Extension education offered farmers practical support to sustain their operations in changing times. Extension programs also explored new opportunities for using remote sensing and mining big data technology to give farmers more management options. This included, for example, the potential of using climate data for custom weather forecasts to predict the amount of precipitation by field and to establish estimates for weed emergence dates.
Some highlights of activities and outcomes from 2014 Extension programming:

- Severe summer weather caused hail damage to parts of southwestern Minnesota corn and soybean fields and Extension responded with an emergency Hail Clinic held at a farmer that had been hard hit. More than 160 local farmers, agricultural professionals and agency personnel attended. Extension crops educators and specialists were able to help advise growers on what fields could recover, what fields were a loss, and options for cover crops or replanting.
- Eighty-nine percent of attendees of Private Pesticide Applicator Recertification workshops reported that, as a result of the workshop, they were more likely to continue or increase the use of crop rotation for corn rootworm management. Ninety-seven percent reported that they were more likely to monitor pests and base their pesticide treatment on threshold levels.
- The Minnesota Hay Bank was formed in 2012 in response to increasing equine-related humane cases and historically high hay prices. By the end of 2014, it had distributed more than 222 tons of hay providing emergency feed assistance to improve horse welfare.
- The research and extension work done on compost barns in Minnesota has received international recognition. The Extension specialist in cow comfort was invited to speak on the program in Denmark and Brazil. As a result, Brazil now has more than 95 farms using a system based on U of Minnesota Extension recommendations, with adaptations for their environment.
- Extension educators and specialists explain the Minnesota agricultural industry to non-agricultural audiences who need to understand farm practices better for their own work. In 2014, the Extension beef team changed a producer-focused educational program into a food service industry program, renaming the program BeefU. This exposed food service professionals to production chain reality -- from the families that raise beef to the corporations that process it and sell it in retail outlets.
- An emergency forage research program was established at sites in southeastern, central and west central Minnesota. Producers were made aware of warm season grass options that have the ability to provide forage within as little as 35 days after planning.

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 specialists offered a webinar through eOrganic, an eXtension community of practice. More than 50 people attended from the U.S. and also some international viewers. The webinar recording is on eOrganic's YouTube page.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	52670	3780760	0	0

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

Patent Applications Submitted

Year: 2014
Actual: 1

Patents listed
201400242 3/19/2014 Linkert Wheat Variety

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	75	133	208

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
2014	3175

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	Development of new crop varieties will help Minnesota growers improve profitability
6	Research will provide information to support strategies to control animal diseases.
7	Extension will provide support in education and consultation to support dairy producers move to organic dairying. (Outcome is expressed as the amount of additional revenue generated by Minnesota dairy producers as a result of the organic market.)
8	Research will help booster the Minnesota barley industry by introducing new varieties and developing new industry opportunities for growers.
9	Research will provide information to help policymakers assess the feasibility of feeding the world's growing population in the coming decades.

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
2014	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Corn and soybeans are the most economically important crops in Minnesota, planted on more than 15 million acres. Glyphosate is the most widely-used herbicide, due primarily to the development of glyphosate-resistant corn and soybean. Repeated use exposes weeds to selection pressure, which leads to resistant weeds. Many weeds resistant to glyphosate are also resistant to other herbicides. Farmers need new and integrated weed management strategies to cope with the problem.

What has been done
An Extension survey found 80 to 100 percent of growers have found that glyphosate has not been performing as well as when they first used it. Asked how long they had been applying it, 63 percent said 20+ years. Extension programming educated growers about other options including rotation, hand pulling, mechanical weed control and manipulating planting dates. These management-intensive strategies require understanding of weed biology. Educators established local field plots and did cultural studies with six different crop rotations.

Results
In evaluations after training sessions, 40 percent of farmers said they are convinced they need to make changes in their cropping systems to manage weeds. These include better targeting of weeds, cultivation, and rotation with crops such as alfalfa or winter wheat that could disrupt weed resistance. Some of the traditional practices were shown to be less expensive and time-consuming than farmers think, especially when precision agriculture tools are added to the mix.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
206	Basic Plant Biology
213	Weeds Affecting Plants

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.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	98

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota has 26 million acres of farmland, but only 480,000 acres, or 1.5 percent, are cover crops. Cover crops aid in suppressing herbicide resistant weeds, help farmers manage fields experiencing heavy weather events and improve soil health. But Minnesota corn and soybean growers are unfamiliar with the possibilities as well as the technology for planting cover crops into standing corn.

What has been done
Extension crop specialists and educators developed a research and demonstration project that furthers knowledge about cover crop options and results. There is a wide range of cover crops available, but in some areas a farmer may have limited options. Specialists and educators put together a team including farmers and a local watershed district to plan a field day to share results from the project. About 185 farmers attended the field day, far exceeding original expectations.

Results

One hundred percent of evaluation respondents indicated they had a deeper understanding of the subject matter and 98 percent said they had situations in which they could use what they learned to change at least one of their practices. One farmer who decided to take Extension advice and use cover crops for the first time planted a new variety of oilseed radish. He left it through the winter with no tillage, and his summer soybean crop thrived. Extension's cover crop demonstration plots and education offer farmers options to maintain profitability, control weeds and nourish the soil. As a result of increasing interest in cover crops and the benefits demonstrated by Extension, an Extension crops educator was invited to Washington to testify at a soil health hearing of the House Agriculture Committee in September 2014.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants

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 Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Porcine epidemic diarrhea virus (PEDV) is a severe threat to the United States swine industry. The U.S. was considered free of PEDV until April 29, 2013, when U.S. PEDV cases were first detected in west central and eastern Iowa. Within weeks, PEDV was identified in central Illinois, Minnesota, and Colorado. The disease effects can be devastating because pigs have no immunity. Mortality rates of 100 percent have been reported in young pigs.

What has been done
Extension's success with controlling new diseases has always depended on sharing timely recommendations and information. With Extension involvement and cooperation, a voluntary group of Minnesota pork producers have met quarterly to encourage open dialogue about the health status of pig herds. This shared information can help contain a disease to single farm because of increased communication with veterinarians, feed delivery, manure haulers and any other industry that does business at pig farms.

Significantly, researchers confirmed that there is no relation between PCV2 levels and PEDV disease status. Thus PCV2 strategies do not have to be adjusted in the event of PEDV outbreaks.

Results
The quantitative outcome refers to all evaluated programs. The pig farms were able to redirect feed delivery, manure hauling, and pig-flow, which minimized exposure and transfer of the virus to other pig sites. Without this effort, many more positive cases of PEDV could have occurred. Locally, reducing the impact of PEDV disease will directly benefit the Minnesota pork industry, which is ranked second in production in the United States, and valued in excess of 6.9 billion dollars in gross income annually to the state of Minnesota.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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 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)
Obesity during gestation increases the risk for maternal and offspring health disorders in dairy cows. Obesity also increases the risk of cows experience gestational weight loss (GWL) which affects approximately 35 percent of dairy cows in the U.S.

What has been done
Researchers completed a multi-year study that included data from over 1000 cows and nearly 500 heifers. They compared GWL incidence among obese and normal weight cows as well as the effects of GWL on both dam and offspring before addressing the causes of GWL and potential solutions. They found a reduced concentration of IGF-1 (insulin like growth factor 1) is a key aspect of GWL and it has a damaging effect on to the immune system and health of the dam and by extension the health and development of the offspring. From this they developed a strategy to produce an elevated IGF-1 concentration during the prepartum period to correct the low concentrations observed in cows experiencing GWL.

Results
To date this new therapeutic strategy has proved to resolve the immunosuppression of the dam and has resulted in reduced incidence of infectious disease (metritis) and increased body weight and survivability of the offspring at birth. This strategy and the results were presented at the American Dairy Science Association meeting in July 2014 and have been shared with regional dairy producers and veterinarians.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Development of new crop varieties will help Minnesota growers improve profitability

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota being on the northern edge of where soybeans are produced means new breakthrough soybean traits and varieties developed by the private sector are not adapted to our growing conditions. Despite this, soybeans are now the second most valuable crop grown in Minnesota (after corn) with a production value of over $3 billion in 2014.

What has been done
U of M soybean breeders have concentrated on developing high yield soybean varieties with healthier profiles and desirable traits that are uniquely adapted to growing conditions in Minnesota. Hundreds of soybean varieties have been developed and released since the breeding program began in 1946, including six new varieties in 2014. Released varieties include both specialty use and general use soybeans and since the 1980s have incorporated key traits and disease resistance such as SCN (soybean cyst nematode).

Results
Since 1946, the number of acres of soybeans planted in MN has grown from tens of thousands to over 7 million acres. Soybeans are now the #1 agricultural export for the state and are used for a variety of purposes including food, animal feed, biodiesel, and other soy-based products.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
212	Diseases and Nematodes Affecting Plants

Outcome #6

1. Outcome Measures

Research will provide information to support strategies to control animal diseases.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Extension will provide support in education and consultation to support dairy producers move to organic dairying. (Outcome is expressed as the amount of additional revenue generated by Minnesota dairy producers as a result of the organic market.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1600000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The number of organic dairy producers in Minnesota continues to grow, and the state now ranks ninth in the country, with more than 200 organic dairy farms. This success story is due to Extension's efforts to change conventional dairy operations to organic.

What has been done
Seeing the potential for organic dairy markets, Extension began working with dairy producers seven years ago to convert dairy production to organic. Extension began working with five dairy farms to convert operations in 2007. The number of farms considering the option has grown steadily, and with Extension effort in 2014, four additional farms are posed to switch.

Results
Dairy farmers have said, "I wouldn't be farming if it wasn't for the change we made. The proof is in the profits. As a result of 600 dairy cows converted from conventional to organic, with the differential price between organic and conventional milk at about 17 cents per pound, $1.6 million of additional new revenue now comes to Minnesota's dairy producers every year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #8

1. Outcome Measures

Research will help booster the Minnesota barley industry by introducing new varieties and developing new industry opportunities for growers.

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)
Profitable barley production in the Midwest is dependent on growing barley varieties that are approved by the malting and brewing industries and meet their grain specifications. Barley production is at an all-time low due to the increased profitability of other crops that can now be grown in the upper Midwest. Additionally, the reemergence of barley diseases has led to a dramatic decline in barley production over the last 10 years.

What has been done
The University's spring barley breeding program focuses on varieties suited to the malting and brewing industries that are willing to pay a premium to farmers that grow a high quality crop. As such, the primary traits of interest are yield, malting quality traits, and disease resistance, in particular Fusarium head blight which renders barley unusable for malting and brewing.

In addition, a new breeding effort began in 2013 to develop two-row varieties which are desirable for microbreweries in Minnesota (as opposed to the six-row varieties that large national brewers prefer).

Results
Developing new and improved malting barley varieties for the Midwest directly impacts farmers by improving their profitability and helping to create a reliable grain supply for the malting and brewing industries. Recent barley introductions from the University have been popular with 'Robust,' 'Lacey,' and 'Quest' being grown on just under 81,225 acres in MN and ND in 2014 (representing 12 percent of the acreage planted). Additionally, an on campus tour with craft and microbrewers was conducted to show them the two-row breeding program and solicit feedback. Nationwide, craft brewing is a $10 billion industry, growing at a rate of more than ten percent per year. The number of craft breweries in the state has Minnesota ranked #20 nationwide. Craft brewers and two-row barley represent an excellent opportunity to revive Minnesota's barley industry in the coming years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms

204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology

Outcome #9

1. Outcome Measures

Research will provide information to help policymakers assess the feasibility of feeding the world's growing population in the coming decades.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Concerns over the long-run future of global food and agriculture have resurfaced in recent years. Spurred by population, income and biofuels growth, many expect agricultural demands to double by the middle of the century. Others foresee looming land shortages with needs of biofuel taking land needed to supply the food to the word's population.

What has been done
Economists at International Science and Technology Practice and Policy (InSTePP) addressed these competing concerns on the future of agriculture in a new study using the International Agricultural Prospects (iAP) model.

Using this model researchers see a future where agricultural consumption increases more modestly than many predict--by around 69 percent (1.3 per cent per year) from 2010 to 2050 using midline population growth projections. Key considerations that led to this conclusion are:
(1) According to the UN we have hit a turning point in population growth with (midline) 2010 to 2050 growth rates projected to be about half the rate of the previous half century.
(2) The world's population is aging. iAP indicates that countries with younger (under 20 years old) or older (over 60 years) populations tend to consume fewer calories on average.
(3) In 2010, the world consumed 7,145 trillion kilocalories of agricultural output as food. The model projects growth to 10,908 trillion kilocalories by 2050 with an additional 7 percent of calories coming from livestock sources.
(4) Biofuels production is projected to grow, totaling 303 billion liters in 2050 (versus 113 billion in 2011) but some of this land diversion will be limited by technological advances in the conversion of agricultural feedstocks to biofuel.
(5) In 2011, 62.4 percent of biofuel feedstock was sugarcane, which the model projects to grow to

73.3 percent by 2050 limiting the effect of increased biofuel requirements on corn, soybean and canola.
(6) The model projects crop yields to continue to grow but at a slower rate averaging an increase of 1.3 percent per year from 2010-2050.
(7) Forty-three percent of the world's suitable cropland was harvested in 2010. iAP projects between 41 and 56 percent of suitable cropland will be required to meet 2050 agricultural consumption.

Results
This new model shows how sustainably feeding the world's growing, more urbanized, and aging population may be accomplished over the next thirty-five years without disrupting the land currently used for forestland and meeting all increasing requirements for biofuel.

The model showcases how the task is doable but will require cooperation from U.S. and international policy makers, agricultural and environmental researchers, and even agricultural producers to be affective.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
604	Marketing and Distribution Practices
609	Economic Theory and Methods

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)

Brief Explanation

Goals were achieved, but programs changed dramatically to address extreme weather conditions.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension's Institute for Agricultural Professionals has a long history and has three large educational events at its core that are repeated across the state, providing agricultural professionals more than 50 percent of their continuing education credits. A 2014 evaluation looked at whether the program was reaching new and intended audiences and meeting the needs of participants. It showed the Field School for Agricultural Professionals has the highest attendance for first time participants, thus meeting the goal of the program to reach new industry staff. The 2014 Research Update for Agricultural Professionals was held at six locations across Minnesota, and results of the evaluations revealed that attendance was the fourth highest since 2005, with 410 participants. When agricultural professionals were asked about the number of clients and acres they had

contact with, they indicated they had on average 46 clients with an average of more than 46,000 acres. Thus, the program had a potential impact on 4 million acres across the state and surrounding regions. Seventy-five of respondents planned to use the session information to make recommendations to others, and 54 percent planned to share knowledge with growers and the public.

Key Items of Evaluation

Extension evaluated a major group of events for agricultural professionals held at six locations across Minnesota. The post-event evaluation indicates that agricultural professionals were each bringing information from the event to an average of 46 clients managing an average of more than 46,000 acres. Thus, the program had a potential impact on 4 million acres across the state and surrounding regions. Of the respondents, 75 percent planned to use the session information to make recommendations to others, and 54 percent planned to share knowledge with growers and the general public.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Sustainable Energy

☑ 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
131	Alternative Uses of Land	0%		10%	
401	Structures, Facilities, and General Purpose Farm Supplies	5%		10%	
402	Engineering Systems and Equipment	5%		10%	
501	New and Improved Food Processing Technologies	5%		5%	
511	New and Improved Non-Food Products and Processes	5%		35%	
601	Economics of Agricultural Production and Farm Management	0%		10%	
605	Natural Resource and Environmental Economics	80%		10%	
610	Domestic Policy Analysis	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	7.5	0.0	38.5	0.0
Actual Paid	15.9	0.0	24.3	0.0
Actual Volunteer	0.8	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**
289485	0	199045	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2305320	0	798250	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1050450	0	2518779	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Research in this program is providing a better understanding of the trade-offs, and intersections of opportunities for sustainable energy with agricultural productivity, and environmental health. The promise of various crops for use as biofuel is being tempered by an understanding of the complexity of natural systems, and competition from other energy sources. Sustainable biofuel production, and the effects of its use on pollution and even human health, makes this an increasingly important issue for researchers to explore.

Research highlights for 2014 include:

- Field research continued in southern Minnesota to evaluate 26 clones of willow for establishment, and biomass production. Several poplar hybrids are also being tested in tight spacing arrangements to determine their suitability as a biomass source.
- Researchers are responding to concerns of the invasive qualities of switchgrass, which is being increasingly bred with improved agronomic traits to support bioindustrial feedstock requirements, by creating factorial experiments in a recently restored prairie. Preliminary data suggests significant differences between switchgrass cultivars, and remnant switchgrass establishment in the restored prairie.
- An in depth study began on identifying the optimal residual regulatory framework for railroads to provide transportation for rural goods.
- A new hybrid hot-melt adhesive was introduced with much of the 2-ethylhexyl acrylate removed and replaced with biomass macromonomers (MMs). Using MMs has shown little to no impact on strength, and film optical clarity. However, peel strength increased by 90 percent with the addition of MMs.
- Researchers discovered the laccase activation process (discovered and reported on in 2013), can be bypassed given the enzymatic saccharification process itself is an efficient step to activate wood biomass for crosslinking in wood bonding. Upon grinding the saccharified solid residue exhibits bond strength that is 250 percent stronger than wood biomass which has not gone through the saccharification process. Wood bond strength of saccharified residues is 70 percent of that for phenol formaldehyde resin (a commercial grade wood adhesive), but researchers believe with a proper bonding agent they can increase this to 80, or even 100 percent.
- A study on the compostability of saccharified wood found that paper sheets comprised of saccharified and non-saccharified woody biomass were almost completely composted after 90 days of incubation. But binderless films exhibited a mass loss of about 50 percent, indicating the "plastic like" nature of the product. Deductility improvement lowered this to 27 percent.
- Researchers examined the potential of using wheat straw as a source of high quality fiber to replace recycled fiber. Two mechanical pumping processes were used to determine the response of straw fiber: (1) BIVIS screw extrusion process and (2) traditional Thermo mechanical pumping. While the BIVIS

process produced material with high shive content and low strength, the refiner based mechanical pumping process resulted in fibers with properties meeting, or exceeding the requirements.

Extension. Sustainable Energy programming from U of M Extension is primarily carried out through the Clean Energy Resource Team project (CERTs). CERTs is a statewide partnership with a shared mission to connect individuals and their communities to the resources they need to identify and implement community-based clean energy projects. CERTs activities in Extension are carried out with the following partners: University of Minnesota Regional Sustainable Development Partnerships, the Great Plains Institute, Southwest Regional Development Commission, the Minnesota Project, and the Minnesota Division of Energy Resources.

In 2014, CERTs demonstrated the significance of its work over time by publishing 145 new stories to its Minnesota Energy Stories blog. These stories included case studies about CERTs seed grant projects, highlights of successful projects, interviews with business owners who made changes to energy consumption with CERTs intervention, and summaries of tours and events that focused on clean energy options. Continuing its work in public education, CERTs hosted 28 events to highlight energy-saving opportunities through workshops, tours, and forums. Additionally CERTs connected with Minnesotans directly through 108 other outreach activities, including convening meetings with community-based organizations and presenting and hosting at tables for other events. CERTs also launched two new campaigns to change practices across entire industries. "Light Up Your Station and Save" assisted Minnesota's convenience stores in using LED lighting retrofits in their canopies. "Gobble Up Savings" assisted turkey farmers in securing funding for LED lighting retrofits in their barns.

Overall, CERTs programming is saving or offsetting 10.9 billion BTUs annually. This is equivalent to heating 136 Minnesota homes for an entire winter.

2. Brief description of the target audience

Extension programming through Clean Energy Resource Teams is delivered in seven regions spanning the entire state of Minnesota.Types of communities that CERTs works with include, but are not limited to, businesses, civic organizations, economic developers, faith groups, farmers, local governments, residents and neighborhoods, schools, and utilities.

Agriculture and natural resources industry representatives, biotechnology company representatives, policymakers, state and federal agency representatives, private citizens, and entrepreneurs.

MAES target audiences include all of the above, and also forest product industry, academic researchers including bio-engineering and forest researchers, and energy and land use economists. Also, agriculture and natural resources industry representatives, biotechnology company representatives, policymakers, state and federal agency representatives, private citizens, and new energy entrepreneurs.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	61958	155465	825	21508

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	20	20

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Seed grant dollars will provide opportunity and support for clean energy projects to occur in Minnesota communities.

Year	Actual
2014	7500

Output #2

Output Measure

- Workshops, tours and forums will provide unbiased information regarding energy efficiency and renewable energy to target audiences.

Year	Actual
2014	28

Output #3

Output Measure

- Subscribed members to the CERTs list serve will receive regular communication and education clean energy resources in Minnesota.

Year	Actual
2014	12005

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research will investigate and help develop novel sources of bioenergy.
2	Participants of workshops, tours and forums will report that they were able to make informed decisions about energy efficiency and renewable energy. (Target reported as percentage of those who took action.)
3	Activities will contribute to quantifiable annual energy savings, either through energy efficiency and conservation efforts or by offsetting current energy sources through the use of renewable energy. (Target expressed is the total number of million BTUs saved as a result of CERTs activities this year.)
4	Research will provide better understanding of the environmental trade-offs and human health impact of renewable energy sources.

Outcome #1

1. Outcome Measures

Research will investigate and help develop novel sources of bioenergy.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The desire for sustainable production of biofuels prompts the need to use non-food biomass feedstock, and green conversion technologies for biofuel production. A single acre of algae, because of its rapid growth rate, can produce over 5,000 gallons of biodiesel fuel per year--100 times as much as soybeans.

What has been done
University research related to algae as a biofuel source ranges from molecular genetics of algae species to growing and separating algae in wastewater to efficient methods of removing phosphorous from wastewater. First, researchers worked to identify high performance algae strains. Over 30 strains were screened with some growing well on wastewater. Second, novel cultivation processes and harvesting systems were developed and tested for efficient use of carbon and nutrient resources.

Results
Life cycle assessments are being used to show how the environmental performance of wastewater-based algae biofuels is generally better than freshwater-based algae biofuels. But, results show only algae biofuels produced from wastewater with a high nutrient loads can have lower environmental impacts then petroleum gasoline. Digestion wastewater has high levels of COD, N and P that make it ideal for this system. This research has resulted in the identification of promising new algae stains, and improved growth conditions for mass cultivation of algae, which resulted in efficient use and management of organics and nutrients in waste streams. Results have been shared with the academic community, and at on-site demonstrations with government officials and the public.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Participants of workshops, tours and forums will report that they were able to make informed decisions about energy efficiency and renewable energy. (Target reported as percentage of those who took action.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Specific target audiences have different means available for saving energy and using clean energy resources. Introducing new technology and its viability for everyday use can help people adopt new clean energy technology. Adoption will result from opportunities for business owners and citizens to share stories and take a look at options, and network with others who have made changes.

What has been done
CERTs hosted 28 events in 2014, reaching audiences such as farmers, small business managers, residents, local units of government and utilities. Each educational event includes content on specific topics such as efficient lighting, biomass energy, major mechanical upgrades, solar energy, and suggested actions Minnesotans can take to advance clean energy.

Results
CERTs carefully considers the likelihood of attendees to take action as a result of events. In 2014, intended adoption varied according to the event. For example, 45 percent of attendees at the Solar Powering conference were likely to start a solar project; 63 percent of turkey barn owners were likely to use LED lighting; 53 percent of those examining solar options were likely to adopt, etc. Past evaluations indicate, though, that only 30 percent of positive responders follow

through on a hopeful project. Considering this, approximately 1 billion BTUs of energy savings or offset is likely to result from attendees taking action after CERTs events.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Activities will contribute to quantifiable annual energy savings, either through energy efficiency and conservation efforts or by offsetting current energy sources through the use of renewable energy. (Target expressed is the total number of million BTUs saved as a result of CERTs activities this year.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	10860

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota's energy supply is not as clean, efficient, reliable, and affordable as it could be. Minnesotans spent $16 billion and consumed a total of 1,852.2 trillion BTUs of energy (electricity, natural gas, petroleum products, coal and biomass) in 2010 to supply energy needs. Energy use spreads across four main sectors: Transportation (26 percent total use for buses, automobiles), residential (23 percent total use), commercial (19 percent total use) and industrial (32 percent total use).

What has been done
CERTs works with Minnesota communities to connect them to resources, research-based information, and networks that advance clean energy projects. The goal is to help Minnesota meet energy efficiency and renewable energy goals, many of which were signed into law in 2007 as Minnesota's NEXT Generation Energy Act. The law requires Minnesota utilities to produce 25

percent of energy using renewable resources by 2025 and established a statewide energy conservation goal of 1.5 percent of annual retail electric and gas sales each year.

Results
CERTs quantifies total BTUs of energy saved annually through its campaigns, technical assistance, utility support and seed grants. The 2014 total is 10.9 billion BTUs in annual energy savings or energy offset by renewable energy. Among these efforts, CERTs' assistance to utility conservation programming resulted in 5.5 billion BTUs of energy savings. The "Recycle Your Holidays" lights recycling campaign resulted in 3 billion BTUs saved, and the 2014 Seed Grant Program saved 783 million BTUs by funding local energy efficiency and renewable energy projects. A program offering individualized technical assistance to rural small businesses and farmers resulted in the implementation of 14 solar projects generating 220 million BTUs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Research will provide better understanding of the environmental trade-offs and human health impact of renewable energy sources.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent concerns about the U.S.'s dependence on foreign oil, and the environmental impacts of fossil fuels have led to increased interest in finding domestic sources of energy. Corn-based ethanol, as an alternative to gasoline, has particular implications for the upper Midwest as this area supplies the U.S. with the majority of the corn grain used for ethanol, and is largely thought

to be a major contributor to future biomass production.

What has been done
Researchers wanted to understand more about the life cycle air quality impacts of ten alternatives to gasoline as they relate to human health--rather than climate change. To accomplish this they looked at all the stages of production, and use of a fuel, and determined how much people would be exposed to pollutants, calculated damage to health, and the economic costs associated with this damage. They then modeled the effects of replacing 10 percent of U.S. vehicles that currently run on gasoline by 2020.

Results
Results showed the potential for both positive and negative effects on human health based on the energy used. Corn ethanol combined with internal combustion engines and electric vehicles powered by electricity from coal had health effects that were 80 percent worse compared to gasoline vehicles. But electric vehicles powered by electricity from natural gas, wind, water, or solar energy were shown to reduce health impacts by at least 50 percent compared to gasoline vehicles. The most important implication of this research is that electric vehicles can cause large public health improvements, but only when they are paired with clean electricity. Research results have been shared with policy makers and regulators, as well as, those that work in the agriculture and energy sectors.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Appropriations changes
- Competing Public priorities
- Other (no factors)

Brief Explanation

The goal to accumulate additional BTU savings in Minnesota yearly is being achieved.

MAES. Researchers reported decreasing interest from stakeholders and a reduction in available funding for projects related to sustainable energy. Several noted they focused on project goals related to climate change rather than sustainable energy in 2014 for this reason. Lower costs of fossil fuels are believed to be a primary reason for this shift.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The CERTs evaluation plan tracks the intentions and follow through of those who are educated or receive seed grants for projects. With careful examination of reported intentions to use solar technology or LED lighting, for example, followed by examination, CERTs has learned they have created, to date, 10.9 billion BTUs in annual energy savings or energy offset by renewable energy. Ongoing evaluation has demonstrated that about 30 percent of those intending to make a change actually make the change.

Key Items of Evaluation

Ongoing evaluation has demonstrated that about 30 percent of those intending to make a change after a CERTs educational event actually make the change. Still, examination of reported intentions to use solar technology or LED lighting, for example, followed by examination, shows that CERTs has created, to date, 10.9 billion BTUs in annual energy savings or energy offset by renewable energy. This number has and will continue to climb each year. Last year, BTU savings was the equivalent of heating 130 Minnesota homes for an entire winter. This years' savings increased that to 136 Minnesota homes.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Climate Change

☑ 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
102	Soil, Plant, Water, Nutrient Relationships	20%		40%	
104	Protect Soil from Harmful Effects of Natural Elements	20%		25%	
123	Management and Sustainability of Forest Resources	20%		20%	
132	Weather and Climate	20%		5%	
605	Natural Resource and Environmental Economics	20%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	16.3	0.0
Actual Paid	0.0	0.0	52.3	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	762169	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	3000226	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	5723578	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES research on climate change is broad and interdisciplinary, utilizing both basic and applied research techniques. It ranges from climatology to forestry to water resources and agricultural products. Research has focused on three areas: building understanding on what is happening to our climate; mitigation--discovering ways to prevent warming from getting significantly worse in the future; and adoption--building resilience into forest and agriculture systems so they are less susceptible to disruption by changing climates.

Research highlights for 2014 include:

- Researchers have developed the first regional evaluation of the total greenhouse gas budget associated with agricultural activity in the Upper Midwest. The results showed a near-neutral impact on climate change and climate change studies in the Upper Midwest should include CH4 and N2O emissions, not only CO2.
- U of M researchers are exploring phenology as a way to measure the effects of climate change on Minnesota's plants and animals. Armed with 120 years of historical data housed at the U's Herbarium, University scientists recorded flowering, fruiting, and leafing dates from 11,489 plant specimens, representing nine different plant families. They were able to discover enough data to develop statistical analysis for 68 percent of their target species.
- Research work on proper levels of nitrogen (N) fertilizer to use while maintaining yield has led growers in irrigated sandy soils to increase their attention to the amount of N fertilizer applied to corn, as well as, the timing of these applications.
- Forest researchers studying afforestation and reforestation to mitigate climate change completed a simulation that showed there is not enough land available to house both forests and crops for food and feed. Looking at North America, the simulation found only British Columbia has a suitable environment for forest plantations that would sequester ample amounts of carbon.
- Scientists developed a new global model for simulating atmospheric nitrous oxide. An analysis is currently underway.
- A model developed to explore the effects of climate change on Midwest agriculture predicts that maize yield will decline in Iowa as temperatures rise. For every one degree Celsius increase, the model predicts a 4.6 percent decline in yield.
- Scientists exploring pennycress as an alternative crop, and weed management strategy, installed new water sensors in fall 2014 that will record soil water content for each plant row throughout the 2015 growing season.
- In an ongoing project working to establish new nutrient management guidelines for sweet corn and other specialty crops, experimental plots were established at the Southern Research and Outreach Center in Waseca with six various levels and types of N fertilizer.
- Researchers looking for alternative tree species to plant in Black Ash forests affected by emerald ash borer, found hardwood species, including swamp white oak, hackberry, and American elm, are able to survive and could be potential replacement species.
- A study on the effects of biomass harvesting on forest productivity indicates removal of harvest residues in aspen-dominated forests has little impact on soil carbon and nitrogen in the medium term (20 years). But forests developing following biomass harvests may develop at a slower rate than areas experiencing less intensive management regimes.
- A study on how minerals affect how soil stores carbon found that exotic earthworms significantly altered the carbon and nutrient cycle in Minnesota forests.
- Researchers completed a study on how Mesotrione, a new herbicide developed to control weeds in corn, interacts with E. coli. The results showed E. coli survived well in the presence of high concentrations of Mesotrione and the herbicide degraded after three hours of exposure. This study suggests there may

be a general adaptation built in that allows bacterial strains to resist damage from herbicides.

Extension. Minnesota is the fastest warming state in the nation during winter months. The average global temperature has risen about one and a half degrees in the past century. In Minnesota, the average temperature has risen about two degrees in the past century. Parts of northern Minnesota have warmed nearly three degrees. Cold weather species like moose and lake trout are disappearing. Maple trees are migrating north. Bugs that once were killed off by harsh winter conditions are surviving to threaten tens of thousands of acres of forest. Lake Superior is one of the fastest warming lakes on the planet. Compared to most other states, Minnesota has experienced faster temperature increases and greater increases in significant rainstorms. All of this has refocused Extension programming that respond to new pressures on cropping systems, greater soil erosion, new forest insect pests, and other changes. Efforts in response to the effects of climate change are reported in the Global Food Security, Water Resources and Forestry and Forest Products Program sections of this report. Efforts specific to Extension educational programming about climate change in Minnesota are reported here. They focus on a 2014 conference, "Building Minnesota's Capacity for Climate Adaptation."

2. Brief description of the target audience

Extension target audiences include decision makers and leaders responsible for preparing communities for change. This includes local government and policy makers, state and local elected officials, environmental groups, water and soil conservation district managers, local officials from watershed districts, the Minnesota Pollution Control, Minnesota Department of Transportation, state emergency managers, and educators.

MAES. Research target audiences also include audiences whose production systems will be influenced by climate change, as well as those who consult or influence the decision-makers of these growers and producers. Other specific audiences include producers and environmental groups, forestry groups, human health services, FEMA, and Extension educators working in food and nutrition, family and community life, and climatology.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	410	0	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	2	44	46

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Research will increase acreage devoted to studying climate effects on crops.

Year	Actual
2014	12

Output #2

Output Measure

- Extension will educate targeted groups, community leaders and citizens to increase knowledge and understanding of climate change issues. (Target expressed as the number of events.)

Year	Actual
2014	13

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research will develop new knowledge and technologies related to climate change. (Measure: number of new crop varieties and genotypes with climate adaptive traits; number of new assessment and management tools developed, including models and measurements; number of new climate relevant databases, monitoring systems and inventories managed or under development)
2	Extension will educate targeted audiences, community leaders and citizens on climate change issues.
3	Research will provide information and guidance to forest managers working to save northern forests from emerald ash borer and climate change.

Outcome #1

1. Outcome Measures

Research will develop new knowledge and technologies related to climate change. (Measure: number of new crop varieties and genotypes with climate adaptive traits; number of new assessment and management tools developed, including models and measurements; number of new climate relevant databases, monitoring systems and inventories managed or under development)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Feeding a growing world will require expanded agricultural production, which may require the conversion of grasslands and forests into cropland. Such conversions can reduce carbon storage, habitat provision and other ecosystem services which presents difficult societal trade-offs.

What has been done
Researchers collected data for 175 crops and pixel mapping of every 9x9 minute surface of the earth to answer how global food demands can be met without compromising carbon stores as ecosystem services. Their model allowed them to identify heavily farmed areas like the U.S. Corn Belt, parts of Western Europe, and eastern China, among others, and seek areas for potential extensification of agricultural land. Results showed the value of focusing on selective extensification in areas surrounding existing highly productive agricultural areas to limit carbon trade-offs while still meeting global agricultural demands in the future.

Results
By focusing on selective areas to expand agriculture in the future, researchers estimate they can save over $1 trillion (2012 US dollars) worth of carbon storage relative to proportional expansion. Study results have been shared with academics, government officials, and national and international agencies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
132	Weather and Climate
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Extension will educate targeted audiences, community leaders and citizens on climate change issues.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The evidence for climate change in Minnesota is convincing, and respondents to a survey of those who participated in the 2013 Climate Change conference reported they didn't need more information on the proof of climate change at the 2014 conference. "You don't need to preach to the choir," one participant said. Rather, they wanted information from Extension on how agricultural producers, forest managers, concerned citizens, and local communities could respond to the effects of climate change.

What has been done
Due to overwhelming interest, the 2014 Climate Change conference was moved to a larger venue to accommodate demand, and registration was capped at 250 to allow for maximum participation. Extension coordinated a statewide Climate Adaptation Partnership to host the conference, which presented case studies, examples, and strategies for responding to the effects of climate change in Minnesota. Break out sessions focused on recreation and tourism, watershed management, plant ecology, and agriculture.

Results

The conference received broad coverage in the media. Minnesota Public Radio produced a series of stories, and an Associated Press report was picked up by national media, including USA Today. A more important result was the action that participants reported they would take following the conference. For example, the Minnesota Department of Transportation has changed the way it orders pipe, so that they would be prepared for extreme flooding events. Participants said they would be taking tools, methods, and strategies presented to develop adaptive practices in their local communities and organizations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

Outcome #3

1. Outcome Measures

Research will provide information and guidance to forest managers working to save northern forests from emerald ash borer and climate change.

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)
Emerald ash borer (EAB) has killed millions of ash trees across the Midwest and Canada. In Minnesota, infestations have been found in the southeastern corner of the state and the Twin Cities metro area. Researchers and environmentalists are concerned how EAB will affect our Northern Black Ash forests which house nearly one billion ash trees on over one million acres.

What has been done
Researchers simulated an emerald ash borer invasion on a four acre plot in Chippewa National Forest. They "girdled" the trees, on the plot effectively killing them. In just two years, a dramatic change had taken place--a once fertile forest wetland was now a grass dominated wetland with flood conditions persisting for six to eight weeks longer than nearby forest areas. This new picture presents little opportunity for new trees to thrive--especially considering the joint looming threats of EAB and climate change. In another area of nearby forest sections of black ash were selectively cut down with the intent of leaving enough trees to control the water table, and allow for new species to take hold before EAB arrives.

Results

Findings suggest that hardwood species, including swamp white oak, hackberry, and American elm can survive on black ash sites, and could serve as replacement species. Several of these, while being resistant to EAB, are also traditionally found in southern Minnesota forests, and would be more adapted to a warmer climate. The thinning process is now starting in other areas of the Chippewa National Forest with plans to plant replacement species on over 4,000 acres. The plan is to shift the forest away from black ash before EAB takes hold.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
123	Management and Sustainability of Forest Resources
132	Weather and Climate
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Competing Programmatic Challenges
- Other (Reporting strategies)

Brief Explanation

Climate change knowledge is incorporated into many Extension programs, each with its own evaluation and management structures. This federal program is used to describe UMN's efforts to describe climate change as an educational topic.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

At our climate change event, evaluation focused only on the satisfaction of attendees, ideas for using the information, and ideas for future events.

Key Items of Evaluation

The overwhelming interest in gathering information related to climate change puts UMN Extension and research in a position of leadership throughout the state, attracting media and leaders from many sectors to educational discussions.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Health and Nutrition

☑ 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
501	New and Improved Food Processing Technologies	0%		20%	
701	Nutrient Composition of Food	0%		20%	
703	Nutrition Education and Behavior	100%		25%	
704	Nutrition and Hunger in the Population	0%		15%	
721	Insects and Other Pests Affecting Humans	0%		5%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		5%	
724	Healthy Lifestyle	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	9.5	0.0	38.5	0.0
Actual Paid	25.6	0.0	41.4	0.0
Actual Volunteer	2.1	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**
303419	0	467133	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1595836	0	2226523	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4971912	0	4754365	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. The research reported under this program covers all aspects of research efforts to improve the health of Minnesota children, and their families. This includes research on understanding the health benefits of various foods in our diet, as well as, work being done in collaboration with industries to improve the flavor, and consumer acceptability of more nutritious options. Several studies are exploring health and nutrition from the point of view of underserved populations in Minnesota including seniors, ethnic, and low-income groups.

Research highlights for 2014 include:

- A study on snack consumption among midlife women explored how the attitudes and motivations surrounding food impact healthy eating and dieting. In the study, normal weight women tried fewer weight maintenance strategies, had higher self-efficacy scores, and were also more likely to have more positive attitudes toward food. The study highlights the need for healthcare professionals to consider motivation, and attitudes, regarding food when advising midlife women on weight issues.
- Researchers studying the effect of heat on various oils discovered that increased heat, length of heat application, and the level of unsaturation in the oil was tied to increased formation of toxic substances.
- Researchers conducted a randomized, controlled-intervention to test nine behavioral economic strategies parents can use in the home to increase their children's vegetable intake. Results are being analyzed.
- Researchers working to develop rapid and sensitive methods for detection of SBAs in the environment were able to construct 3-D microfabricated scaffolds for bone tissue engineering.
- Food scientists were able to block the bitter compound catechin via Maillard chemistry, and thermal processing.
- Flavor specialists improved the flavor quality of UHT milk by using natural products from olive oil waste streams to suppress off-flavor pathways.
- Novel bitter compounds in whey protein in Cheddar cheese were identified, and reported, to play a role in the flavor perception of aged Cheddar flavor.
- Researchers discovered that some gastric bypass patients taking vitamin D supplements post-surgery experienced small improvements in their vitamin D status while others remained vitamin D deficient. Further research is needed to ascertain if these results can lead to a broader discovery on vitamin D as it relates to obesity.
- A study on milk- and soy derived proteins effect on blood pressure found no impact on blood pressure at the levels tested. Researchers also concluded a new delivery method for bioactive peptides is needed to continue such research (incorporating them into cookies was unpalatable for the study participants).
- Researchers found Eicosapentaenoic acid (EAP) enhances fatty acid storage, and energy dissipation

capacity in subcutaneous adipocytes, contributing in part to EAP's metabolic benefits.

- Building on previous work related to children's acceptance of whole grain alternatives when partnered with foods they already like, researchers identified Chinese chain restaurants as an ideal opportunity to introduce brown rice as a substitute for white rice. Consumption statistics suggest the availability of brown rice in Chinese restaurants would lead to increased patronage among brown rice eaters.
- A new whole-wheat pre-cooked alkaline noodle designed for the Asian market tested well for overall quality and taste compared to traditional pre-cooked noodles. The product is designed to satisfy customer's needs for a tasty and quick choice, with their desire for a healthier alternative.
- A study on children's snacking habits found snack choices are dominated by foods high in added sugar and energy. Nutritionists suggest substituting low sugar, whole milk yogurt paired with fruit or vegetables at snack times to increase consumption of valuable nutrients like vitamin D, calcium, and potassium which are traditionally underrepresented in children's diets.

Extension: To ensure program excellence and resilience as federal funding becomes less secure, Extension restructured its Health and Nutrition programs in FY2014. Minnesota SNAP-Ed funding, in particular, was on a downward trend due to the new formula for state allocations from the Healthy, Hunger-free Kids Act (December 2010). When extreme temporary funding cuts were sustained in FY2013, staffing levels were maintained for one full year before the restructure, tapping non-federal funds and cost-saving measures.

The restructure included an initial 40% reduction in staff, with plans for some level of restaffing. EFNEP was reduced in the Minneapolis-St. Paul metropolitan area with a third of the previous numbers of paraprofessionals at the outset. Eventually, there will be 3/4 of the previous number of paraprofessionals. SNAP-Ed moved to a regional model from its previous county-based approach. Initially, staff was reduced to a quarter of the previous number of field staff. Eventually, there will be approximately half the previous number of field staff. SNAP-Ed staff moved from an exclusive focus on direct and indirect education to a full range of complementary public health approaches at the organizational and community level, which also impacts direct contacts.

Extension, however, continued to monitor the impact of nutrition education programming on consumption of foods like low fat dairy and calcium, whole grains, fruits and vegetables, as well as positive changes in food shopping and preparation and physical activity. Programs proved to make a difference in the consumption of fruits, vegetables, low fat calcium, and whole grains among youth, teens, and adults. An evaluation of a comprehensive school-based program called Go Wild with Fruits and Vegetables revealed a variety of results. (See Evaluation Results.) The evaluation was extremely valuable in increasing understanding of the benefits and limitations of an intervention like this one.

2. Brief description of the target audience

- Children, parents, and other adults from low-income families.
- Professionals who work with low-income families.
- Members of Minnesota's ethnic minority groups who bring a history of food and nutrition based on culture and lifestyle.
- School personnel seeking assistance in implementing federal regulations and improving healthyl food choices of children.
- Increasingly, community organizations, policy makers, and public institutions.

MAES research target audiences also include:

- Researchers in diet, nutrition, and human health fields.
- Health practitioners including dietitians, nurses, and physicians.
- Food industries.

- The public.

3. How was eXtension used?

Nutrition education staff were part of an "Ask an Expert" panel and are active on communities of practice. They also utilize eXtension to search for information on topics related to health and nutrition.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	11354	79270	18960	31206

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

Patent Applications Submitted

Year:	2014
Actual:	1

Patents listed
61/982,228 6/5/2014 Methods of making modified alcohol containing products

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	9	60	69

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Classes will be provided in individual and group settings that teach about diet quality, food safety, food resource management and food security. (Target expressed as number of workshops/classes taught.)

Year	Actual
2014	2009

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Program participants will increase human nutrition knowledge. (Target expressed as percentage of participants who report knowledge change.)
2	Program participants will increase their skills in selecting and buying food that satisfies nutritional needs, managing food budgets and preparing affordable foods within the food groups. (Target expressed as percentage of participants who reported learning those skills.)
3	An increased number of program participants will use research-based information from Extension to improve their intake of healthful foods and engagement in physical activity. (Target expressed as a percentage of participants who self-report change.)
4	Research will support families, children and youth access to healthy foods. (Measure: Number of active research projects on families' ability to access healthy and affordable foods.)
5	Research will provide the technology and knowledge to improve food to increase healthy foods' desirability and consumption.

Outcome #1

1. Outcome Measures

Program participants will increase human nutrition knowledge. (Target expressed as percentage of participants who report knowledge change.)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Program participants will increase their skills in selecting and buying food that satisfies nutritional needs, managing food budgets and preparing affordable foods within the food groups. (Target expressed as percentage of participants who reported learning those skills.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	92

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
People with limited resources often run short on food at the end of the month. Some may not realize they can make healthier choices at the store that will affect how they eat at home. The choices and habits that children experience at home are known to affect eating habits throughout a lifetime, ultimately impacting health and well-being. Knowledge of what constitutes a healthy food choice is translated into behavior at the store and, ultimately, at home.

What has been done
Nutrition education classes taught teens and adults about shopping and cooking at home. Previous evaluations have shown that education should be reinforced over time and with multiple workshops, with learning and hands-on experiences, in order to change behavior. We measured the effects of six or more classes on managing food budgets and preparing affordable foods within food groups. The knowledge ultimately affected behavior change.

Results
Ninety-six percent of adults and 87 percent of teens increased their knowledge of ways to shop for and prepare food (average = 92 percent). Moreover, this knowledge related to some behavior

change: 30 percent of teens and 38 percent of adults reported changing their shopping and food preparation habits after learning about healthy options.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #3

1. Outcome Measures

An increased number of program participants will use research-based information from Extension to improve their intake of healthful foods and engagement in physical activity. (Target expressed as a percentage of participants who self-report change.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Home budgets, as well as life experiences, have prevented some families preparing food that can improve their health and well-being. Being exposed to the importance of healthy eating to avoid conditions like obesity and diabetes can prevent the ultimate negative outcomes of these illnesses.

What has been done
Nutrition education and SNAP-Ed programs promote and deliver community education to promote healthy nutrition choices. Longer-term education in community settings is emphasized in order to move people beyond knowledge change and into behavior change.

Results
Among those individuals who attended a minimum of six hours of classes, 40.33 percent improved their intake of healthful foods and engagement in physical activity. Adults showed the greatest change in eating vegetables and fruits. In addition, 49 percent increased their consumption of low fat dairy and calcium, 37 percent increased their physical activity, and 28 percent increased consumption of whole grains. To a lesser extent, teens increased their consumption of fruits and vegetables, and 41 percent increased consumption of low fat dairy; 36

percent increased consumption of whole grains, and 28 percent increased their physical activity. Finally, youth significantly increased their consumption of fruits and vegetables.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #4

1. Outcome Measures

Research will support families, children and youth access to healthy foods. (Measure: Number of active research projects on families' ability to access healthy and affordable foods.)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Research will provide the technology and knowledge to improve food to increase healthy foods' desirability and consumption.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the CDC, Americans eat twice as much salt as recommended. While the health risks associated with high sodium intake are widely known, many Americans won't sacrifice taste to eat healthy.

What has been done
Food scientists at the Flavor and Research Education Center are exploring how we can produce great and "salty" tasting products, with less sodium. Their research shows the first bite is significant as only 10-20 percent of the total sodium in food is released in the mouth. This means that 80 percent of sodium in food is wasted flavor-wise by being eaten, but not tasted. With this

knowledge, they developed a test to show how the sodium in bread dissolves in your mouth. From this data, researchers are finding ways to slow down the release of salt -- such as adjusting the interaction between salt and protein (which can cause salt to stick to food), thus allowing for an earlier release.

Results

Researchers believe they can formulate processed foods to have up to 40 percent less salt content without impacting the flavor in any way. This technology and knowledge will allow food producers to use significantly less sodium while keeping customers happy and away from the salt shaker.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
701	Nutrient Composition of Food
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

As noted in the introduction, health and nutrition programs were reshaped in 2013 and 2014 in order to ensure program excellence and resilience in the face of less secure federal funding. As a result, the number of adults served by Extension for health and nutrition programs decreased by 48 percent from 2013 to 2014, and the number of youth served directly decreased by 62 percent. In our plan of work for future years, we will describe program interventions focused more on community, organization, and policy outcomes that will stimulate more healthful choices at the family level.

MAES. Given the economic downturn in the grain-based industry researchers working to incorporate more whole grains in children's diets had difficulty funding plate waste studies. Additionally, challenges discovered within the food system in the delivery grain-based foods to schools and restaurants led us to not report an outcome regarding youth access to healthier food choices in 2014.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

During the 2012-2013 school year, 397 students at 22 elementary schools throughout Minnesota participated in seven Go Wild with Fruits and Vegetables classes taught by

Extension's SNAP-Ed Educators. An evaluation that concluded in 2014 used a protocol including group randomization into a treatment group, and a group with delayed treatment used as a control group. As part of the evaluation, students wore pedometers and answered survey questions about fruit and vegetable intake, physical activity and healthy habits. Parents also answered surveys about their children. During this evaluation we used various tools to measure BMI, physical activity, quality of life, and fruit and vegetable intake. There were four key findings:

1) **The program increased the propensity of youth to try new foods.** Parents raved about how their child was much more willing and excited to try new foods. Of all respondents, 48 percent reported that their child is more willing to try new foods. When children are excited to try new foods, they are more likely to find healthy foods they like. Parents explained that the school program reinforced discussions about healthy eating already happening at home, allowing for positive social influence. Parents also appreciated this new willingness, because it is less financially "risky" to buy foods that children had eaten and liked at school.

2) **Parents reported that their child's participation in the nutrition education program had healthy effects on other members of the family.** As children create healthy household habits such as food preparation, these habits are likely to become long term. Of respondents, 32 percent indicated that the program had influenced more people than just the child in the program, indicating that other family members were trying healthy foods.

3) Based on the Day in a Life questionairre completed by students, there was an increase in fruit intake between October 2012 and 2013. About a year following, the students maintained this habit of eating more fruits.

4) **However, there was an overall decrease in vegetable intake during the program, and vegetable consumption decreased in the year following.** This general pattern of increasing fruit intake to a greater degree than vegetable intake is consistent with other published research. Vegetable intake across the board is hard to influence. As a result, Extension will look at emphasizing the importance of vegetable intake during nutrition classes.

Key Items of Evaluation

An examination of a school-based nutrition education program found very positive results in causing children to try new foods. Moreover, the child's participation in the program had a positive effect on fruit intake during and after the intervention. However, vegetable intake decreased before and after the program. While many components of the program should be successfully replicated, designers will pay attention to more focused attention on vegetables.

V(A). Planned Program (Summary)

Program # 5

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
501	New and Improved Food Processing Technologies	30%		50%	
503	Quality Maintenance in Storing and Marketing Food Products	30%		50%	
504	Home and Commercial Food Service	40%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	8.6	0.0	6.0	0.0
Actual Paid	16.0	0.0	11.0	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**
518131	0	200242	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1701747	0	720985	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
614571	0	965941	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. With advances in technology, food safety research has become increasingly complex and interdisciplinary. University researchers are committed to assuring a safe food system for consumers while also delving into consumers increasing expectations for high quality and flavorful food. In 2014, MAES research on food safety issues provided new information and strategies that can be used by growers, processors, and manufacturers.

Research highlights for 2014 include:

- Work continues on engineering versatile Lactococcus lactis (L. lactis) to produce novel proteins that are useful to the food industry. Synthetic biology is being utilized to redesign genes based on the L. lactis codon to allow for efficient production of target proteins. A hyper-thermophilic beta-galactosidase enzyme has been produced using this strategy. This enzyme allows for efficient production of the novel prebiotic galactooligosaccharide (GOS).
- Researchers have identified two independent regulatory systems that regulate production of Nisin, a food grade lantibiotic that is used worldwide as a natural food preservative. Their next step is to mutate the IANRI gene Bifidobacterium longum DJO10A.
- Data indicates that barley beta glucan can be used in dairy systems as a gelling agent. Previously, it has been shown barley beta glucan is incompatible with the caseins in milk causing phase separation due to depletion flocculation. Research results indicate reducing the size of barley beta glucan molecules can prevent this.
- The University Imaging Center (UIC) facilities are an excellent example of advances in technology allowing for broader collaboration between researchers in various disciplines including food safety. In 2014, 420+ projects from 72 units utilized the staff, light and electron microscopy instrumentation at the UIC's three locations.
- Research continues on improving the use of NMR and MRI instrumentation for characterization of physiochemical properties of food ingredients and food products. Upon completion of the research tasks, it is expected a non-thermal processing platform will be developed and can be adapted for processing many food materials.
- A study on improving the quality and flavor of beverages showed food polymers can be used to produce nanoemulsions using microfluidization under high pressure. The results provide understanding of how manufacturing parameters and formulation influence the formation of nanoemulsions.
- Researchers working to validate the use of the Minnesota Easy Culture System II Bi-plate and Tri-Plate to identify common mastitis pathogens in milk have concluded that Bi-Plate and Tri-Plate results most reliable when used to classify infections in broad diagnostic categories such NG, GP, or GN. The Bi-Plate and Tri-Plate will have intermediate ability to identify infections as being caused by Staphylococcus spp., Streptococcus spp., or Staph. aureus.

Extension

The statistic that drives Extension's food safety program is the following: According to the U.S. Center for Disease Control, one in six Americans get sick each year from the food and water they consume. Annual foodborne illnesses cost $77 billion. Extension food safety programs in 2014 focused on having the most positive impact to lower the numbers.

Nine percent of jobs in Minnesota are in the restaurant industry, and the expected state job growth in the industry is 9.8 percent. This means many new employees will enter the workplace. Moreover, turnover is high. Nationally, the food service industry has a yearly turnover rate of 300 to 900 percent.

Four food safety Extension educators train food service industry managers and servers, as well as educate consumers. Extension's food safety certification course for food managers is offered in English and Spanish, in person and online. The Extension food safety program offers several classes that have evolved in response to success and need. For example, in 2014:

• Extension Educators developed a customized Cooking Safely for a Crowd webinar for Second Heartland Food Bank, which provides outreach to food shelves in 57 counties. Thirty volunteers and staff from food shelves and community meal programs participated.

• In response to the expansion and growth of high-speed Internet access in Minnesota, consumer food safety and food preservation outreach and education is delivered mostly online. The food safety website hosts 324 web pages for consumers and the food industry. The successful one-week Food Safety for Festival and Event Planners course is one example of a course developed into a hybrid online course.

• In response to the 2014 Minnesota safe food sampling legislation, the Minnesota Farmers' Market Association recruited Extension food safety educators to train farmers' market managers and vendors on how to provide food samples safely.

• Three educational videos were created to address frequent food safety errors. The need for these presentations was identified by health regulators from the Minnesota Department of Agriculture and Health.

• In response to a request for food safety employee training at an aquaponic farm, educators developed a Food Safety Training for Aquaponic Farmers curriculum. A food safety educator initiated a cross capacity webinar discussion to share experiences, connections, and best practices from economic development, agriculture, horticulture, nutrition, and food system educators.

Extension's food safety programs also help Minnesota food processing companies through employee training and plant food safety "process protection"; i.e., getting employees involved to create a culture of food safety.

2. Brief description of the target audience

Research supports the food development and food processing industries while the direct audiences of outreach efforts are food service workers (through relationships with the National Restaurant Association), food handlers in community locations, fishermen and farmers, and high-risk audiences through the organizations they trust.

3. How was eXtension used?

In 2014, the program team used eXtension to search for educational resources and to research issues related to 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	1837	649192	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	2

Patents listed

8,641,872 02/02/2014 Non-thermal Plasma Synthesis with Carbon Component

8,623,841 01/07/2014 Medical and Nutritional application of highly refined cellulose

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	19	19

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops or other educational events conducted.

Year	Actual
2014	95

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research will increase number of viable technologies to improve food safety.
2	Research will increase understanding of threats to food safety from microbial and chemical sources.
3	Participants of Food Safety program classes will achieve significant learning gains regarding research-based food safety knowledge and skills. (Measure is the percentage of participants who achieved significant learning gains.)
4	Participants of Food Safety program classes will significantly improve their food safety practices as a result of attending the program. (Measure is the percentage of participants that significantly changed one or more of their food safety practices as a result of attending classes intended to improve food safety practices.)
5	The Minnesota Department of Health reports an 18 - 20 percent decrease in critical inspection violations in establishments that employ a Certified Food Manager. Food Safety Education programs will certify food manager. (Measure expressed as percentage of pass rates.)
6	Research will increase international implementation and understanding of risk analysis in food safety.

Outcome #1

1. Outcome Measures

Research will increase number of viable technologies to improve food safety.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the U.S., soybean is recognized by the FDA as one of the big eight food allergens. While soybeans alone are not a major food in the American diet, soybeans are widely used in processed food products.

What has been done
Utilizing unique methodologies researchers produced glycated protein hydrolysate under industry friendly conditions. Chromatographic separation was optimized to retain all protein/peptides (glycated and non-glycated), and remove free sugars. The nutritional quality and bioactivity was maintained and advanced stages of Maillard reaction were not detected. Solubility and thermal stability of whey protein hydrolysate was enhanced upon partial glycation. Additionally, the antihypertensive activity of whey protein hydrolysates was preserved. Their findings demonstrated the possibility of using partially glycated protein hydrolysates in various products with enhanced storage stability.

Results
Their observations have confirmed that protein allergenicity can be decreased with limited exzyamtic huydrolysis and glycation. Results were presented at the Institute of Food Technologists annual meeting in June 2014 and at the 7th International Whey Conference in September 2014.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #2

1. Outcome Measures

Research will increase understanding of threats to food safety from microbial and chemical sources.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent outbreaks of gastroenteritis due to contamination of food crops have highlighted the need for more research on how food pathogens like Salmonella and E.coli interact with plants.

What has been done
University food scientists are exploring, through advanced genetic technologies, the interactions of Escherichia coli O157:H7 (EHEC O157) with lettuce and spinach. They determined that (EHEC O157) is able to persist for at least 120 hours on spinach leaves without any decrease in viability. They also identified genes relevant to E. coli interaction, survival, and attachment to spinach leaf surfaces. Genes involved in biofilm modulation (bhsA and ybiM) are upregulated in EHEC O157 (similar to what was found with lettuce). This indicates this pathogen utilizes similar mechanisms for different produce.

Results
Notably, researchers have been able to use models and protocols they developed during their work with lettuce and apply them to spinach. The data shows how EHEC appears to be able to exploit different routes of contamination for fresh produce using similar genetic networks, but with different timing. Understanding of the genetic principles that govern the abilities of food-borne pathogens is critical for the development of effective prevention strategies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #3

1. Outcome Measures

Participants of Food Safety program classes will achieve significant learning gains regarding research-based food safety knowledge and skills. (Measure is the percentage of participants who achieved significant learning gains.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New safe food sampling legislation was passed in Minnesota in 2014 to assure food quality in farmers' markets. The law paves the way for safe food sampling at farmers' markets for all vendors and food demonstrations without added licenses or fees. The Minnesota Farmers' Market Association recruited Extension food safety educators to train farmers' market managers and vendors how to provide food samples safely.

What has been done
The training was based on the needs expressed by asking farmers' market vendors, managers and trade association board members what they needed. The Safe Food Sampling for Farmers' Markets training reached 140 farmers' market managers and vendors. In addition, Educators developed materials for SNAP-Ed staff and conducted a webinar training for 38 Extension staff.

Results
Participants' determination to use food safety tools improved from slight before the course to great upon course completion. The success of the training session resulted in an invitation to speak at the Fall Minnesota Farmers' Market Association video conference and a grant to produce workshops in 2015.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service

Outcome #4

1. Outcome Measures

Participants of Food Safety program classes will significantly improve their food safety practices as a result of attending the program. (Measure is the percentage of participants that significantly changed one or more of their food safety practices as a result of attending classes intended to improve food safety practices.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	85

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Minnesota Food Code adopted by the Minnesota Department of Health and Department of Agriculture requires that food service establishments employ a Certified Food Manager. The manager must attend food safety training and pass a certification exam, and then every three years, they must take four hours of training to renew their certification. Since the food safety training for food managers has been required in Minnesota, there has been an 18-20 percent decrease in critical violations (unsafe food handling practices) during health inspections. Food safety education not only benefits the health of Minnesotans, but also the economy of the state. The average cost of a foodborne illness outbreak to a restaurant is about $75,000.

What has been done
The Serve It Up Safely Certified Food Manager Renewal Course, developed by U of M Extension educators and food science specialists, is the premier course that meets requirements set by the Minnesota Department of Health. In 2014, Extension taught 21 sections of Serve It Up Safely at 13 locations to 222 certified Food Managers; 378 people registered for the online version that has been updated to the changing federal food code. Eight additional food manager certification classes were offered in Spanish in 2014. In addition 29 two-hour onsite employee training courses were offered in Spanish.

Results
More than 85 percent of course participants responding to a survey said they made gains in keeping accurate and useful records and adopting new food safety techniques. For example, they reported designating a Person In Charge, setting up standard operating procedures, doing a

better job of record keeping (e.g., time-labeling food in coolers, recording temperatures of food and better cleaning and sanitizing.) They also reported training 1135 staff at their food service establishments since their last class.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service

Outcome #5

1. Outcome Measures

The Minnesota Department of Health reports an 18 - 20 percent decrease in critical inspection violations in establishments that employ a Certified Food Manager. Food Safety Education programs will certify food manager. (Measure expressed as percentage of pass rates.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	83

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Appropriate workplace behaviors and systems are necessary to keep the public safe from foodborne illness.

What has been done
As noted in earlier outcomes, Extension is the primary trainer for Minnesota's food serving industry. Ultimately, the learning and behavior outcomes result in certification that has been linked to the reduction of foodborne illness.

Results
Eighty-three percent of the participants passed the test and were certified.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service

Outcome #6

1. Outcome Measures

Research will increase international implementation and understanding of risk analysis in food safety.

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)
Risk analysis for food safety is used not only to produce and manufacture high quality food products but is also used for establishing international and national standards and market regulations. Use of risk analysis allows for the strengthening of food safety systems, and the reduction of food-borne illnesses.

What has been done
Researchers contacted professionals working in food safety in academia, government, and private sectors in Latin American and Caribbean countries by email, and surveyed them to access their individual knowledge of risk analysis, and their perceptions of its implementation in the region.

Results
From 279 participants, 97 percent reported a familiarity with risk analysis concepts, but less than 25 percent were able to identify its key principals. Reported implementation of risk analysis was relatively low at 46 percent. Industries from countries with a long history of trade with the United States and the European Union reported a higher degree of risk analysis implementation. This suggests commerce may be a driving factor for achieving higher food safety standards in the region. The results were shared with industry professionals and used to identify potential opportunities for collaboration at meetings in Puerto Rico.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Goals for Food Safety programs were accomplished.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of food safety program examines the degree to which education and certification programs change food management behaviors in the workplace and other places where there is "cooking for a crowd." By changing the precursors to outbreaks of foodborne illness, Extension programs decrease the likelihood of foodborne illness. In addition, program evaluators have been monitoring the degree to which materials and programs adapted for Spanish-speaking workers are achieving goals similar to those in English-speaking programs. In 2013, Extension demonstrated that participation in a four-part Spanish Certified Food Manager class resulted in passing rates 8 percent higher than national passing rates, and scores that were 5 percent higher than the average of national passing scores.

Key Items of Evaluation

As the primary food safety certification agent for the Minnesota Department of Health, Extension has successfully trained food service workers in food handling, resulting in demonstrated behavior and system changes in the work place. Adaptation of the program for Spanish-speaking food service workers has successfully prepared a growing number of employees to prevent foodborne illness. In all, 83 percent of food service workers are certified, a process known to decrease foodborne illness by 18 to 20 percent.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Water Resources

☑ 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
111	Conservation and Efficient Use of Water	10%		20%	
112	Watershed Protection and Management	40%		20%	
133	Pollution Prevention and Mitigation	40%		30%	
403	Waste Disposal, Recycling, and Reuse	10%		20%	
605	Natural Resource and Environmental Economics	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	10.8	0.0	29.0	0.0
Actual Paid	16.3	0.0	27.4	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**
531083	0	318427	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1747648	0	1611830	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
653803	0	1913865	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. From our ten thousand lakes to the great Mississippi River, water has been a key economic strength throughout Minnesota's history, and has helped to shape the state's identity. But our waters are constantly facing new threats from invasive species, climate change, and adjustments to land use. MAES research helps support Minnesota's water resources in a variety of ways including studies on erosion, drainage systems, and aquatic species.

One new project, expanding on previous work related to dissolved oxygen (DO) in trout streams, is exploring how winter dynamics play a role in DO concentrations, and aquatic insect populations.

Research highlights for 2014 include:

- Ninety-two species and 4,542 more specimens of Trichoptera were added to University of Minnesota Insect Collection.
- Research on invasive aquatic plants and their effect on water quality continued at several local lakes. Early season endothall treatments have been shown effective at two lakes in both 2013 and 2014 with no noticeable adverse effects on native plants.
- Field sampling was concluded for a long-term sediment redistribution project. Data analysis is underway to determine the effects of erosion, transport, and deposition of surficial sediments on the whole landscape carbon balance.
- A study of Minnesota compost sites explored the quantity and quality of sub-surface water under active compost sites, and at adjacent undisturbed sites. Overall, results indicated that water levels were low as contact water was not found in lysimeters under the compost piles following rainfall simulations. Surface water samples were analyzed for commercial organics, and none of the measured compounds exceeded drinking water Health Risk Limit standards set by the Minnesota Department of Health. Furthermore, 503 tested metals were only detected when yard waste was present, except mercury and silver which were not found above detection limits for any samples.
- Economists exploring how water scarcity and misallocations can negatively affect economies, and thus US agricultural trade, gathered data in eight African countries. Early results show that better water policy for agriculture will help spur African economies, and trade with the US.
- Research on reclaimed water, such as sewage sludge ash, as a source of Phosphorous for crops found that plants treated with sludge ash grew at a similar rate to those treated in a more traditional fashion. While some heavy metal concentrations were increased, the increases were not enough produce unsafe levels in either soils, or plant tissue.
- Work began on a rural stream hydrology handbook. It will be used as a tool by local conservation staff when working with landowners to explain the effects of land management on erosion.
- Researchers created maps using ArcGIS to show areas of concern along the Cannon River watershed. The maps are now being used by the Cannon River Watershed Partnership to work identifying places where soil, and channel restorations should be implemented by farmers and landowners.

Extension. Population growth, agriculture, home and commercial development, and new kinds of pollutants continue to pose challenges to Minnesota's water resources. Sewage systems, industrial regulations, and better technology have solved problems, but rivers and lakes continue to suffer. In 2014, Extension Water Resources programs helped Minnesotans tackle these issues at the local and state level, formed new collaborations with farmers and local water resource professionals and citizens, and educated public officials to increase the ability of local communities to address their water issues.
Some examples of activities and outcomes in 2014:

- A new Extension specialist, hired to focus on irrigation, worked with farmers who grow potatoes on irrigated fields, teaching them to save water while preventing runoff of excess nitrogen and other

nutrients. He demonstrated new technology to use current weather data from weather stations to measure crop water use and create individual field irrigation scheduling programs that update automatically, allowing them to irrigate only when necessary to conserve water.

• Extension water quality specialists worked with the Minnesota Agricultural Waters Resources Coalition (MAWRC), which has been collecting data on the impact of agriculture on water quality through its Discovery Farms programs. To date, the MAWRC has six Discovery Farms around the state--some monitored by the U of M, some by the MN Dept of Agriculture. As U of M Extension monitored one of the Discovery Farms, they found that a nearby city adding more sediment, phosphorus and other pollutants per acre into the local lake than the farm. The exception was nitrate, which was six times higher for the farm. To address nitrate levels, the farmer installed a woodchip bioreactor-- a 350-foot long underground trench filled with wood chips that filter nutrients from his runoff.

• The Dakota County agricultural water quality program has offered outreach and education about farming practices that can help protect water quality. This program was developed in response to nitrate levels in some local drinking water wells found to be above health limits. In 2007, the county Extension educator conducted a survey of about 350 local farmers. A follow up survey conducted in 2014 showed that farmer' adoption of conservation and nutrient management practices, such as establishing farmland conservation easements and using soil nitrate testing, had increased significantly. The survey results also showed adoption of practices developed since the 2007 survey, such as split nitrogen application and use of the Economically Optimum Nitrogen Rate.

• As part of Extension's Watershed Education Program, educators and specialists offered workshops on land use decisions and their impact on clean water. The programs were attended by city, township, and county level decision makers. One group of participants involved leaders from the Leech Lake Band of Ojibwe and students from Leech Lake Tribal College, bringing a new partner to the table for community problem-solving.

• Minnesota has more than 500,000 homes with residential onsite wastewater treatment representing about 30 percent of the population. Nearly half may not comply with states rules or be failing. Contrary to general public perceptions, properly designed and maintained onsite systems may provide at least as effective a level of treatment as a large municipal plant at an equal or lower cost. Extension's Onsite Sewage Treatment Program has been training professionals and the public in safe, cost-effective and environmentally sound waste water treatment practices since 1973. In 2014, it trained more than 1,700 professionals who design, install, inspect, and maintain onsite septic systems, helping to improve local waste water treatment and reduce lake and groundwater pollution.

2. Brief description of the target audience

Target audiences for Extension's Water Resource programs include local government and elected and appointed officials and their staff. Local government engineers and planners, consulting engineers, and architects are also targeted, as they help communities make decisions that impact Minnesota's waters. Farmers and natural resource and horticulture professionals are engaged as partners, learners and agents of change. Those who are engaged in septic system installation and maintenance are given training for certification. Homeowners are another key audience, including shoreland owners, lake association members, and volunteers.

Target audiences for MAES research includes soil and water scientists, geomorphologists, state and county regulatory personnel, farmers, landowners, drainage contractors, crop consultants, engineers, conservation staff, and environmental and conservation groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	11503	15998	0	0

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	1	5	6

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of products developed to provide useful information about shoreland, storm water and septic system management in web links, printed products and media.
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of educational events conducted about water quality, stormwater issues and shoreland management, revegetation and use of plants to maintain shoreland structures.

Year	Actual
2014	143

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Local decision-makers will know: 1) Where stormwater goes; 2) Major stormwater pollutants and their impact and 3) Components of plans, policies and practices their community could implement to maintain clean water and minimize impacts from stormwater.
2	Shoreland target audiences will practice one or more of five watershed friendly landscaping behaviors. (Outcome expressed as a percentage of workshop participants.)
3	Extension education, consultation, and training programs in onsite sewage treatments systems will help homeowners and local and state government to maintain Minnesota's water quality.
4	Research will uncover causes of non-point source pollution in Minnesota lakes and rivers.
5	Research will provide information for water flow restoration projects in the state.

Outcome #1

1. Outcome Measures

Local decision-makers will know: 1) Where stormwater goes; 2) Major stormwater pollutants and their impact and 3) Components of plans, policies and practices their community could implement to maintain clean water and minimize impacts from stormwater.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	94

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota's local elected and appointed officials have to make decisions that have an impact on the quality and conservation of this precious resource, but most have little training on the issues. Extension's Nonpoint Education for Municipal Officials (NEMO) has been filling that gap.

What has been done
In 2014, four programs were provided by NEMO in the Twin Cities region. More than 200 local elected and appointed leaders participated, representing 37 communities and six watersheds. The participants learned about best management practices for shorelines and stream banks, and how to prevent or minimize pollution.

Results
Participants reported that, as a result of the training, they would review and revise their community's ordinances in collaboration with their local watershed organization. They would invest in municipal good housekeeping practices for pollution prevention such as street sweeping and storm water practice maintenance, and they would ask critical questions about storm water management before approving a project or proposal.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #2

1. Outcome Measures

Shoreland target audiences will practice one or more of five watershed friendly landscaping behaviors. (Outcome expressed as a percentage of workshop participants.)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Extension education, consultation, and training programs in onsite sewage treatments systems will help homeowners and local and state government to maintain Minnesota's water quality.

2. Associated Institution Types

- 1862 Extension

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)
Minnesota has 87 highway area rest stops. These are in areas without access to sanitary sewers and municipal treatment plants, so they all use onsite septic systems. Some are older, and some are subject to greater pressures. The Minnesota Pollution Control Agency needed a plan to service and, if necessary, repair or update the systems.

What has been done
Extension Onsite Sewage Treatment Program surveyed and inventoried all 87 highway rest stop septic systems and developed a database of all the septic systems and their condition.

Results

The Minnesota Pollution Control Agency has used this to make a priority list of what septic systems should be worked on first, thus assuring that the most vulnerable systems receive attention before possible breakdown and resulting pollution of the groundwater.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

Outcome #4

1. Outcome Measures

Research will uncover causes of non-point source pollution in Minnesota lakes and rivers.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many Minnesota lakes are experiencing unprecedented algae bloom which threatens fish and can affect recreational activities. Phosphorous (P) has been identified as having a strong effect on algae growth, and many Minnesota lakes have seen increasing concentrations of P over the years.

What has been done
High levels of P in the upper Midwest have largely been blamed on agricultural run-off but University researchers were interested to see if other factors may contribute to the increase in P in our water and riverbanks. Utilizing historical data, researchers looked at changes along the Mississippi River upstream from Lake Pepin that may have impacted P levels. Key findings were a series of meat-processing plants added in the 1880s, raw sewage being discarded in the river prior to the 1930s, and usage of high P detergents starting in the 1940s.

Results
Researchers then looked at several features of the river and riverbanks including total P, particle size distribution, and the ability of the riverbank materials to absorb P. From these measurements, they estimated P concentrations in Lake Pepin for scenarios before, and after 1850. Their results

showed that P in Lake Pepin pre-1850 was predominately caused by eroded riverbanks, while post-1850 industrial, and human pollution, added to the levels of P available for rivers to carry to the lake. The best solution for Lake Pepin is to control P pollution upstream, thus controlling the amount of P that could be absorbed by the river banks, and ultimately find its way into the lake. Understanding the various ways P finds its way into our river system is a key consideration for government regulation, and conservation groups. By exploring alternative sources, researchers can provide additional recommendations for lowering P levels--such as, continuing to upgrade sewage treatment systems in rural and urban settings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

Outcome #5

1. Outcome Measures

Research will provide information for water flow restoration projects in the state.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnehaha Creek is among the most valued surface water features in the Minneapolis metro area. Water flow in Minnehaha Creek depends heavily on discharge from the stream's origin, Lake Minnetonka, the outlet of which is closed during drought periods to maintain water elevations in the lake resulting in low- (or no-) flow conditions in the creek.

What has been done
Researchers worked with the Minnehaha Creek Watershed District (MCWD) to conduct a series of field investigations and desktop models to explore if stormwater can be used to augment

baseflow levels in the creek. One such project applied a REW (Representative Element Watershed) model to study the streamflow of the creek. Results showed that excessive pumping of groundwater from bedrock aquifer wells are another potential reason the creek experiences zero or nearly zero flow conditions.

Results

Results have been passed on to aid the MCWD in their restoration project. The model will be used to assess where in the watershed system advanced infiltration systems will be beneficial to augment baseflow. The research ties into a long-term effort by the MCWD and cities along the creek to restore stretches of the waterway, and to help people understand the importance of wetlands in an urban setting.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other ((No Factors))

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of water resource programs examine the degree to which participants learned and also examines particular actions taken by communities and community leaders to change policy, educate the public or create structures that protect water. In 2014, a compelling story tracked Extension's contributions to a statewide plan to better manage the septic systems in Minnesota's 87 rest areas.

Key Items of Evaluation

In 2014, a compelling story tracked Extension's contributions to a statewide plan to better manage the septic systems in Minnesota's 87 rest areas.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Community Economics and Public Finance

☑ 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
602	Business Management, Finance, and Taxation	10%		50%	
608	Community Resource Planning and Development	90%		50%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	12.1	0.0	3.4	0.0
Actual Paid	18.2	0.0	7.2	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**
459450	0	174944	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2249313	0	740034	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
469716	0	384787	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supported community economics and public finance research in 2014 focused on the impact of public policies, and, how rural, suburban, and urban communities and businesses are affected by change. Outdoor recreation and research related to consumer consumption are also niche research areas that fall within this program.

Research highlights for 2014 include:

- Governor Dayton added $455 million to the state's budget reserve after receiving feedback from U of M researchers in 2013 on the importance of growing the state's reserve to protect against future economic downturns.
- Researchers exploring how the recent infestations of bark beetle affects visitation collected data via questionnaires at three sites (Minnesota, Colorado, and Hartz, Germany).
- A model of collaborative consumption was developed and tested with consumers. Several variables were identified that predicted intended participation in collaborative consumption including: materialism, perceived integrity of other collaborative consumers, attitude toward collaborative consumption, subjective norm (i.e. perceived social expectation to take part in collaborative consumption) and past collaborative consumption experience. This model will be used to identify variables that predict engagement in collaborative consumption that can be used by marketers interested in developing new forms of business.
- A study on financial literacy of high school students found student background and characteristics, teachers and classroom dynamics all play a role in the financial knowledge gain experienced by students. These findings show subject matter content alone is not enough to create behavior change and learning context must be considered.
- Researchers studying how governments can create public value through tax and spending policies found public value is created when policies focus on remedying market failures, creating public goods and addressing concerns about fairness in social welfare functions.

Extension. Extension's applied research informs economic development efforts in local economies, especially in Greater Minnesota and rural areas where there are fewer public resources for professional economic development staff. In 2014, economic impact analysis reports informed a host of economic issues and opportunities, including the emerging industries created from cold hardy grapes developed at the University of Minnesota and elsewhere, the economic contributions of the aerospace industry in northeast Minnesota, and local economic "shocks" such as plant closings. A new program offering called the Futures Program leads local decision makers through in a discussion of the economic impact of several local industries, noting that some industries generate more economic "ripples" than others. With more informed decisions, economic developers are better able to garner political will for investments.

In all, the community economics team at the University of Minnesota created 96 applied research reports in 2014. (These can be found at www.extension.umn.edu/community/research/.) In 2014, 21 community plans were attributed, at least in part, to contributions made by Extension research. Several communities attribute significant business investment in their community to Extension's reports about local markets and opportunities.

In addition, new state policy adopted in 2014 will stabilize Minnesota's reserve funds. This new policy is directly attributed to the research and economic modeling by Extension state economist Tom Stinson.

2. Brief description of the target audience

Primary audiences for community economics programs include chambers of commerce, the tourism industry, economic development officers, local and state government, and nonprofits that make decisions about local economic development efforts.

An important target audience for MAES research is state policymakers, particularly those responsible for shaping the state's tax system.

3. How was eXtension used?

One staff member contributed to and was quoted in an eXtension article about Business Retention and Expansion.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	6267	25558	550	0

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	7	9	16

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational workshops provided (face-to-face and on-line).

Year	Actual
2014	143

Output #2

Output Measure

- Number of community-based applied research studies regarding (for example) retail trade, business retention and expansion, economic impact and tourism development.

Year	Actual

2014 96

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants in Community Economics programs will increase their knowledge of relevant community economic development topics. (Target expressed as the percentage of participants reporting increased knowledge.)
2	Participants in community economics educational programs will apply research and education to business and/or community improvements that affect the local economy. (Target expressed as a percentage of participants in community economics programs who follow through with action steps they wrote after receiving applied research reports or completing educational programs.)
3	Methodologies recommended by the Extension state economist resulted in policy changes that can stabilize Minnesota's "rainy day fund." This change that will last well into the future.
4	Communities will create and implement plans for the future using analysis and data provided by Extension Community Economics educators. (Target expressed as number of communities that created and implemented plans in 2014.)
5	Research will provide policymakers with information on the effectiveness of current government programs.
6	Research will analyze and provide increased knowledge on issues affecting child care quality and stability for low-income households.

Outcome #1

1. Outcome Measures

Participants in Community Economics programs will increase their knowledge of relevant community economic development topics. (Target expressed as the percentage of participants reporting increased knowledge.)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Participants in community economics educational programs will apply research and education to business and/or community improvements that affect the local economy. (Target expressed as a percentage of participants in community economics programs who follow through with action steps they wrote after receiving applied research reports or completing educational programs.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Technology makes it possible for rural businesses to compete with anyone anywhere, and creates opportunity for both new marketing and business efficiency. These opportunities can only be realized if businesses have the information they need to adopt new technology.

What has been done
Extension community economics educators bridge research and practice so that businesses and communities make the best use of technology. With online webinars and hands-on workshops, educators provide insights from research, as well as evidence-based practical advice for those learning about technology.

Results
At least six months after hands-on and online workshops about opportunities to improve business through technology, participants were surveyed to see whether they took action to improve their web presence. Evaluation showed that 100 percent had changed their web site using information

from trainings. Actions included more frequent updates of a web site, making web sites "mobile-friendly," taking advantage of consumer review sites, getting located on GPS maps accurately, checking the online listing presence of businesses, and making use of QR codes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development

Outcome #3

1. Outcome Measures

Methodologies recommended by the Extension state economist resulted in policy changes that can stabilize Minnesota's "rainy day fund." This change that will last well into the future.

2. Associated Institution Types

- 1862 Extension
- 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)
Minnesota, like most states, has a "rainy day fund" to bridge budget gaps caused by unforeseen revenue shortfalls. However, there has been no political agreement on how large that rainy day fund should be. In good times the governor and legislature typically favor spending increases or revenue decreases rather than supplements for rainy day funds.

What has been done
As state economist, Extension faculty Tom Stinson developed a statistical model to identify the appropriate budget reserve. Recognizing that the size of a state's budget reserve is dependent on the volatility of revenues, estimates of volatility were developed. These estimates were used to define a probability density function for Minnesota revenues. Given a pre-selected failure rate (that the reserve would fail to cover a shortfall only 5 percent of the time), that function could determine the size of the necessary reserve.

Results
In 2014, major changes to Minnesota's budget reserve were enacted into law. Among other

things, new legislation established an adequate and adjustable budget reserve target. Under the new law, the Minnesota Management and Budget Commissioner specifies the percentage needed following an annual evaluation of revenue volatility, and adequacy of reserves. That target is set as a percentage of each biennium's revenues, not a fixed dollar amount. This allows the size of the reserve to grow automatically without legislative action. Finally, the legislation creates an automatic mechanism that transfers 33 percent of all future November forecast balances to the reserve until the target is reached. Stinson's work created new stability in Minnesota's financial management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation

Outcome #4

1. Outcome Measures

Communities will create and implement plans for the future using analysis and data provided by Extension Community Economics educators. (Target expressed as number of communities that created and implemented plans in 2014.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	21

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Assumption and politics can lead communities to uninformed choices with regard to economic development investment. These uninformed choices deplete community resources, as well as communities' hope for the future.

What has been done
Extension's Community Economics team works with Minnesota communities as they develop their economic strategy, offering education, research, analysis, and advice. With solid research and informed action, communities chart courses that are realistic, well-informed, and supported by the community. As a result of educators' consultation with regions and communities, they often tailor their approach to address local opportunity. Applied research informs approaches to retaining and expanding local businesses, understanding economic change, knowing and growing retail trade, and tourism development.

Results
In 2014, 21 Minnesota communities reported they used applied research from Extension to create and implement plans for economic development. Condition changes include: county-based economic development plans, marketing plans for future retail development, plans to get local broadband, plans to create a walkable and bikeable city, plans to integrate alternative forms of energy, and strategies to improve food access in a low-income neighborhood. In one case, an analysis of local retail markets was used as the primary data source for a business researching a place to locate. This ultimately resulted in more than $1 million in facility investment by the company. Similarly, such data resulted in the building of a 16-unit senior housing center.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development

Outcome #5

1. Outcome Measures

Research will provide policymakers with information on the effectiveness of current government programs.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Low income human capital leads to a number of poor outcomes for individuals and communities. This is particularly true for vulnerable populations including those living in economically disadvantaged households. The Supplemental Nutrition Assistance Program (SNAP), is a federal assistance program that provides food assistance to low-income households. SNAP is the largest component of the USDA's nutrition program, and on average 14 percent of Americans participate.

What has been done
Researchers wanted to access how SNAP affects the well-being of children in the program. Traditionally, SNAP impact data is collected, and presented annually leaving little knowledge on the short-term gains of the program.

Results
By using quarterly SNAP consumption data researchers were able to determine child food insecurity rates at different intervals before, and after their involvement with SNAP. Notably, food insecurity among children increased in the three months prior to SNAP participation. It then declines once the family uses SNAP. Once off SNAP food insecurity returned to levels noted in the 4-12 month period before participation began. This study highlights several positive impacts of SNAP on well-being that had been overlooked by using annual data to analyze the program's effectiveness. The results have important implications for food assistance programs and policymakers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #6

1. Outcome Measures

Research will analyze and provide increased knowledge on issues affecting child care quality and stability for low-income households.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The majority of American children spend a large amount of time in nonparental care arrangements prior to starting school. Instability in child care arrangements can negatively affect child development. This is especially true for low-income households.

What has been done
Researchers wanted to understand the factors that lead to adjustments in child care arrangements. They undertook a multi-year study with low-income households in Minnesota to discover the prevalence of and reasons behind child care changes.

Results

Over a six month period, researchers noted a 50 percent child care turnover rate among study participants. Factors leading to child care changes included: job loss, changes in family composition, or a change in caregiver availability. Parents were also more likely to have switched their care provider if they had previously expressed disappointed in their child's experience. The significance of stability in care for children's development is well-documented. This study provides parents and policymakers with insights into how, and why these changes are taking place, and showcases the importance of the quality of the care provided. Results have been passed on to policymakers and were presented to the Minnesota Department of Human Services.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Competing Programmatic Challenges

Brief Explanation

Community economics programs are growing in popularity and productivity. Outcomes have been affected positively.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As indicated in the 2015 UMN Plan of Work, community economics programs borrow from the scholarly models of community capitals (Flora, et. al.) and Public Value (Kalambokidis) to examine and articulate the ultimate outcomes of community development programming. Ripple Effect Maps are created with communities to help them see and celebrate outcomes as they work together.

Ripple Effect Maps are currently being deployed to analyze the effects of community-based Tourism Assessment Programs (TAP). TAP uses asset-based community development processes, a site assessment by visiting team of experts, and written recommendations developed by the University of Minnesota to examine the possibility for diversifying a local economy through tourism development. Using ripple effect mapping, we engaged program participants and other community stakeholders in focus groups to identify intended and unintended outcomes and impacts of TAP. Mapping the changes provided stakeholders with a powerful visual of the progress they had made toward their tourism development goals. Several long-term impacts were documented in three main areas: (1) increased community cooperation, (2) enhanced marketing of local assets and experiences, and, (3) expanded attractions. By coding results of this study within the Community Capitals Framework, we will show each community how their involvement in the Tourism Assessment Program and subsequent development efforts can have a greater impact on the long-term sustainability of their communities.

Key Items of Evaluation

Using ripple effect mapping, we engaged program participants and other community stakeholders in focus groups to identify intended and unintended outcomes and impacts of Tourism Assessment Programming. Mapping the changes provided stakeholders a powerful visual of the progress they have made toward tourism development goals. Several long-term impacts were documented in three main areas: (1) increased community cooperation, (2) enhanced marketing of local assets and experiences, and, (3) expanded attractions. By coding results of this study within the Community Capitals Framework, Extension will show each community how their involvement in the Tourism Assessment Program impacted long-term sustainability of their communities.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Leadership and Civic Engagement

☑ 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
608	Community Resource Planning and Development	50%		50%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	50%		50%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	11.6	0.0	1.0	0.0
Actual Paid	17.4	0.0	2.2	0.0
Actual Volunteer	0.8	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**
531207	0	2582	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1912023	0	324155	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
537624	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension Leadership and Civic Engagement programs use multiple interventions to improve the quality of leadership, civic gatherings, and public participation processes. Because long-term cohort groups are proven to strengthen the social capital available in a community and, consequently, the impact of the program, outreach efforts encourage their implementation throughout the state.

Leadership for water quality issues has been a new focal point of these leadership and civic engagement cohorts since 2013. Six of the 20 cohort groups convened in 2014 were designed to strengthen civic engagement to protect lakes, streams, and watersheds. Four of these were built upon regional watersheds; one brought together leadership of Soil and Water Conservation Districts across the state, and another addressed leadership issues in a portion of the Mississippi watershed. (For a description of all cohort audiences, see **description of target audience.**

Research by Extension fellow Ben Winchester indicates that in most rural areas of Greater Minnesota, each leadership position has only 25-50 candidates available, and this assumes that the elderly and disabled are able to accept leadership positions. This "leadership gap" means that more people in rural Minnesota should be ready to lead. As noted in the Outcomes, 66.5 percent of those participating in these leadership education programs increased their level of involvement in at least one of their leadership roles (either a new role, an increase from "inactive" to "active" or "leader" roles or an increase from "active" to "leader" roles.) Ripple effect mapping evaluations conducted in 2014 examined the ultimate impact of this new leadership for communities.

Typically, Experiment Station funding is not expended on Leadership and Civic Engagement research topics.

Research for Leadership and Civic Engagement programs is typically gathered from the University of Minnesota's Humphrey Institute of Public Affairs, using Extension funding. An Extension specialist also gathers research from across the country related to leadership education and civic engagement.

MAES. There is a small amount of MAES effort tracked to this planned program. Specifically, this money goes toward research projects related to community leadership, new technology regarding personal protective gear, restorative justice, and social work research in encouraging youth participation in community leadership.

Research highlights from 2014 include:

- A research project was completed in 2014 on the role of restorative justice dialogue in solving conflict. During the year industry professionals from 22 countries and 14 states participated in in trainings or lectures on restorative justice, and victim offender mediation.
- A novel, tactile distance-sensing glove for firefighters proved effective in lab tests detecting gaps, and relative changes in distance between obstacles.
- An open loop system for detecting healthy lifting positions for pesticide applicators was developed. Initial tests validated the sensor's ability to detect healthy lifting postures when integrated into a disposable coverall.
- Research exploring the determents of educational outcomes in developing countries is exploring "what works" that can be utilized from previous studies. This work is aimed to assist international organizations and social scientists that work on educational reform in developing countries.

2. Brief description of the target audience

In 2014, 20 leadership and civic engagement cohorts were convened. Of these:

- Six programs convened individuals who could strengthen leadership for water quality issues in the

State of Minnesota.
- Six were county-based programs aimed at strengthening the ties and visions among communities in that county.
- Three addressed agricultural issues, including one border-to-border Minnesota cohort and two cohorts delivered in Morocco, in which farmers were trained to build leadership among local cooperatives.
- Three programs attracted emerging leaders across multi-county regions.
- One brought together volunteers and key partners from among Extension's stakeholder groups in an effort to strengthen the leadership they provide to Extension and to their communities.
- One served Extension staff in the North Central Region of the U.S. (NELD)

3. How was eXtension used?

One leadership and civic engagement educator is part of the leadership team for the Enhancing Rural Communities Community of Practice. She provides peer review services to this community of practice and strengthens her personal scholarship through the affiliation.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3216	26410	323	0

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	3	2	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of community cohort groups convened to develop leadership skills and create civic connections.

Year	Actual
2014	20

Output #2

Output Measure

- Number of workshops and other structured gatherings that provided communities with increased skills, knowledge and behaviors related to leadership and civic engagement.

Year	Actual
2014	195

Output #3

Output Measure

- Number of local applied research studies about leadership and civic engagement to better understand gaps and opportunities that inform local action.

Year	Actual
2014	20

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants in Leadership and Civic Engagement programs will increase their knowledge of relevant leadership and civic engagement topics. (Target expressed as the percentage of participants reporting increased knowledge.)
2	Structured community gatherings such as public meetings, forums or planning sessions are more productive. (Target expressed as percentage of evaluated participants who report in follow-up surveys that participation in a Leadership and Civic Engagement cohort program helped them make meetings, planning sessions, or committees more productive.
3	Community leadership cohort members will increase the intensity of their leadership. (Target expressed as the percentage of evaluated participants who increase their involvement in at least one of their organizational roles.)
4	Communities will work across sectors and interests to address public problems. (Target expressed as percentage of participants in community leadership or civic engagement programs who increase their level of bridging social capital, as measured by a pre and post-survey.

Outcome #1

1. Outcome Measures

Participants in Leadership and Civic Engagement programs will increase their knowledge of relevant leadership and civic engagement topics. (Target expressed as the percentage of participants reporting increased knowledge.)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Structured community gatherings such as public meetings, forums or planning sessions are more productive. (Target expressed as percentage of evaluated participants who report in follow-up surveys that participation in a Leadership and Civic Engagement cohort program helped them make meetings, planning sessions, or committees more productive.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	97

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Before a community event is a success or an economic development strategy is implemented, a community meeting takes place, or more likely, a bunch of meetings. That makes leading good community meetings important as communities come together to govern or solve problems. It isn't practical or affordable for communities to hire professional facilitators for every meeting, so some knowledge of good facilitation needs to be available at the front of the room.

What has been done
Extension leadership and civic engagement educators make learning skilled facilitation a key element of leadership and civic engagement education in Minnesota. The goal is to help emerging and existing leaders understand how critical good meetings are to success, and to make skilled facilitation a habit among community leaders.

Results

Alumni of leadership programs were surveyed to examine whether skills they acquired in Extension programming helped them to make meetings, planning sessions, or committees more productive in their organizations or communities. Of the 148 alumni who replied, 97 percent said that productivity was enhanced at least "to a slight extent," and 83 percent reported enhancements to a moderate or great extent.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #3

1. Outcome Measures

Community leadership cohort members will increase the intensity of their leadership. (Target expressed as the percentage of evaluated participants who increase their involvement in at least one of their organizational roles.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	67

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
UMN Research Fellow Ben Winchester has sought to better understand the need for leaders in Minnesota. He considered the number of board and elected positions needed by government and nonprofit entities and estimates that one in 34 must serve in a leadership position in very rural areas, whereas in metropolitan areas one in every 143 residents must serve. According to the Blandin Foundation's Rural Pulse Survey, only 41 percent of rural Minnesotans say they have been asked to serve.

What has been done
The leadership and civic engagement team at the University of Minnesota Extension offers organizations, sectors and local groups the opportunity to sponsor leadership education cohorts. By doing this, program sponsors actively ask others to accept new leadership in communities and organizations, and invest in the opportunity to grow the confidence and competence of those who are asked to lead. In 2014, 20 such cohort groups were sponsored.

Results
During 2014, leadership role change data was collected among 161 participants of seven leadership cohort programs. Of these, 66.5 percent increased their level of involvement in at least one of their organizational roles after participating in a cohort program (either a new role, or an increase in responsibility within existing involvements).

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #4

1. Outcome Measures

Communities will work across sectors and interests to address public problems. (Target expressed as percentage of participants in community leadership or civic engagement programs who increase their level of bridging social capital, as measured by a pre and post-survey.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	56

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Communities need to look beyond their borders to find alliances that can be leveraged to solve problems and increase resources. Because state and federal governments have handed more responsibility to communities and counties, these relationships create more effective local governance. Local governments and sectors can pool resources to attract business and funding to the workshed, as many rural households live in a community, work in another, and are schooled in yet another. Cooperation helps rural regions thrive.

What has been done
Leadership and civic engagement program activities at the University of Minnesota Extension intentionally increase connections among communities. By creating new relationships among individuals and organizations, entire regions become more collaborative in their approach to remaining vital as an economy and community.

Results

Extension examined the success of five leadership education programs in creating stronger ties between and among communities represented in the program. Three of these were county-based "bridging" programs, and two were civic engagement cohorts of individuals willing to provide leadership for Minnesota's water quality issues. Among 87 program graduates who responded, 56.3 percent said their relationships across the communities had increased, and that the overall level of "bridging social capital" had increased from the beginning to the end of the cohort program, as measured by survey items pertaining to connections in communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Cultural Adaptation)

Brief Explanation

Goals were achieved in 2014.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As indicated in the 2015 UMN Plan of Work, Leadership and Civic Engagement programs borrow from the scholarly models of community capitals (Flora, et. al.) and Public Value (Kalambokidis) to examine and articulate the ultimate outcomes of community development programming. Ripple Effect Maps are created with communities to help them examine what happened because of their efforts to learn and to use information to design and implement community development plans. The outcomes they report can be categorized into "community capitals" that are known to create thriving communities.

In 2014, ripple effect maps were deployed to analyze the effects of two long-term leadership and civic engagement cohort programs -- the Minnesota Agriculture and Rural Leaders' Program and the Water Quality Civic Engagement cohort in Southwest Minnesota.

Ripple effect mapping conducted among MARL program alumni revealed outcomes resulting fromthe additional leadership they provided to communities. The focus group of alumni who attended the ripple effect mapping credited the program for 61 outcomes. These were coded and counted below:

Human Capital 28 45.9%
Civic/Political Capital 21 34.4%
Social Capital 13 21.3%
Financial Capital 7 11.5%
Cultural Capital 4 6.6%
Built Capital 1 1.6%

Natural Capital 1 1.6%

There were many examples of alumni stepping up their activity in school boards, Chambers of Commerce, and commodity industry boards. There was one particularly compelling story about program alumni (from several MARL cohorts) creating a 20 megawatt wind farm in Southwest Minnesota. Another alumnus worked very hard to keep a local grocery store open (through succession planning) in a community where there was only one store.)

The Civic Engagement Program in Southwest Minnesota conducted a ripple map that discovered concrete outcomes from integrating public participation into water quality work. A citizens' group for water quality came to fruition through the program and got enough buy-in to collect water quality data across an entire watershed. In the end, 40 years of data about water quality were pulled together and compiled for a 2015 report, allowing the community to identify trends over time. Also as a result of the program, the watershed applied for state funds for a rain garden project as a result of the program and were selected to pilot a statewide program to create one water quality plan for the entire watershed. At the local level, one lake community mobilized and established a goal to take their lake off the list of impaired lakes.

Key Items of Evaluation

Ripple effect mapping is a process that gathers alumni of leadership and civic engagement programs to examine the outcomes that they attribute to being part of a leadership and civic engagement cohort. In 2014, the longitudinal effects of two cohort were evaluated. The process identified numerous actions taken by alumni as they increased the level of leadership they provided to communities. Effects included leveraging social capital and human capital to bring new civic and political power to communities. Alumni shared stories of creating wind farms, saving small town businesses, working together to clean lakes and rivers, and more.

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Building Healthy, Strong Families

☑ 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
801	Individual and Family Resource Management	40%		50%	
802	Human Development and Family Well-Being	40%		50%	
806	Youth Development	20%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	20.1	0.0	8.1	0.0
Actual Paid	32.5	0.0	8.7	0.0
Actual Volunteer	1.1	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**
681691	0	228490	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2240259	0	715182	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4623214	0	6519	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES research in 2014 to build strong, healthy families focused on social and economic issues facing Minnesotans, and providing advances in knowledge and training for professional social service agencies throughout the region. The research concentrated on challenges for key populations, some of which are traditionally underserved, including youth, seniors, and military, as well as, on the effects of new technology on communication within families.

One new project is exploring the barriers and difficulties Minnesota's refugee population face when undergoing mental health screening upon arrival in the state.

Research highlights from 2014 include:

- Social scientists looking at how assisting families can ultimately help survivors of mass trauma, piloted a parenting intervention model among several populations exposed to mass trauma. Early results are very promising.
- Social science researchers completed two Discernment Counseling training sessions which were attended by 143 industry professionals.
- Researchers studying the effect of disabilities in the child welfare system are expanding their examining with national data to discover the prevalence nationwide. Early findings show that parental disability is the third highest reason for removing a child from a parent's home, and in some states the most common.
- Family social science researchers, focusing on understanding associations between family communication and child adjustment in situations when children and parents are not genetically related, found that family communications is especially important during the transition to young adulthood.
- Results of a study demonstrating the importance of family relationships and parent-child satisfaction in families with children conceived via in vitro fertilization will provide guidance to professionals working with couples considering adoption and in vitro fertilization.
- Researchers accessing communication in military families successfully developed a coding scheme to access emotional communication and successfully coded a sample of 336 military families. Post-test evaluations will be performed over the next two years.
- Social scientists exploring the significance of, and issues associated with, kinship care presented to staff at a local social service agency concerning new knowledge on the effect of parental alcohol abuse on children's placement with relatives.
- Researchers studying the perceived justice of inheritance expanded their study to include stepfamily structures, and how that may affect the perception of "fairness." Results are being analyzed.
- Scientists exploring how important Vital Involvement (IV) is for Alzheimer's patients partnered with Giving Voice Chorus, a Twin Cities based chorus of Alzheimer patients and their care partners. The partnership allows scientists to observe and advise choir staff on ways to enhance IV.

Extension. In past years, we reported many knowledge and behavior changes resulting from Extension's financial literacy programs. These impacts are consistent enough that it can be assumed to be a product of Extension's curricula approaches. In 2014, we report the impact of the Community Mentoring Program, which has developed partnerships with community organizations to bring this effective curricula to more communities and cultures in Minnesota. Community Mentoring Program partnerships with 80 community-based organizations are deeply engaged -- with integrated technology-based education, rigorous evaluation, technical assistance, and implementation grants that provide a full package of train-the-trainer methodologies to help community organizations succeed in replicating Extension's results. As a result, we can report that 80 agencies brought the program to 2,000 Minnesotans in 2014, causing the percentage of program participants from minority populations and limited resources to increase by 16 percent.

Similarly, Extension is monitoring whether online access to parenting education could be effective in

reducing familial conflict. In 2014, this was proven, and follow-up evaluation showed improvements in family relationships after contentious divorce.

Extension is reporting only the two outcomes described above for the Building Healthy, Strong Families result because they are condition changes rather than knowledge or behavior change. Moreover, the knowledge and behavior changes have been reported routinely in the past.

2. Brief description of the target audience

The Building Strong, Healthy Families programs reach professionals in collaborating agencies, such as mental health professionals, parent educators, schools, courts, family service agencies, health care settings, organizations, and businesses. These intermediaries bring education and support to families in trusted places and through professional relationships. In 2014, the program was successful in increasing outreach to minority and immigrant populations through intentional partnerships with such community organizations. In 2013, approximately 33 percent of the total number of program participants were from minority populations. In 2014, that percentage increased to nearly half of participants (49 percent). This intentional shift required program leaders and educators to develop educational resources from the ground up, creating cultural and linguistic modifications to program delivery.

Research target audiences also include Extension educators, community action participants, family social scientists, social workers, marriage counselors, caregivers, family resource management researchers, government public policymakers, and economic development professionals.

3. How was eXtension used?

Educators and specialists in the Building Healthy Strong Families program area have connected to eXtension in a variety of ways, including being active on various Communities of Practice and an "Ask the Expert" team, answering questions on resource management around health care reform, military financial learning, and disaster preparedness. Extension staff searches eXtension for research and educational resources, and uses the site to promote Minnesota educational curricula and teaching events such as national webinars.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12456	203043	979	0

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	22	15	37

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of publications distributed.

Year	Actual
2014	3166

Output #2

Output Measure

- Number of community-based workshops held.

Year	Actual
2014	751

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Professionals who work with parents and families will improve their skills. (Outcome expressed as a percentage of participants who report improving skills.)
2	Parents will improve their parenting practices. (Outcome is the percentage of participants reporting improvement.)
3	Parents who are mandated to participate in Parents Forever because of contentious divorce situations will reduce conflict in front of their children following divorce. (Outcome expressed as percentage of parents who report reducing conflict.)
4	Individuals, families and employees who participate in Resource Management programming will report they have increased confidence (increased efficacy) in financial management, decision-making and planning for later life. (Outcome expressed as percentage of participants who report increasing efficacy.)
5	Individuals, families and employees who participate in Resource Management programming will report they have used the knowledge and materials provided by the program to change behaviors related to targeted financial management goals. (Outcome expressed as a percentage of participants who reported making behavior change.)
6	UMN Extension will significantly increase the amount of financial literacy training available to low-income and minority Minnesotans throughout the state. (Target expressed is the number of agencies delivering programming with proven outcomes in helping families manage their finances.)
7	Research will provide information related to inheritance best practices to practitioners working with aging populations.
8	Research will provide new information to assist family and parent educators working to integrate technology into their parent education efforts.

Outcome #1

1. Outcome Measures

Professionals who work with parents and families will improve their skills. (Outcome expressed as a percentage of participants who report improving skills.)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Parents will improve their parenting practices. (Outcome is the percentage of participants reporting improvement.)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Parents who are mandated to participate in Parents Forever because of contentious divorce situations will reduce conflict in front of their children following divorce. (Outcome expressed as percentage of parents who report reducing conflict.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	54

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research shows that less than half of American children can expect to live with both biological parents throughout childhood. Children who experience family disruption often live with parental conflict before, during, and after the divorce. Children in these households are more likely to be poor, and are more likely to have emotional problems and lower academic achievement. Longitudinally, these children are more likely to conceive a child in their teens and get in trouble with the law.

What has been done
For more than a decade, UMN Extension has delivered and rigorously evaluated a program that works with Minnesota's court system and local service agencies to reach parents during highly contentious divorce. Parents Forever teaches parents that the effects of divorce on children can be reduced if they create a plan focused on children's needs, if they use effective parenting approaches, communicate effectively, make joint decisions, and avoid putting children in situations where loyalty to either parent is threatened.

Results
In 2014, thousands of parents completed the program online. Results of the online education format demonstrated effectiveness in behavior change at a six -month follow-up. Fifty-four (54) percent of parents reported a significant decrease in conflict observed by their child. Further, parents reported significant improvement in their ability to cope compared to others going through divorce or separation. These results have large or very large statistical significance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development

Outcome #4

1. Outcome Measures

Individuals, families and employees who participate in Resource Management programming will report they have increased confidence (increased efficacy) in financial management, decision-making and planning for later life. (Outcome expressed as percentage of participants who report increasing efficacy.)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Individuals, families and employees who participate in Resource Management programming will report they have used the knowledge and materials provided by the program to change behaviors related to targeted financial management goals. (Outcome expressed as a percentage of participants who reported making behavior change.)

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

UMN Extension will significantly increase the amount of financial literacy training available to low-income and minority Minnesotans throughout the state. (Target expressed is the number of agencies delivering programming with proven outcomes in helping families manage their finances.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Choices about money and family finances have a strong context within culture and community. To best reach families who most need family financial literacy, finding trusted liaisons is critical.

What has been done
The Community Mentorship Program (CMP) was designed to build the capacity of grassroots organizations to conduct financial literacy training, especially in the language of participants. CMP includes an initial two-day workshop, mentoring from Extension educators about program delivery, mini-grants to fund program implementation, and a follow up meeting to share experiences among agencies.

Results
Extension increased the capacity of participating agencies to increase financial literacy training available in their communities. The incentives and services provided by CMP resulted in a 60 percent implementation rate after the initial workshop. Since its inception, 80 agencies across the state conducted nearly 160 financial literacy programs for approximately 2,000 Minnesotans, a majority of whom are culturally diverse. Online evaluation systems indicate these programs result in participants being significantly more satisfied with their financial situation. Participants report being better able to create a budget and pay monthly bills, and are managing their debt and saving money for financial emergencies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

Outcome #7

1. Outcome Measures

Research will provide information related to inheritance best practices to practitioners working with aging populations.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Virtually all families regardless of shape, size, ethnicity, or socioeconomic status will deal with asset distribution in the future, and with baby boomers aging this will be an increasingly important issue. However, very little research has been done to develop best practices concerning inheritance decisions, and to explore how inheritance affects families.

What has been done
U of M social scientists set out to explore the multiple meanings behind the concept of "being fair" in inheritance situations. Researchers designed, created and coded a, first of its kind, intergenerational family systems qualitative database focused on inheritance decision making. They also used vignettes to further delve into study participant's meaning and perspectives. Findings revealed that procedural justice criteria are relevant for judging the concept of fairness in inheritance situations, these include: participation, information, decision structure, correction, ethnicity, neutrality, and ground rules. Additionally, studies found concern about specific criteria and their importance differed amongst families and their situations with particular concerns about the perceived "meaningfulness" of certain possessions.

Results
The findings show inheritance communication and planning would benefit from: (1) assessment tools to help family members identify fair inheritance practices and address specific concerns for their situation and (2) training practitioners addressing concepts and criteria of "being fair" when working with families. Research findings have been disseminated directly to families and practitioners working with families and aging populations. Outreach has included webinars, in-person training on the state and national level, as well as, the continued development of the Extension's outreach program "Who Gets Grandma's Pie Plate?"

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

Outcome #8

1. Outcome Measures

Research will provide new information to assist family and parent educators working to integrate technology into their parent education efforts.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Despite widespread adoption of information and communications technologies (ICTs) by families in the United States, little is known about parents' use of ICTs in regard to parenting.

What has been done
Family social science researchers conducted a study on parents' use of four widely used ICTs (text message, email, social networking sites, and Skype) to communicate with family. They were particularly interested in discovering how usage differed based on the age of the child.

Results
Findings revealed ICTs use for parent-child communication increased overall with child's age, and communication with a co-parent via text messaging was more likely among parents of school age children. But, significantly, parents of adolescent children were less likely to communicate using ICTs (text, or email) to non-resident family than parents of school age children. These results show parents' use of ICTs is dynamic, reflecting developmental differences in the child, and rational differences in the family system. Examining how parents are using specific ICTs to communicate with family furthers our understanding of the impact of technology on communication processes occurring within families in today's digital age.

Study findings have been passed on to assist practitioners, and family and parent educators who are adapting to new media, and working to integrate technology into parent education efforts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Populations changes (immigration, new cultural groupings, etc.)
- Other (Advancing of technology and community partnerships within programming)

Brief Explanation

The Building Healthy, Strong Families program area has consistently demonstrated impacts regarding improved skills, behaviors and confidence. These consistently evaluated results were not reported this year in favor of reporting on an important conditional change. Extension significantly increased the degree to which family financial literacy results were replicated within communities of color within trusted organizations.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

To demonstrate that Minnesota's community agencies could effectively create financial literacy impacts in their communities, the program measured the extent to which agencies participating in the Community Mentorship Program implemented the program, and then tested the results of financial literacy education replicated by those agencies. Seven agencies participated in a pre-survey (n=152). Six completed the post-survey and three completed the follow-up survey (n=61). Data was matched between participants who completed both the pre-and the post-surveys (n=129), and between participants who completed both the pre-and the follow-up surveys (n=54).
In the pre-survey, participants endorsed their top financial priorities as either paying monthly expenses (78.9 percent), saving money for an emergency (35.5 percent), saving for a long-term goal (19.1 percent), getting out of debt (27 percent), improving credit (15.8 percent), or other (3.3 percent). Top financial priorities that participants identified as "other" included a business, children's education, family needs, budgeting, and house expenses.

Key Items of Evaluation

By embedding a tested financial literacy program within 80 community-based organizations, and providing a myriad of incentives and support to implement the program, Extension significantly increased the amount and quality of financial literacy programs available in the state of Minnesota. Evaluation demonstrated that these 80 agencies were able to create changes in the financial priorities and actions taken to address those priorities. These effects rippled throughout the state, serving approximately 2,000 Minnesotans. A majority were from culturally diverse communities with limited resources.

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Youth Development

☑ 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
805	Community Institutions and Social Services	50%		0%	
806	Youth Development	50%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	49.6	0.0	0.0	0.0
Actual Paid	59.0	0.0	0.0	0.0
Actual Volunteer	452.9	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**
1658529	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
3820880	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
8899708	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Youth Development Center at Extension manages statewide programs that engage youth in enriching programs while informing and educating the field of youth development. These out-of-school 4-H activities are directed at three national mission mandates:

1. Science, Technology, Engineering, and Math, including the science of agriculture
2. Citizen and Leadership
3. Animal Science

Because 4-H club membership is known to have the most positive youth development outcomes, Extension focuses on recruiting for club membership, with special outreach to immigrant and minority youth who are not typical 4-H communities. Club membership has grown from 26,000 in 2014 to 32,017 in 2014. (This is a 2.2 percent increase from 2013.) Of these, 15 percent are non-white youth. In urban Minnesota, where there are significantly greater numbers of minority residents, 54 percent of club members are non-white youth. This diversity is the result of focused effort to build new partnerships and create learning environments that are responsive to the context of youth in their neighborhoods and communities.

Adult learning efforts continue to build capacity in the youth development field in Minnesota. Research investigates the components of quality youth programming and evaluates ways to best integrate those components into youth development experiences. Youth development programs organizations serving youth across the state, supporting their efforts to design, deliver and test these practices.

In 2014, short-term and longitudinal evaluations of the 4-H program are featured. The evaluation found changes in youth behavior, helping youth master a topic and get involved in community life in a way that made a difference. More important, a retrospective analysis of 4-H youth who participated in 2006 demonstrated that the program made a significant difference in educational outcomes, as compared to a matched group of Minnesota youth.

2. Brief description of the target audience

The target market for 4-H clubs is youth. Training and resources to support staff and volunteers assure that they create quality learning environments that are inviting, accessible and welcoming to a broad range of Minnesota youth. The Urban Youth Program audience includes adults working with schools in urban areas, as well as agencies, organizations, and volunteers interested in building sustainable youth programs. Youth leadership programs target young learners who are working in the context of their neighborhood or community to make a difference.

Through adult learning efforts, Extension serves individuals, organizations, and systems that work with and on behalf of youth. This includes volunteers who work in 4-H programs, as well as volunteers and staff of other community-based programming.

3. How was eXtension used?

Twelve educators in the 4-H and Youth Development program areas reported using or contributing to eXtension in 2014.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12720	7764	63412	0

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	11	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational offerings delivered for youth-serving organizations through both face-to-face and on-line offerings.

Year	Actual
2014	34

Output #2

Output Measure

- Number of organizations participating in technical assistance that adopt quality improvement strategies for their youth-serving organizations and networks.
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Percentage of youth participants (sixth grade and higher) who report being satisfied with their first year of participating in 4-H programming, thus making long-term engagement more feasible.

Year	Actual

2014	85

Output #4

Output Measure

- Number of lead adult volunteers in 4-H clubs will be trained to work with Minnesota's young people who participate in 4-H program activities.

Year	Actual
2014	1463

Output #5

Output Measure

- Number of 4-H program clubs that now use a validated assessment tool to guide quality improvement efforts.

Year	Actual
2014	65

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Youth involved in Minnesota's 4-H programs over a significant period of time will report mastery of a topic of interest as a result of their 4-H investment. (Outcome expressed is a percentage of highly involved youth who report mastery.)
2	Youth involved in Minnesota 4-H programs at high participation levels will report contributions to their community as a result of their 4-H involvement. (Outcome is the percentage of highly involved youth who report community contributions.)
3	Adult participants in educational offerings will report that they increased their understanding and knowledge of a given youth development topic. (Outcome expressed as a percentage of participants in agreement.)
4	Adults who volunteer to work with youth will create a receptive community and positive learning environment through 4-H. (Target expressed as volunteer hours spent with 4-H clubs that are replicating youth program quality elements.)
5	4-H programs in Minnesota facilitate strong educational outcomes for participating youth.

Outcome #1

1. Outcome Measures

Youth involved in Minnesota's 4-H programs over a significant period of time will report mastery of a topic of interest as a result of their 4-H investment. (Outcome expressed is a percentage of highly involved youth who report mastery.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	82

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Youth have diverse interests, some of which school hours are unable to nurture. It is up to the field of youth development to offer a rich array of opportunities so that youth can come to understand their own skills, abilities, and interests and develop them to the fullest extent possible.

What has been done
Program activities in 4-H clubs, offered in every Minnesota county, tap the talents of passionate volunteers to teach and coach youth in activities such as photography, fashion design, public speaking, drama, and other activities. Increasingly, 4-H activities are focused on STEM learning, building on the rich history in nurturing agricultural activities.

Results
In a 2014 summative evaluation, parents of 2013-14 first year members were asked about their children's activities and successes. In that study, 82 percent (n=775) of parents agreed that "during 4-H last year, my child became really good at something (he or she) worked on. Moreover, in a a longitudinal look at 4-H program alumni, 54 percent of alumni agreed that "mastery of a topic of interest in 4-H helped me with what I am doing after high school."

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. Outcome Measures

Youth involved in Minnesota 4-H programs at high participation levels will report contributions to their community as a result of their 4-H involvement. (Outcome is the percentage of highly involved youth who report community contributions.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	71

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Community development research has identified that broad engagement of community residents is an important contribution to the health and well-being of that community (Flora and Flora). Moreover, "social usefulness" and a sense of control are an important factor in preventing social problems among adolescents such as substance abuse, teen pregnancy, and delinquency (Riessman, 1990; Black, Tobler & Sciacca, 1998 and Forneris, et. al., 2010).

What has been done
Through leadership education and the engagement of community volunteers and organizations, 4-H programs connect youth to community efforts where their leadership can be tested and can make a difference.

Results
The national "Universal Common Measures" project undertaken by 4-H identifies community contributions by youth as a common goal worth measuring. As part of that project, Extension surveyed 4-H youth in the 8th through 12th grade. In 2014, 71 percent (N = 354) of those surveyed reported that they led a project that made a difference in their community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. **Outcome Measures**

Adult participants in educational offerings will report that they increased their understanding and knowledge of a given youth development topic. (Outcome expressed as a percentage of participants in agreement.)

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Adults who volunteer to work with youth will create a receptive community and positive learning environment through 4-H. (Target expressed as volunteer hours spent with 4-H clubs that are replicating youth program quality elements.)

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

4-H programs in Minnesota facilitate strong educational outcomes for participating youth.

2. **Associated Institution Types**

- 1862 Extension

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)
The Forum for Youth Investment advocates that Minnesota help youth be "Ready by 21"; i.e., ready for work, college and life. The combination of preparedness and openness to learning is ideal for development. It means youth are equipped with key skills they need to survive and thrive in their next opportunity for learning.

What has been done

4-H programming provides multiple out-of-school opportunities for youth to increase their curiosity, their confidence, their discovery, and their ability to learn.

Results

In 2014, multiple evaluations examined the longitudinal effects of Minnesota 4-H on educational outcomes. A 2014 Academic Achievement Study (Blyth, et.al.) found that those who attended 4-H in 2006 attended school more regularly, showed higher achievement on standardized tests, graduated high school at higher rates, and enrolled in post-secondary programs more often than non 4-H participants. The National Student Clearinghouse provides evidence that 4-H youth graduated from higher education institutions at a faster pace than non-4H young adults. (See Evaluation Results for more information.)

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Goals were achieved.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

4-H and Youth Development programs are evaluated a number of ways -- from assessing learning gains and satisfaction at the local and event level, to conducting longitudinal studies that look for long-term impacts, to participation in nationwide efforts to track consistent outcome measures for 4-H.

In 2014, a major longitudinal study was completed by Dr. Dale Blyth and colleagues. Dr. Blyth notes that previous research at Tufts University found that youth who participate in 4-H had significantly better grades than other youth, were less likely to have risky or problem behaviors, and were more likely to see themselves going to college. Blyth sought to examine the longitudinal impact of long-term participation in the 4-H program.

Blyth linked 4-H data from youth in third through eighth grade who participated in the program in 2006 (n =25,707) to data from the Minnesota Department of Education and Human Services, choosing a comparison group of youth who did not participate but whose characteristics were similar to those of the 4-H group. The comparison group was matched on district/school number, gender, grade, race/ethnicity, free/reduced lunch eligibility, special education receipt, attendance rate and school mobility in 2006, prior child protection involvement, and prior out-of-home placement. Attendance, graduation rates, and MCA II test scores were used as key outcome measures for five years until the sample was in 8th through 12th grade.

Findings from this study suggest that the youth who participate in Minnesota's 4-H program are on a better course for academic learning starting early in their academic

careers than youth who do not participate in 4-H. Youth involved in 4-H attend school at consistently higher levels, and score significantly higher on standardized tests of math and reading than their non 4-H peers, regardless of the duration or intensity of their participation. For some groups of youth, extensive 4-H involvement over time is associated with significantly better attendance and higher reading and math scores as compared to youth who are involved in 4-H for a shorter duration. Parent involvement in 4-H is associated with increased math scores, but not with increased reading scores or school attendance.

Key Items of Evaluation

A longitudinal study of 4-H long-term participants compared educational outcomes to those of similar youth using a myriad of demographic and life factors. **Findings:** Youth who participated in 4-H had consistently higher attendance and better math and reading scores than their non 4-H peers. Parent involvement in 4-H was associated with increased math scores, but not with increased reading scores or school attendance. 4-H youth with more extensive involvement over time had higher attendance and better reading and math scores than other youth.

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Fish, Wildlife and Conservation

☑ 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
135	Aquatic and Terrestrial Wildlife	20%		45%	
136	Conservation of Biological Diversity	20%		50%	
903	Communication, Education, and Information Delivery	60%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	5.2	0.0	19.7	0.0
Actual Paid	14.3	0.0	18.7	0.0
Actual Volunteer	30.5	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**
431199	0	196016	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1743360	0	1591140	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
551183	0	1180263	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supported research on into environmental sustainability, including wildlife and conservation, spans several academic departments. Minnesotans care deeply about protecting the state's natural resources, and U of M natural resource researchers provide the science to support the stewardship within the state. In 2014, research was focused environmental stewardship, maintaining diversity in the ecology of Minnesota, and in maintaining and improving the quality of wildlife habitats.

Research highlights for 2014 include:

- Researchers exploring the effects of invasive plant species completed their 11 year field study on Canadian thistle. Initial results found there were significant differences in invasion by Canadian thistle in the first three to five years, but, after eight years, Canadian thistle decreased to such an extent that it is now no longer deemed a threat.
- A study on garlic mustard determined MN populations are decreasing following successive years of excessive spring rainfall followed by late-summer droughts. Despite this observation garlic mustard remains an invasive pest in Minnesota, and will continue to be monitored.
- A study tracking tigers in Asia found female tiger home range size, and the number of female home ranges within a given population, are a better measurement for assessing the resilience of tiger populations than simple tiger numbers. Occupancy surveys for large carnivores are a critical tool for conservation efforts when dealing with small populations where inbreeding depression is a possibility.
- The University of Minnesota Insect Collection added 13,502 specimens in 2014. The collection's total holdings now number 3,863,368 specimens, representing 50,975 species, a net gain of 240 species from 2013.
- Digital satellite imagery revealed more detailed land cover and use classification of the seven county Twin Cities metro area. Five level one classes were identified with 93 percent accuracy, and 10, more specific, level two classes at 91 percent.
- Researchers continue to use polymerase chain reaction (PCR) tests on moose blood samples provided by the Minnesota Department of Natural Resources (MNDNR). They hope the tests will help uncover the cause of mortality in Minnesota moose populations.
- Researchers were able to acquire and disseminate metagenomic data on tick-borne pathogens (Rickettsia and Anaplasma species). Defining microbiomes of major vector ticks will assist in evaluating and monitoring these microbial communities.
- Work continues on a next generation sequencing data set for tigermoths, but an evolutionary analysis was completed with additional analysis of the evolution of moth's defenses, and mating behaviors underway.
- Researchers tracking waterbird species in the Great Lakes region reported 413,000 pairs of 14 species nesting at 310 sites. This represents an 11 percent increase in overall population numbers and a 24 percent decrease in number of sites since the 1990s. While 14 species were accounted for the waterbird population is largely dominated by three species: ring-billed gull, herring gull, and double-crested cormorant.
- Research on leeches revealed leech cocoon formation and shedding involve a behavioral sequence that researchers are working to characterize.
- A study on Chronic Wasting Disease (CWD), and other prion diseases, using an orally-and horizonally-infectable rodent model successfully confirmed PO-infection of transgenic mice. These mice developed clinical disease between 273 and 389 days post infection. Researchers are currently repeating this study to confirm their results.
- Analysis on a cost-estimator for grassland and wetland restoration was completed.
- A study began on the effects of hydrological change on vegetation dynamics of prairie wetlands.
- Samples were collected throughout Minnesota and screened for IncA/C plasmids to discover probable sources of IncA/C plasmids, and how they spread in the environment. This data will be used to map the environmental locations of the plasmids relative to the geography of the state.
- Researchers using fecal samples to evaluate declining moose populations throughout the state obtained 74 additional samples through a partnership with the MNDNR.

• Researchers developed an integration population model for the spotted owl. The model unequivocally demonstrated a precipitous decline of the spotted owl population over the last 20 years.

Extension

Extension's 2014 programming in natural resources is reported under several Planned Programs in this report, including Forestry, Water Resources and Climate Change, with outcomes specific to those areas. A major Extension program reported under this Planned Program is the Master Naturalist program, which taps the power of volunteers to protect, sustain, and improve and Minnesota's natural resources.

In 2014, the Minnesota Master Naturalist program entered its tenth year, and has already exceeded its original goal to have 1,000 volunteers trained by 2015. There are now more than 1,577 Master Naturalists volunteering across the state, and the new goal is to have 1800 trained volunteers by the end of 2015.

A more focused outcome reported under this Planned Program is the long running White Earth Academy in Math and Science, which is the result of significant collaboration between Extension and White Earth Reservation elders. The program reached a milestone in 2014 in that the program reached its first second generation students. The Boys and Girls Clubs of the White Earth nation was a new partner for the program in 2014. The program reached 59 students, of which 56 were American Indians. Topics included climate change and its impact on frogs and the habitat of golden winged warblers. Students learned about the effects of invasive aquatic and terrestrial species on the natural resources of the White Earth Reservations.

2. Brief description of the target audience

Fish, Wildlife and Conservation research and outreach programs focuses on working with concerned citizens and volunteers who are trained and have served in a variety of roles. Target audiences also include the Minnesota Department of Natural Resources, Soil and Water conservation districts, U S Fish and Wildlife Services, Health and Human Service Departments and Environmental Sciences, public schools, others involved in environmental science educator programs, and youth on the White Earth Reservation in Northwest Minnesota.

Other targeted audiences for **research** projects include: other researchers, students and scholars in natural resource issues. Specialists in urban ecosystems, sustainability managers, multi-functional agriculture, environmental agencies, rural planners, public land use managers, and social and natural scientists.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	833	718421	0	0

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	4	27	31

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Master Naturalists trained and supported in Minnesota.

Year	Actual
2014	1577

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Citizens will explore their natural environment, resulting in increased knowledge and meaningful discovery about Minnesota's environment and environmental issues. (Target expressed as percentage of program participants reporting new knowledge.)
2	Citizen stewards will commit time to exploring and conserving the environment, and teach others about the environment and stewardship. (Target expressed as number of hours reported by volunteers and others involved in programs.)
3	Citizens will, through exploration, conservation and education, influence environmental conditions on significant land acreage in Minnesota. (Target expressed as number of acres Master Naturalists report that they influence each year.)
4	Citizens and professionals will be more connected with others in regional communities of interest through exploration, teaching and conserving natural resources. (Target expressed as percentage of participants who report new network connections.)
5	Researchers will partner with and provide conservation agencies with management strategies to assist endangered species in the Great Lakes region.

Outcome #1

1. Outcome Measures

Citizens will explore their natural environment, resulting in increased knowledge and meaningful discovery about Minnesota's environment and environmental issues. (Target expressed as percentage of program participants reporting new knowledge.)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Citizen stewards will commit time to exploring and conserving the environment, and teach others about the environment and stewardship. (Target expressed as number of hours reported by volunteers and others involved in programs.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	63530

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Citizen stewards for conserving the environment are often the most efficient and effective actors. Across Minnesota, citizens have been especially effective in identifying and acting to eradicate invasive species, and to monitor environmental effects.

What has been done
Through collaborative relationships within Extension programs and with other agencies, Extension mobilized a corps of Master Naturalist volunteers to address current issues in need of citizen action.

Results
More than 60,000 hours of time was invested in citizen-driven environmental projects. As noted in outcome number two, a major effort for Master Naturalists in 2014 was the identification of invasive species along important river banks.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Citizens will, through exploration, conservation and education, influence environmental conditions on significant land acreage in Minnesota. (Target expressed as number of acres Master Naturalists report that they influence each year.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1790552

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The goal of the Master Naturalist program is to harness the power of volunteers to help protect Minnesota's natural resources. To be certified as a Master Naturalist, volunteers must initially complete 40 hours of training and 40 hours of volunteer service on a supervised project. To maintain certification, they must complete eight hours of advanced training and 40 hours of volunteer service annually. Master Naturalist's make up a network of skilled volunteers who engage in outreach and increase Minnesotans' understanding and appreciation of the natural world. Volunteers also make it possible to run low-cost programs and save taxpayer dollars.

What has been done
In 2014, Master Naturalist volunteers focused on the growing problems of invasive species along vulnerable river banks. Volunteers also worked at nature centers and science museums across the state. Another long-term project cleaned up and restored a historic area located between Minnehaha Falls Park and Fort Snelling. Workshops were offered to Master Naturalists to explore major natural areas of Minnesota: Prairies and Potholes, North woods and Great Lakes, and Big Woods and Big Rivers.

Results
More than 85 percent of participants in Master Naturalist training workshops reported achieving learning gains, and more than 70 percent reported changing behavior after training. Volunteers

used that learning to create change in their communities, ultimately affecting 1,790,552 acres in 2014. Volunteer actions included seed collection, tree planting, and removal of invasive species such as buckthorn. Master Naturalist volunteers themselves find the experience life changing. One volunteer was a senior in high school when she took the Master Naturalist training and has gone on to pursue an environmental education careers. She writes, "When I became a Master Naturalist, I had no intention of making a career out of the environment. You've truly made a lasting difference for me."

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Citizens and professionals will be more connected with others in regional communities of interest through exploration, teaching and conserving natural resources. (Target expressed as percentage of participants who report new network connections.)

2. Associated Institution Types

- 1862 Extension

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)
Those who maintain the environment must remain vigilant over time. Research has shown that connections with others who care make a difference by creating sustained efforts to protect the environment.

What has been done
The development of an advanced training program for Master Naturalists sustained the interest of volunteers over time as they learned new information and developed new regional connections across the state.

Results
Advanced training of existing Master Naturalist volunteers connected them to new resources and leaders, including Ely Field Naturalists, a regional group of professionals who bring nature training to the public, residential learning centers such as Wolf Ridge and Eagle bluff, and non profits that offer experiential learning such as the Boulder Lake Environment Learning Center and Tamarack Wildlife Center. Master Naturalists were also connected with the Minnesota Conservation Corp. In fact, a Corps member now works out of the U of M Cloquet Forestry Center.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Researchers will partner with and provide conservation agencies with management strategies to assist endangered species in the Great Lakes region.

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)
The Great Lakes are a major region of importance for nesting waterbirds, but habitat destruction due to increased recreational, residential, and commercial use has put several waterbird species in danger of extinction. In 1985 piping plovers were placed on the U.S. endangered species list. Historically, piping plovers nested throughout the Great Lakes (estimated population 500-800 pairs), but declined to just 11-14 pairs, all within the state of Michigan, by the 1980s.

What has been done
University researchers began to study the piping plover in the early 1980s in collaboration with the Michigan Department of Natural Resources, the U.S. Fish and Wildlife Service, and other conservation agencies. A variety of management techniques have been utilized over the years including captive rearing, temporary artificial incubation, mini exclosures, and nest moving. Public reporting of piping plover sightings and a bird banding program run by University researchers

became important tools to determine migration routes, wintering sites and critical data on breeding.

Results

Traditionally, only 25 percent of piping plovers manage to survive and return to breed at nesting locations. Research results show fledging success is highest during hot, dry summers and the first ten days after hatching are incredibly important to provide management strategies to exclude and discourage predators and disturbance. Piping plover nesting pairs increased from 60 in 2010 to 70 in 2014, representing an important shift toward recovery of this endangered species. Additionally, birds are beginning to return to former breeding areas in northern Michigan, Apostle Islands National Lakeshore in Wisconsin, and on Manitoulin Island in Ontario. Research findings have assisted state and federal agencies in the development of and refining of conserving plans for waterbird species throughout the Great Lake region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Changes in counting methodology)

Brief Explanation

The Master Naturalist program is changing its definition of "direct" and "indirect" contacts. This has caused a shift in the number of persons served under "direct" the number served decreased dramatically (from more than 200,000 in 2013 to 833 in 2014). This should be seen as creating more integrity in our ouput models.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In past years, we have reported on the success of the Master Naturalist program in creating successful volunteers who provide education to others. In fact, past evaluations have empirically shown that Master Naturalists are seen to be a quality provider of education by those who have benefited from their volunteerism.

However, not every person trained in the Master Naturalist program provides the 40 hours of training that is requested of those who are certified. In 2014, Extension continued its evaluation of the Master Naturalist program by asking those who had not delivered 40 hours of volunteer time for the reason they did not follow through. Information from this survey can be used to improve the program in the future if factors are ones that can be addressed by the structure of the program.

There are three main reasons that inactive Master Naturalists did not follow through. The first, named by 43 percent of respondents, was a major life changing event. Of these, a move out of the area, illness or family problems were prominent. The second (with 42

percent of responses) was "other." Among "other" reasons listed was that participants had, in fact, provided the hours but had not registered them online. Other reasons included generally being too busy, not liking the training well enough to act on it, not feeling confident enough to do the work, or not being well enough informed about opportunities to volunteer. The third reason, identified by 41 percent of the respondents, was that the 40 hour commitment was too much.

Program leaders can take the information from potential volunteers to improve systems or communications. Ultimately, the goal is to provide well-informed educators and volunteers to communities across Minnesota.

Key Items of Evaluation

In 2014, Extension asked those who had not delivered the required 40 hours of volunteerism why they had not followed through. Information from this survey can be used to improve the program in the future if the factors are ones that can be addressed by program leaders.

There are three main reasons inactive Master Naturalists did not follow through in providing 40 hours of volunteer work. The first, named by 43 percent of respondents, was a major life changing event. Of these, a move out of the area, illness, or family problems were prominent. The second (with 42 percent of the responses) was "other." Among "other" reasons listed was that participants had done volunteer work but had not registered them online. Other reasons included being too busy, not liking the training well enough to act on it, not feeling confident enough to do the work, or not being well enough informed about opportunities to volunteer. The third reason, identified by 41 percent of the respondents, was that the 40 hour commitment was too much.

Program leaders can take the information from potential volunteers to improve systems or communications. Ultimately, the goal is to provide well-informed educators and volunteers to communities across Minnesota.

V(A). Planned Program (Summary)

Program # 12

1. Name of the Planned Program

Forestry and Forest Products

☑ 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
123	Management and Sustainability of Forest Resources	50%		40%	
124	Urban Forestry	25%		20%	
125	Agroforestry	25%		20%	
133	Pollution Prevention and Mitigation	0%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	8.5	0.0	33.7	0.0
Actual Paid	16.4	0.0	35.3	0.0
Actual Volunteer	0.9	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**
528053	0	416682	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1621083	0	2525769	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
748917	0	3416009	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Minnesota has over 17 million acres of forests that support a forest products industry that adds more than $8.9 billion annually to the state's economy. Research on forestry and forest products focuses on protecting and using this vital state resource to its fullest potential. Threats including diseases, pests and climate change are particularity concerning for researchers and conservationists. Diseases alone account for 65 percent of the wood volume lost in forests annually.

MAES supports basic and applied research on managing and maintaining our state's forests and developing new forest products. Some research results in this area are reported under the Climate Change and Sustainable Energy programs.

Research highlights for 2014 include:

- Surveys revealed heterobasidion irregular e (a.k.a. Circles of Death) has entered southeastern Minnesota and is causing mortality in red pines. This disease has previously been reported in Wisconsin and 24 other countries. Additional surveys are being conducted to determine the extent of the infestation, and to assist with the development of management guidelines.
- Research on wood decay fungi has revealed new information on how the woody plant cell is degraded. Results suggest the need for a new classification system for decay fungi.
- Work to map the distribution boundaries of earthworms in the region of the northern hardwood forests continues.
- Three eastern white pine disease gardens have been established in high rust risk areas. These trials will provide estimations on the level of rust resistance heritability between parents selected for putative resistance and their open pollinated, or controlled pollinated progeny.
- As part of a program working to increase white pine blister rust resistance in eastern white pine, a 23-year old progeny was planted in a high area near Lake Superior. While survival was limited to only 2.3 percent of the seedlings planted, survivors are being used in the eastern white pine breeding program.
- Researchers are collecting and storing ash seeds as part of an ash gene conservation program. To date, they have collected seed from over 350 black ash, and 150 green ash.
- About six years ago, Flavin-dependent monooxygenases were identified by U of M researchers as the most likely candidates to depolymerize-lignins. Since then, researchers' characterization of a salicylate hydroxylase from lignin degrading enzymes has led to a patent application. This represents a major discovery in the field of lignin biodegradation.
- A bid experiment was conducted with the St. Louis County Land and Minerals Department to evaluate the impact payment method has on the prices offered by timber buyers. In addition, data was collected for 584 tracts sold by the Department from 2003 to 2014 to analyze how gross revenue per acre for a timber sale is influenced by timber sale characteristics.
- Researchers studying the response of various first-year tree species to the effects of climate change found a species-specific model is best for considering emergence, and development rates, but growth and survival data can be captured in broader groupings. Specifically, the broadleaf temperate group exhibited the best growth, and conifers had the shortest survival times.
- A study modeling how global warming could increase the negative impact caused by European earthworms in northern Minnesota forests found that the effect of warming could in fact slow-down the impact by creating less favorable soil conditions for earthworms. However, the model also shows, if warming is accompanied by even distributions of rainfall, this might sufficiently offset the water losses caused by higher evapotranspiration.
- Results from focus groups with individuals owning 20+ acres in the Lake States region revealed payment amounts offered for carbon credits are not likely, on their own, to encourage participation in carbon markets. Landowners preferred the other potential benefits of carbon management (e.g., improved stand species mix, wildlife, and trails), and any potential tax benefits.

Extension. Minnesota forests are undergoing both economic and environmental stress, and

Extension forest programming in 2014 addressed those problems. Climate change is challenging native forest ecosystems and allowing invasive pest species that previously could not survive winter in Minnesota to get a foothold in northern forests.

The power of Extension's volunteer networks has been harnessed to tackle new forest threats. Results from 2014 efforts of the Forest Pest First Responder program and Wasp Watchers program are reported in Outcomes. As new research emerges on the cold tolerance of Emerald Ash Borer, forest program teams are updating management strategies. Moreover, the proactive vigilance of Extension-trained volunteer networks has meant the Emerald Ash Borer has been contained so far to only six counties in the state.

Invasive species training has been incorporated into multiple programs. For example, in 2014 an Extension forest specialist integrated education on designing insect traps into the White Earth Reservation student summer math and science program in collaboration with Reservation foresters.

Another major focus in forestland management for Extension programming has been helping private forestland owners make management decisions, and helping to encourage local community involvement of private forestland owners. As so much of Minnesota forestland is in private hands, the long term health of Minnesota forest depends on owners supporting the sustainability of their own land, as well as neighboring lands. For example, the Extension forest team has been working with groups such as the North Shore Forest Collaborative to foster community discussion about restoring conifers to forests of dying birch trees that are owned by many thousands of landowners.

In 2014, Extension continued its long running Shade Tress short course, the largest annual urban forestry conference in the U.S. This conference targets municipal tree inspectors and also trains Master Gardeners on tree care.

Another volunteer program that was piloted in 2013, the "Citizen Pruner Program," was so successful that it was expanded in 2014 to eight additional communities. Extension educators worked with communities to find and train volunteers to conduct on-the-ground pruning of city owned trees. This helped communities develop more architecturally sound trees and lessened the burden on local budgets by using volunteers for critical yet less dangerous and less technical work.

Extension forestry activities in 2014 also have supported Minnesota's tourism industry. Forest teams worked with two communities to create three "Tree Treks" which incorporate QR-coded signage for trees in urban parks for informal education of park visitors. The Tree Treks are marketed by the communities and the QR codes are linked to web sites that Extension creates for the communities.

2. Brief description of the target audience

In 2014, Extension education and support in forestry issues reached forest landowners, natural resources professionals, farmers, state and local forest policy makers, community volunteers, woodland owners, city workers who care for trees, Soil and Water Conservation officials, city foresters, and Minnesota loggers.

Target audiences for **research** include forest and forest products researchers, information specialists in natural resource management, public forest land management decision-makers and policymakers, plant pathologists specializing in tree diseases, wood products industry, biotechnology and biofuels industry, arborists, conservators, and biological science researchers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	7358	124842	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	2

Patents listed

61/953,1183/14/14 Compositions Including Lignin
14/364,4486/11/14 Lignin Degrading Methods

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	10	55	65

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops, tours, and demonstration projects that increase awareness of landowners, volunteers, loggers, natural resource professionals and businesses involved in forestry, agroforestry, urban forestry and forest products.

Year	Actual
2014	132

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Program participants (landowners) will learn new information that helps them manage forest land. (Target expressed as percentage of participants.)
2	Program participants will improve forest management on a significant number of acres. (Target expressed as number of acres on which management was improved.)
3	Extension education and outreach efforts will help control urban forest and landscape invasive species. (Outcome is the number of landowners who are working with state departments to control and eradicate invasive species because of early detection by Extension and its volunteers.
4	Extension education and outreach will help contain the spread of Emerald Ash Borer. (Outcome is the number of Minnesota counties where the emerald ash borer has been contained due to Extension's efforts.)
5	Research will provide new protocols to assist forest managers and conservationists with protecting Minnesota forests from invasive pests.

Outcome #1

1. Outcome Measures

Program participants (landowners) will learn new information that helps them manage forest land. (Target expressed as percentage of participants.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
About 45 percent of Minnesota forestland is privately owned. When landowners don't protect the conservation value of the property, it gets sold and often subdivided. When forestland is subdivided into five or 10 acre plots it is no longer economically viable. Minnesota has more than a half million forestland owners, and that population is getting older. The average age of Minnesota forestland owners is now 63. For both economic and environmental reasons, it's important that thoughtful and planned estate decisions be made about that forestland.

What has been done
To address this potential forestland fragmentation issue and help landowners make decisions that are best for them and for the environment, Extension offered a series of workshops on land transfer issues. The workshops were an interdisciplinary effort with Extension specialists in family development because workshop presenters have found it is important to start with a family conversation that articulates values before discussing options such as conservation easement, or selling intact. Because family members can be living in different places, web-based technology was used to connect family members for the discussion.

Results
A recent study of the results of this training has shown nearly 100 percent of the families who have attended the workshops engaged in family conversations about land transfer decisions, and the majority had decided to keep the land intact.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #2

1. Outcome Measures

Program participants will improve forest management on a significant number of acres. (Target expressed as number of acres on which management was improved.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many Minnesota farmers are also woodland owners. However, this woodland is often unmanaged and underused. With better management, woodlands could be an asset to farms.

What has been done
The Extension forest team established three silvopasture demonstration sites in central Minnesota. They also worked with livestock producers who practiced unmanaged woodland grazing, educating them about silvopasture as a best management tool that can be used for profit and also to improve the environment.

Results
As a result of this work, at least 30 farmers have started using silvopasture, covering at least 3000 acres. These farmers reported considerable livestock weight gain yield of $10,000-$15,000 average income per year. They also reported seeing an increased presence of wildlife in their pasture. The program's success has led to the landowners and producers exploring the potential of silvopasture to manage underground vegetation and invasive species in grazed wooded system.

4. Associated Knowledge Areas

KA Code	Knowledge Area

123 Management and Sustainability of Forest Resources
125 Agroforestry

Outcome #3

1. Outcome Measures

Extension education and outreach efforts will help control urban forest and landscape invasive species. (Outcome is the number of landowners who are working with state departments to control and eradicate invasive species because of early detection by Extension and its volunteers.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	82

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To control invasive species, early spotting of the invasion is better. Once an invasive species has a foothold, elimination of the pest is vastly more difficult and sometimes impossible. Knowledge, in this case, is power. And this power is even more important because Minnesota forest and water pests are on the rise and on the move.

What has been done
The Forest Pests First Detector program is credited for early detection of the emerald ash borer. As a result, only six counties have been affected. The Detector program trains volunteers to identify, scout, and track invasive pests. In 2014, Extension led volunteers in two large surveys of the Root and Cannon Rivers to assess the presence of four invasive species: Oriental Bittersweet, Japanese hops, cut-leaved teasel and Japanese knotweed. Volunteers surveyed 40 miles of the Root River and 40 miles of the Cannon River.

Results
All species except teasel were found. A follow up found large infestations of Japanese hops on river banks. This information was funneled to the Department of Agriculture which verifies and enters them into a Mapping System to track the range and scope of infestation. Early detection has allowed resource and land managers to perform aggressive management of invasive species, helping to control and possibly eradicate them. As a result of the efforts of the Forest Pest First Detector, the Minnesota Department of Agriculture has agreements with 82 landowners for crews to work across property lines to control Oriental bittersweet. The Minnesota Department

of Natural Resources is using the First Detectors model for early detection and rapid response invasive plant management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
124	Urban Forestry

Outcome #4

1. Outcome Measures

Extension education and outreach will help contain the spread of Emerald Ash Borer. (Outcome is the number of Minnesota counties where the emerald ash borer has been contained due to Extension's efforts.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The problem with identifying a new Emerald Ash Borer infestation is that ash borers stay hidden in the leaves of a tree while they girdle its bark. By the time they are noticeable the damage is done. But one wasp has been identified as the ash borers enemy. Finding the wasp can track the emerald ash borer.

What has been done
An offshoot of the First Detector program, the Wasp Watcher program is a citizen science project that uses the Cerceris wasp, which does not sting humans, for bio-surveillance. Volunteer Wasp Watchers are trained to identify the wasp and find its nests, as the wasp can be followed to find the ash borer. The wasp likes full sun and sandy compacted soils for its nests, making them easy to spot at ground level. Elementary school ball fields have been found to be a favorite nesting spot of the wasp.

Results
In 2014, with the help of new and returning volunteers, more than 40 new sites were checked and 10 confirmed Cerceris colonies were found. Thirteen colonies were found at baseball diamonds in the Twin Cities and Rochester. Sites were monitored in the six counties where emerald ash

borer has been identified. Minnesota's aggressive detection system has been credited to keeping the ash borer infestation to only six counties. The Wasp Watcher project is getting citizen volunteers involved in collecting mass quantities of data that allow the state agencies to better manage their resources and target their response to control invasive species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
124	Urban Forestry

Outcome #5

1. Outcome Measures

Research will provide new protocols to assist forest managers and conservationists with protecting Minnesota forests from invasive pests.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Non-native earthworm invasions are causing substantial adverse effects to hardwood forest ecosystems in Northern Minnesota. Earthworms threaten the long-term productivity of forests by eliminating understory plants, reducing tree regeneration, increasing soil compaction and erosion, and causing nutrient runoff.

What has been done
Researchers set out to create a rapid assessment method to measure the level of earthworm invasion at a location based primarily on a visual assessment of the forest floor. They worked at two sites, one in northeast Minnesota and one in northwest Wisconsin where they calculated earthworm biomasses, and uncovered relationships between individual forest cover matter and the presence of different species of earthworms.

Results
A five-stage rapid classification protocol was developed for conservationists, land managers biological technicians, researchers, and citizen science monitoring programs to use for assessing

earthworm invasion. A two-hour training session has been made available, and feedback shows the training was easy to follow, and 90 percent found it critical for effectively assessing earthworm invasion. This protocol can also serve as a blueprint to develop protocols in other regions experiencing earthworm invasions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (no factors)

Brief Explanation

The goal of engaging with communities and landowners to strengthen the stability of Minnesota's forests is being achieved.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Forestry team tracks whether education of citizens and professionals results in local action to protect forests or to use them for economic or natural resource gains. In 2014, education resulted in better use of silvopasture on Minnesota farms and helped Minnesota address invasive species on river banks and in communities.

Key Items of Evaluation

In 2014, education resulted in better use of silvopasture on Minnesota farms and helped Minnesota address invasive species on river banks and in communities.

V(A). Planned Program (Summary)

Program # 13

1. Name of the Planned Program

Agricultural Business Management

☑ 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
601	Economics of Agricultural Production and Farm Management	50%		20%	
602	Business Management, Finance, and Taxation	50%		20%	
603	Market Economics	0%		30%	
604	Marketing and Distribution Practices	0%		20%	
610	Domestic Policy Analysis	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	11.1	0.0	4.8	0.0
Actual Paid	17.6	0.0	13.7	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**
597445	0	243846	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1765590	0	737963	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
583945	0	2664537	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension
Minnesota farmers faced a far different economic reality in 2014 than the last few years, with record corn and soybean prices loweredand an increase in crop production expenses and farm rental rates. Sound agricultural business management became even more critical. In the midst of tight profit margins and uncertainty about the implications of the new Farm Bill, the education and support offered by Extension agricultural business management programming in 2014 was especially important.

Major programming focused on maintaining several Extension Agricultural Business programming in 2014. The Ag Business Management team focused on maintaining several long term programs while they educated Minnesota farmers on the implications and new policies of the new Farm Bill. The Agricultural Act of 2014, commonly called the Farm Bill, changes many programs and rules affecting farms. The Extension ABM team developed local and online training and workshops to help farmers make decisions regarding Farm Bill programs. Educational events for crop farmers began at the end of 2014 and continue, and outcomes will be reported in 2015. So far Extension and the Minnesota Farm Service Agency have partnered to conduct 37 meetings with more than 6,500 attendees. Results from Farm Bill education and training for dairy producers are reported in the Outcomes section of this report.

Extension Agricultural Business Management program delivers significant portions of its content through websites and online learning, extending its reach and accessibility. For example two websites provide a wealth of land economic information including landeconomics.umn.edu, which had 8451 visits last year and FINBIN with 14,680 visits. The Farm Transition and Estate Planning programming which was detailed in the 2013 report continues to produce significant action outcomes. Another series of workshops reached 183 farmers. More than 46 percent of them reported that they had completed a business transition and personal estate plan within six months of attending a workshop. Requests for the farm transition estate planning information have come from North Dakota Extension, University of Maine Cooperative Extension, Irish Agricultural and Food Development Authority, and the Canadian Ag Consortium. Another important program reported this year under Outcomes focused on long-term health care planning to protect farm assets.

MAES research to improve the profitability of Minnesota agriculture included studies in risk analysis, and in analysis of regulatory policies to support the stability of agricultural business. Profitability of niche markets like organic dairy was of particular interest to researchers in 2014 along with concerns of broader market trends like successfully transitioning to organic farming. While finding ways to utilize new technologies to increase farm profitability is seen as important to the industry, research is needed to first access the risk/benefit in adopting these technologies.

Research highlights for 2014 include:

- Researchers developing transition guidelines for farmers considering switching to organic hosted three sessions with organic crop consultants, organic inspectors, and organic grain buyers, along with, organic and transitioning farmers. They gathered input from attendees on project plans. Attendee feedback showed weed control, and fertility remain the top concerns for those considering the transition.
- Fourteen e-learning modules along with several organic transition case studies are in development to provide farmers needed information and insights into the benefits and potential pitfalls involved with the transition to organic.
- A recent study completed on farmers transitioning to organic systems identified significant problems facing transitioning and recently certified organic farmers. Overall time requirements, access to capital, current profitability, and cash flow challenges were identified as management problems by survey respondents. Cost and availability of inputs, yields, weed management, and access to land were identified as additional concerns.

• Researchers conducted a study to uncover why a high profit group of farmers was increasing in profit compared to a low profit group. They worked to identify characteristics, practices, and tendencies of the top income group that differ from the rest of farmers studied. One significant difference was the increased likelihood of low income group farmers to have inherited their farm from family while high income farmers had often purchased from family members. A second key finding was that farmers in the high income group spent more time reading farm management educational materials.

• Research on stockmanship training on dairy farms arranged for seven dairy farms in Minnesota and Wisconsin to participate in their study (six of the seven agreed to have video surveillance installed). Video and injury reports pre and post-training will allow researchers to analyze whether stockmanship training decreases injuries for workers, increases cattle flow, and profitability on dairy farms.

• Lameness in horses is among the most important issues for horse owners, and it has a significant economic cost to the equine industry. Researchers enrolled 11 horses in a study on the effects of anti-inflammatory proteins on lameness.

• Researchers have begun a project to access how the stacking of multiple plant-incorporated-protectants and herbicide tolerant crop traits has affected corn farmers' pest management decisions over the past decade.

2. Brief description of the target audience

Major audiences for this program are Minnesota farm owners, farm families, and farm managers. Audiences also include farm management professionals, rural financial institutions, agricultural leaders, and state and federal policymakers. Other audiences include local Extension educators, regional office directors, farm information line staff, and Minnesota State College system farm management instructors. Other target audiences for research include farmers and researchers interested in crop, livestock, organic cropping systems, food processors, food retailers, food system professionals, policymakers, national and international food and trade analysts, and scholars interested in food systems, rural financial institutions, and micro-finance in institutions and policymakers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8127	25931	0	0

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	3	14	17

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational events that deliver agricultural business management content.

Year	Actual
2014	147

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants of the Agricultural Business Management (ABM) program workshops/classes and conferences will achieve significant learning gains regarding research-based agriculture business management knowledge and skills. (Target expressed as the percentage of participants who achieved significant learning gains as a result of attending ABM program workshops/classes and conferences.)
2	Participants of Agricultural Business Management (ABM) workshops/classes and conference sessions intended to improve participant agriculture business management practices will significantly improve their management practices as a result of attending the program. (Target expressed as a percentage of participants that significantly changed one or more of their agriculture business management practices as a result of attending workshops/classes and conference sessions intended to improve participant management practices.)
3	Research will provide information to horse owners and industry professionals on new management strategies related to horse diets.

Outcome #1

1. Outcome Measures

Participants of the Agricultural Business Management (ABM) program workshops/classes and conferences will achieve significant learning gains regarding research-based agriculture business management knowledge and skills. (Target expressed as the percentage of participants who achieved significant learning gains as a result of attending ABM program workshops/classes and conferences.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Current statistics indicate that one in two people will need some long-term health care in their lifetime and one in ten people will have a nursing home stay of more than five years. Today in Minnesota, the average annual cost of a semi-private nursing home room is $75,000. Given current Minnesota Medicaid rules, the only way to protect farm or small business assets for long-term health care costs is to purchase long-term care insurance. Not addressing this issue potentially places farm or small business assets at financial risk, especially if the current business operator has an heir that wants to continue the business.

What has been done
Agricultural Business Management educators and specialists offer long-term health care planning workshops. Extension collaborated with two elder law attorneys to develop the content. Six months following each workshop, participants were asked to complete a follow up evaluation to assess changed behavior and find out what actions the participants had taken and the results of those actions.

Results
One hundred percent of participants said they had increased knowledge of the issues and 85.7 percent said they had begun the planning process. They reported the amount of business and personal assets sheltered from long-term health care costs as a result of having a plan in place. The dollar amount they reported, and thus the financial impact of the program effort, was more than $11 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation

Outcome #2

1. Outcome Measures

Participants of Agricultural Business Management (ABM) workshops/classes and conference sessions intended to improve participant agriculture business management practices will significantly improve their management practices as a result of attending the program. (Target expressed as a percentage of participants that significantly changed one or more of their agriculture business management practices as a result of attending workshops/classes and conference sessions intended to improve participant management practices.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Farm Bill passage in 2014 contained many new policies and directions that farmers needed to absorb to make decisions about their own operations. The Dairy Margin Protection Program was introduced in the Farm Bill and took the place of former Farm Bill programs that related to dairy. The program allows dairy producers to protect a portion of their milk production from declining milk-feed margins. Dairy producers had several decisions they needed to make: whether to sign up or not; is so, how much milk production to protect, and at what margin to protect their milk production.

What has been done
Extension presented 18 meetings across the state in October and November, in addition to online training, in partnership with the Minnesota Farm Service Agency. More than 940 farmers attended these training sessions, representing Minnesota dairy operations with an average of 150 cows.

Results

More than half the participants said they intended to use the information they learned to make decisions regarding the Dairy Margin Protection Program. Estimates of the total gross farm revenue the participants reported they would protect using the tools the training offered ranged from greater than $2 million to less than $100,00, with a little more than half reporting $100,000 to $500,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
603	Market Economics

Outcome #3

1. Outcome Measures

Research will provide information to horse owners and industry professionals on new management strategies related to horse diets.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In Minnesota, the horse industry contributes $1 billion to the state's economy annually. Hay is likely the most expensive dietary component for adult horses, while pasture represents a more affordable feed option, at approximately one-third the cost of hay.

But pasture feeding raises concerns of overeating and even malnourishment if pasture spaces do not contain a proper mix of forages. Many horse owners are in need of management strategies that restrict pasture intake while maintaining a horse's natural environment.

What has been done
Researchers conducted an experiment to explore the effect of grazing muzzle use and forage type on horse intake. The research team planted 10-by-20 foot plots with different types of grass.

They employed four adult stock horses that had been acclimated to wearing grazing muzzles. For two years, the horses were given access to the grazing plot (50 percent of the time with muzzle and 50 percent without). Researchers then calculated the amount of grass the horses consumed. Results showed that grazing muzzles limited horse intake by 30 percent, regardless of the forage species available.

Results

These results will aid horse owners and professionals in estimating forage intake of muzzled horses on pasture, and provide a better understanding of how to optimize forage use in horse diets, translating into economic efficiencies for horse owners, and improved horse health. Results were presented to horse owners and industry professionals through several mediums, including face-to-face Extension horse ownership programs and field days, websites postings, e-newsletters sent to over 3,000 horse owners, and presentations at the 2014 Midwest American Society of Animal Science and American Society of Animal Science meetings.

In total, one million horse owners and industry professionals were reached in Minnesota and throughout the U.S.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Competing Programmatic Challenges

Brief Explanation

Goals were met in this program, but the need for education about the farm bill changed the type and amount of programming that was delivered in 2014.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The results of a 10-year cumulative evaluation of agricultural business management programs in farm transition and estate planning completed in 2014 and showed that 198 businesses in the program had developed and implemented a business transition plan. Two hundred and seventeen businesses had developed and implemented an associated personal estate plan. When the program results in an orderly plan for transfer of the farm business and personal assets to the next generation, the effect is protected assets. The value of protected assets due to the program is more than $460 million. This translates into a financial impact of more than $7,800 per dollar of program cost spent over the ten-years.

Key Items of Evaluation

Tracking the management changes and investments of those who participate in programming helps program leaders understand the financial impact of the program. The financial impact of this program where there is now an orderly plan for transfer of the farm business and personal assets to the next generation is over $460 million. This translates into a financial impact of over $7,800 per dollar of program cost spent over the ten-years.

V(A). Planned Program (Summary)

Program # 14

1. Name of the Planned Program

Housing

☑ 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
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	100%		100%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	1.7	0.0
Actual Paid	11.4	0.0	4.8	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**
405548	0	60569	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1499263	0	350684	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
475896	0	173371	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES research in housing spans several departments and research groups, including the work of

researchers in social science, community economics, design and public policy. More often than not, MAES research is connected back to Extension education programming and compliments Extension's work in this area.

One new research project for 2014 is looking at pest management in urban housing and how research can offer new information on pest dispersal. Additionally, researchers in this area are placing more focus on under-served populations whom are often at risk for housing issues.

Research highlights for 2014 include:

- Researchers exploring the effects of recreational housing in rural areas expanded their collected data by adding a case study in Aitkin County.
- Last year, we mentioned a move toward researchers exploring groups at high risk for housing security issues, such as seniors and low-income families. In 2014, focus groups with African American seniors in the Twin Cities area were completed and are now being analyzed.
- We have previously mentioned a cross-cultural study being done on housing needs that takes into account the requirements of varying cultural groups. This year, researchers identified eight principles needed for culturally sensitive design which will aid community leaders and minority group advocates.
- In an ongoing study of multi-family housing, interviews were conducted with owners, architects, property managers and residents of five affordable multi-housing projects in the Twin Cities. Researchers will assess this data concerning energy and water consumption in the buildings.

Extension.

The housing market is slowly recovering from a long downturn, and economic pressures have increased the need for sound decisions on the part of both builders and buyers. Extension housing programming supports Minnesota's housing industry, and provides information to potential buyers on energy efficiency and new housing options. The impact of Extension radon training programming was discussed in 2013. This program continues to train home inspectors, contractors and builders to test occupied housing for indoor radon concentrations and how to mitigate harm. Course graduates have reduced radon in more than 60,000 homes per year.

Another highlight of the Extension Cold Climate Housing program in 2014 was collaborating with the U of M Center for Sustainable Building to create an exhibit on high-performance housing for the Eco Experience building at the Minnesota State Fair. The building attracted more than 100,000 visitors during the 10-day event. It was an opportunity to demonstrate four efficient and durable Zero Energy Ready home construction systems that the Cold Climate Housing team has been modeling and demonstrating to builders and contractors. Extension's housing team is small, but in 2014 it increase its visibility and impact to larger audiences.

2. Brief description of the target audience

The target audiences for Extension housing programs are builders, remodelers, contractors, radon mitigaters and others involved with avoiding and resolving environmental problems in homes. Another audience is home owners and prospective home buyers interested in innovation and energy efficiency in new home construction and energy retrofit options for existing homes.

The target audience for research also includes economic developers, planners, elected officials, businesses interested in the housing stock market of their communities, social science researchers, interior designers, architects, urban designers, and planners.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1272	7000	0	0

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	3	2	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Educational courses will be delivered to the target audiences.

Year	Actual
2014	58

Output #2

Output Measure

- New research will result in the development of new and revised educational materials. (Target expressed as the number of new or revised curriculum materials.)
  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	Improve the durability of new homes by working with builders. (Target expressed as the number of builders trained.)
2	Improve the availability of healthy and affordable housing through the mitigation of indoor environmental risks. (Target expressed as number of homes affected.)

Outcome #1

1. Outcome Measures

Improve the durability of new homes by working with builders. (Target expressed as the number of builders trained.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1272

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New housing construction costs are rising while existing home prices are still not back to previous levels. As a result, builders are experiencing pressure to keep costs down and provide innovative, energy efficient homes. Home remodelers also need options to improve the health and energy efficiency of existing Minnesota homes.

What has been done
A new set of workshops focused on high performance building practices. Housing specialists provided information on Zero Energy Ready Homes efficient enough to use a renewable energy source such as solar. Training also demonstrated three new techniques to improve energy efficiency in existing homes. One was a method to add exterior foundation insulation; another installed a high efficiency water heater to heat both space and water in a home. Another innovation resolves ice dams by wrapping a roof from the outside.

Results
All three of these options were demonstrated at an affordable housing project in north Minneapolis, which was put on the market and sold. The innovative home building and retrofitting innovations demonstrated at the workshops are now being accepted and used by some Minnesota builders and contractors who are interested in establishing in a niche market. One builder who collaborated on a Parade of Home high performance home in 2013 received a Housing Innovation Award given by the U. S. Department of Energy for leading edge construction.

4. Associated Knowledge Areas

KA Code	Knowledge Area
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #2

1. Outcome Measures

Improve the availability of healthy and affordable housing through the mitigation of indoor environmental risks. (Target expressed as number of homes affected.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bed bugs have been a household pest for over 3,300 years. In the 1950's bed bug populations were dramatically reduced thanks to mass insecticide treatments like DDT and Lindane. However, in recent years, bed bugs have become an increasing issue with every state in the U.S. reporting infestations. Bed bugs impact overall health, finances, and even the emotional well-being of those facing an infestation.

What has been done
Researchers and extension educators are focusing on integrated pest management strategies (IPM) and developing key partnerships to attack the bed bug issue with Extension's "Block the Bug 2020" campaign. The Bedbug.umn.edu website received 436,733 visits during the reporting period (a 300 percent increase over 2013). The site features three multilingual bed bug control videos developed in partnership with City of Minneapolis, Minnesota Department of Agriculture, and ECHO Minnesota. Additional research is now taking place to discover more on how and why pests move within and between city buildings and how this movement can be anticipated and ultimately stopped. A SCOPE (Scientific Coalition On Pest Exclusive) leadership group was assembled to aid in this process.

Results
By using IPM strategies researchers plan to reduce bed bug populations without negatively impacting the environment. By focusing on awareness and outreach they are catching infestations early which help limit costs for both individuals and property managers, and ultimately

the spread of these pests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges

Brief Explanation

The limited number of housing specialists in Extension was decreased even more in 2014, due to retirements. This depleted the accomplishments of the program.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations of housing programs involve models by the Environmental Protection Agency, along with known learning gains and behavior changes among home inspectors, contractors, and builders who participated in measurement and mitigation courses. In 2014, programming was focused on incorporating new energy-saving technology into the work of home builders.

Key Items of Evaluation

In 2014, programming was focused on incorporating new energy-saving technology into the work of home builders.

V(A). Planned Program (Summary)

Program # 15

1. Name of the Planned Program

Horticulture

☑ 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
102	Soil, Plant, Water, Nutrient Relationships	5%		15%	
132	Weather and Climate	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		20%	
204	Plant Product Quality and Utility (Preharvest)	20%		15%	
205	Plant Management Systems	50%		20%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		15%	
213	Weeds Affecting Plants	5%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	13.1	0.0	59.7	0.0
Actual Paid	17.5	0.0	49.7	0.0
Actual Volunteer	66.7	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**
565519	0	449823	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1852511	0	4419595	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
803827	0	4801486	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES horticultural research supports a growing and diversified sector of Minnesota agriculture, including fruit and ornamental crops, vegetables, potatoes, forages, and grasses. U of M horticultural research is perhaps best known by its "stars" - the Honeycrisp apple, and the Frontenac, Marquette and La Crescent wine grapes that made the Minnesota wine industry possible. But U of M horticultural research has had impact on a wide range of crops and management practices with a recent increased focus on organic cropping systems, and the effects of pesticides.

One new project began in 2014 exploring the effects of high tunnel environments for organic horticultural crops. Beyond extending our local growing season, high tunnel systems can improve fruit and vegetable crop quality, while protecting vulnerable plants from bad weather, pests, and diseases.

Research highlights for 2014 include:

- Grape breeders have been working hand-in-hand with enologists to breed new cold-hardy grape cultivars with lower sugar and acidity levels. Several new selections within the breeding program are showing promise in this area.
- Two of five grape cultivars (MN 1220 and MN 1258) that were released for trials in nine other states have been determined to have excellent fruit and wine quality. They will be considered for commercial release in the near future.
- The University's first pink blueberry, Pink Popcorn™ (formerly MNPINK1) was released and licensed in 2014. It is the first pink blueberry hardy to zone 3.
- Six apple selections are in advanced testing at multiple sites throughout the U.S. and one completed testing and was released in 2014.
- A new DNA test was developed to predict apple scab resistance, moving forward this will be used to assist with the selection of parents, and seedlings in the apple breeding program.
- Two potato varieties, MonDak Gold and Runestone Gold are now being grown as certified seed, and tested in various markets.
- Research conducted on increasing the red color of potatoes discovered future research in this area should concentrate on increasing biosynthesis of anthocyanins rather than on soil conditions.
- A gene expression study on wild potatoes has identified cold tolerance genes that can be transferred from wild species to crop plants for improved resistance.
- A study on the effect of insecticides used for tree disease management on nearby perennial plants found that the use neonicotinoid imidacloprid reduces the survival of some insects including lady bugs and butterfly larval.
- U of M scientists exploring the connection between golf course turf and pesticides discovered that a clothianidin insecticide application to bluegrass resulted in 171 ppb clothianidin in clover nectar. This is a

sufficient number to reduce bumblebee colony health (which in previous research was found to be as low as 20 ppb).

• Two new cultivars of perennial ryegrass were licensed to growers in northern Minnesota (Green Emperor and Royal Green).

• A new breeding program was initiated in hairy vetch (Vicia villosa) for use as a cover crop with breeding objectives to improve winter hardiness, and early maturity.

• Twenty-six fine fescue varieties were subjected to heat stress tests. Overall, the varieties exhibited superior tolerance to heat stress, and maintained high quality throughout the tests.

• A survey with land managers identified management and aesthetic characteristics as the most important for consumers when considering alternative low-input grasses.

• A new dwarf phenotype of interspecific Gladiolus xhybridus with a compact inflorescence was discovered 2014. This new plant has potential for use for both indoor potted plants, and containers.

• A 13-month field experiment comparing the growth and genotypes of reed canarygrass in both wetland, and upland conditions found a significant genetic variation that researchers plan to explore further.

• Using LC-MS University plant researchers have discovered a quick way to screen for IAA conjugates and identify novel indolic compounds in plants.

• A lawn care survey was conducted in July 2014 with homeowners in the Twin Cities area. Of the 359 respondents, 31.8% had inaccurate perceptions of the path that water travels when it left their yard. Those with inaccurate perceptions were found to water, fertilize, and apply pesticides at higher rates, and be less aware of the potential environmental impacts of their lawn maintenance.

• A three-year survey in the Prairie Pothole region of ND was conducted on native bees. Over 160 species were identified, and conclusions on the requirements for forage and nesting habitats will help policymakers protect native bee populations.

• A long-term experiment was completed on enemy exclusion in prairie plots. It found that fungicides receive the greatest benefits (increases in plant productivity) in high diversity as compared to low diversity plant communities.

Extension

The Extension Horticulture program is broad, including programming for commercial fruit and vegetable producers, the landscape and greenhouse industry, and Minnesota home gardeners. It is best known statewide by the general public for its Master Gardener program, which in 2014 received new energy and impetus with a new statewide director, 2.5 FTE's added, and its home base moved to the University of Minnesota Arboretum in Chaska, Minnesota. More than 2,300 trained Master Gardener volunteers give 130,400 hours of service in their communities each year.

In 2014, the Horticulture program was on the front line addressing home gardeners and horticultural industry growers about the changing climate. Questions related to the increase in dramatic weather events, plant growth zone shifts, changes in plant selection, and cultivation practice adjustments. Change in action impacts are reported in the Outcomes section.

Some activities and impacts from Horticulture programming in 2014 include:

• Landscaping education for home owners showed them how to use native and heirloom plants to reduce erosion along lake shorelines.

• Extension educators identified new lawn disease problems resulting from a cold and wet spring. The team helped owners manage the disease without the use of fungicides.

• An Extension horticultural specialist worked with the Minneapolis Parks and Recreation board to restore the turf around a city lake.

• A Colorful Growers project in one community provided youth with business experience growing produce and selling it at local venues.

• Horticultural specialists promoted pesticide reduction with the use of biorational insecticides that are compatible with the conservation of beneficial insects and pollinators at integrated pest management program workshops for turf growers, landscapers, greenhouses, nurseries, and retail garden centers.

• An Arboretum and Extension learning garden hosted a "Smart Snacks" event. The Smart Snack garden concept grows healthy snacks (edible plants) for both people and bees. Master Gardeners shared information about how to create community gardens at schools, churches, libraries and other public places.

• A multimedia ebook released in 2014 has been accessed by more than 1,000 Minnesota strawberry growers.

• Master Gardeners represented Extension at the Gichi Manidoo Giizus Pow Wow in 2014, and told the story of the Fond du Lac Extension Master Gardeners who volunteer on behalf of the tribal community.

• Summer classes sponsored by Master Gardeners in two urban counties called Evenings in the Garden hosted a group of teens from the local juvenile alternative facility, offering them a look at opportunities for jobs in landscaping and the world of gardening.

2. Brief description of the target audience

The audiences are:

1) Fresh market producers, including growers of fruits and vegetables for processing, the processing industry, associated agribusiness turf professionals, nurseries and garden centers, and landscape professionals. Several of these groups have high representations of new immigrants.

2) Consumers of horticultural information for yards, gardens and landscapes. These include audiences where information is needed in a timely fashion and those who want to build basic knowledge about horticulture and environmental stewardship over time. Community-based initiatives mobilize schools, neighborhoods, and non-profit organizations to create and maintain green spaces.

3. How was eXtension used?

Extension Horticulture specialists shared expertise and information; Master Gardeners accessed horticultural information.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	263252	2163949	0	0

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

Patent Applications Submitted

Year:	2014
Actual:	3

Patents listed
13/999,110 1/14/2014 Rhododendron plant named UMNAZ 493
13/999,113 1/14/2014 Rhododendron plant named UMNAZ 502
ROII29159138 12/11/2014 Antibacterial and Antifungal Flavanone-3-alkyl Esters for Use in Agriculture and Human Health

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	9	36	45

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops, classes and seminars that provide information to professionals in the commercial horticulture industry.
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of volunteer hours leveraged by Master Gardeners, trained by Extension, will deliver hours of educational service to the residents of Minnesota. (Target expressed as the number of volunteer hours committed by Master Gardeners in a year.)

Year	Actual
2014	130400

Output #3

Output Measure

- Number of horticultural educational and training events offered to professional and home gardeners and Master Gardeners

Year	Actual
2014	24117

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants of Horticulture program events will achieve significant learning gains regarding horticulture. (Target expressed as the percentage of participants who achieved learning gains.)
2	Participants of Horticulture program events intended to improve participant horticulture practices will improve practices as a result of attending events. (Target expressed as a percentage of participants that changed one or more horticulture practice.)
3	Research will support niche horticultural crops' growth.
4	Education will create opportunity for change in horticultural practices to support community environmental health. (Target is the number of municipal golf courses changing management behaviors to protect bees.)
5	Research and Extension will support change in horticultural practices to reduce pesticide use that affects bee health.
6	Research will develop new hardy plant varieties with desirable qualities for consumers.
7	Research will develop new fruit varieties to increase consumer interest and extend growing seasons for producers.

Outcome #1

1. Outcome Measures

Participants of Horticulture program events will achieve significant learning gains regarding horticulture. (Target expressed as the percentage of participants who achieved learning gains.)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Participants of Horticulture program events intended to improve participant horticulture practices will improve practices as a result of attending events. (Target expressed as a percentage of participants that changed one or more horticulture practice.)

2. Associated Institution Types

- 1862 Extension

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)
Currently, there are 2,000 to 2,500 Minnesota high tunnels operating in Minnesota. Growers have now successfully used high tunnels long enough to experience disease issues associated with lack of rotation, density in planting, and humid, warm conditions in tunnels. Surveys in previous years revealed that growers are unaware of or unable to diagnose disease of their high tunnels. Resolving this problem is vital for the sustainability of the Minnesota high tunnel industry.

What has been done
Extension Horticulture specialists surveyed more than 18 high tunnels throughout the year and provided disease diagnostic services to Minnesota high tunnel growers. They used the data to determine which diseases were important to high tunnel vegetable production and delivered that information to growers at site visits, conferences, and individual consultations.

Results

Follow up showed that growers are not only better able to identify several of the most important and most common diseases but several are rotating and changing management practices to manage disease.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants

Outcome #3

1. Outcome Measures

Research will support niche horticultural crops' growth.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Demand for locally grown produce, including strawberries, is high in Minnesota. However, our cold winter temperatures make it hard to grow perennial strawberries. And even when Minnesota growers are successful, local berries are only available for a short three-week period in June.

What has been done
University of Minnesota scientists are working with day-neutral strawberry varieties, which are annuals that do not need to survive Minnesota winters or require the long-days of June to bear fruit. While typically these varieties have not performed well in cold climates, researchers have been experimenting with the addition of low tunnel systems to decrease issues connected to poor weather, climate, and even pests.

Results
In 2014, an e-book was created for commercial strawberry growers providing general guidance and information on new management techniques being discovered at the University. While day-neutral berries do not fruit until late-July, when combined with a low tunnel system, they can continue to fruit through October. Not only does this extend the season by up to four months for growers, but it also allows consumers to enjoy locally produced fresh produce for a much longer period.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #4

1. Outcome Measures

Education will create opportunity for change in horticultural practices to support community environmental health. (Target is the number of municipal golf courses changing management behaviors to protect bees.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The decline of honey bees and wild bee pollinators continues to attract attention and concern worldwide. People want to help honey bees and native bees by planting bee-friendly flowers and reducing the use of insecticides that harm bees, as well as herbicides that kill floral resources for bees.

What has been done
Extension Bee Squad programming trains beekeepers and provides ways for the public and organizations to help bees. The Bee Squad program grew significantly over the past three years. In 2012, The Bee Squad began keeping bees at a local golf course. In 2014, the program was

widely celebrated, and they met with the executive director of the Minnesota Golf Course Superintendents' Association to talk about about how golf courses could make their grounds friendlier to bees. This information was shared with the superintendents of Minnesota golf courses.

Results
The Bee Squad is now in conversation with six additional golf courses in the Twin Cities area which are interested in the Hive to Bottle program. More importantly, the golf courses have made decisions about managing their grounds that are in the best interest of bees and other pollinators. They have reduced pesticide input and are willing to pay more for pesticides that are safer for bees.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #5

1. Outcome Measures

Research and Extension will support change in horticultural practices to reduce pesticide use that affects bee health.

2. Associated Institution Types

- 1862 Extension
- 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)
When insecticides were first developed, their use in protecting plants was embraced because they were not toxic and were applied to soil rather than sprayed, reducing nontarget effects on beneficial insects. Neonicotinoid insecticide imidacloprid was registered in 1994 and is now the second most widely used agrochemical in the world. A problem with the use of systemic insecticides is that they remain in the plant and are expressed in pollen and nectar. This translocation of systemic neonicotinoid insecticides into pollen and nectar could be a factor

contributing to decline in honeybees and bumble bees. However, how much insecticide was translocated from soil to pollen and nectar in flowering plants was not known.

What has been done
In 2014, a UMN researcher and Extension horticultural specialist demonstrated that flowers of nursery and greenhouse plants contained levels of systemic neonicotinoid insecticides that alter behavior and killed off foraging beneficial insects such as lady beetles, lacewings and bees. She brought her research to Master Gardeners, home gardeners, and horticultural industry groups. Master Gardeners shared information in meetings and consultations. People began to realize that insecticides might influence bee and beneficial insect health and decided to alter their insecticide use.

Results
Engaged citizens brought concern to local community officials and local ordinances were developed to reduce systemic insecticide use in favor of shorter acting insecticides. The specialist testified at the Minnesota State Legislature and, convinced by this testimony, Minnesota state bee labeling laws were established to protect bees by reducing the use of systemic neonicotinoid insecticides on flowering plants that bees visit. As of July 1, 2014, a new plant labeling law is now in effect in Minnesota to protect pollinators from exposure to toxic levels of insecticides. The new law requires that plants advertised as "beneficial to pollinators" must be free of detectable levels of certain systemic insecticides.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #6

1. Outcome Measures

Research will develop new hardy plant varieties with desirable qualities for consumers.

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)
Azaleas are highly desired for their showy, colorful blossoms. While landscape staples in more temperate regions, historically azaleas have not been hardy passed -4°F. Even when northern gardeners could find a cold hardy variety, they have had to settle for shades of pinkish-mauve.

What has been done
Researchers first began crossing northern hardy azaleas with their more colorful southern versions in 1957. Through these initial crosses, a discovery was made. Crossing plants from the northern and southern zones results in a plant that in its second generation is hardier than the original northern parent. Twenty-one years later, the first cold hardy azaleas were introduced to the nursery industry.

Results
Since the initial release in 1978, U of M plant breeders have focused on expanding the line with new colors, increased disease resistance, attractive fall foliage, increased fragrance, and even extended bloom periods. New technology allows breeders to eliminate crosses with undesirable characteristics much earlier in the process saving breeders time, resources, and money. In total, 16 azaleas have been released by the University of Minnesota (including two new releases which will be available Spring 2015) that feature cold hardiness to zone 3 and flower bud hardiness of -30° to -45° F. The "Lights Series," as they are known, feature hues from traditional pink-mauves to red, orange, white, lemon yellow, peach, and lilac.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)

Outcome #7

1. Outcome Measures

Research will develop new fruit varieties to increase consumer interest and extend growing seasons for producers.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota is home to around 150 apple growers and produces millions of apples every year. Expanding the apple growing season for these and other northern growers is a complicated process since the season cannot be pushed back without risking frost damage.

What has been done
University of Minnesota apple breeders have been utilizing the strong genetic stock available in our breeding program to develop new cold-hardy apple varieties that offer (1) great crisp texture, and taste and (2) earlier ripening dates than varieties now on the market. In the late 1990s, they set out to develop an apple that would combine the wonderful texture and flavor of Honeycrisp with the desired earlier ripening date found in more southern varieties. In total, approximately 14,000 varieties were considered and discarded with one hitting the mark.

Results
In 2014, MN55 was officially released to the market. A cross between Honeycrisp and MonArch, MN55 promises a crisp, juicy taste that will ripen up to four weeks before Honeycrisp, thus extending the Minnesota apple season into late August and opening northern orchards up to Labor Day weekend visitors. Notably, MN55 is also the fastest apple variety to complete the breeding cycle in the University's 100 year apple breeding history. It took only 17 years from start to finish.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Other (No factors)

Brief Explanation

Horticulture programs leverage the interest of volunteers and the science of research to tackle specific challenges. Several challenges were addressed in 2014.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Horticulture programs leverage the interest of volunteers and the science of research to tackle specific challenges. Several challenges were addressed in 2014. Evaluation of horticulture programs examine the degree to which behaviors are changed or organizational or policy changes are made as a result of education. In 2014, horticulture programs effectively changed behaviors that support bee health and further the role of high

tunnels in increasing the season for growing vegetables in Minnesota's cold climate.

Key Items of Evaluation

Evaluation of horticulture programs examine the degree to which behaviors are changed or organizational or policy changes are made as a result of education. In 2014, horticulture programs effectively changed behaviors that support bee health and further the role of high tunnels in increasing the season for growing vegetables in Minnesota's cold climate.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
8200	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
456	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
2	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
5	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.