

2015 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 the accomplishments of the University of Minnesota's Agricultural Experiment Station (MAES) and Extension in 2015. Fifteen programs provide the organizing structure to report both MAES and Extension outcomes and to address NIFA priorities. Two programs -- agricultural business management and water resources -- have been added as federal programs because of considerable programmatic effort brought to these issues in 2015. Agricultural stakeholders charged Extension with delivering farm bill education, and new partnerships have come into place to protect Minnesota waterways.

Extension reports on programs and initiatives as defined by our structured programs and NIFA priorities. MAES describes research conducted for those program issue areas. In many cases, MAES research informs Extension programming. Only one program in this joint Extension and MAES report, Youth Development, has no MAES component.

MAES. Summary of 2015 Activities

This report summarizes the effort and results of 385 MAES-funded research projects conducted by 286 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 on 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. Researchers also continue to increase their focus on underserved audiences within the state including seniors, minorities, and low-income individuals. In 2015, 45 projects had components tied to underserved populations in Minnesota and around the world. Emerging industry needs and key investments from the Minnesota State Legislature were also influential in shaping research plans and topics throughout the year.

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." In 2015, this plan was expanded to embrace a research agenda featuring five interrelated Grand Challenges:

- Feeding the world sustainably
- Advancing health through tailored solutions
- Fostering just and equitable communities
- Enhancing individual and community capacity for a changing world
- Assuring clean water and sustainable ecosystems

Significantly, challenges align easily within research projects currently funded by MAES and we anticipate they will lead to more interdisciplinary research opportunities throughout our partner colleges and the University as a whole.

One such opportunity is the new Long-term Agricultural Research Network Model (LTARN). LTARN is a

unique multidisciplinary project that incorporates temporal and spatial components of applied field research around food, bioproducts, fiber, and health objectives. The project uses the existing Research and Outreach Center (ROC) system to coordinate research on soil microbial communities, cropping system research, and nutrient management across several disciplines.

New Funding Opportunities Push Research to New Heights

MnDRIVE continues to be a driving force behind interdisciplinary research at the University. To date, MnDRIVE funding has supported 210 projects, produced 41 potential patents or licenses, created 321 jobs and forged more than 75 external partnerships with companies throughout the state, many of which are in the food and agricultural sector.

Other key opportunities:

- Construction of a new, \$6 million, 10,500 square foot bee research lab on the Saint Paul campus. When it opens in 2016, the new facility will house both the Bee Lab's research and extension programs.
- The Minnesota Aquatic Invasive Species Research Center laboratory received a much-needed renovation in 2015 including new equipment that will allow for cutting-edge research on zebra mussels, curly-leaf pondweed, Asian carp, and more.
- The Minnesota Terrestrial Invasive Species Research Center officially opened in 2015. Four new projects were approved for funding through the center for 2016, among them are projects on oak wilt and buckthorn.
- MN Legislature approving \$2 million for research and outreach to combat the outbreak and effect of avian influenza (H5N1) in the state. This funding was received through our Rapid Agricultural Response Fund (RARF) along with an additional \$600 thousand for other RARF funded projects in 2016-2017.
- MN Legislature approved \$1 million in 2015 to expand the work of the Forever Green Initiative. This funding allowed for seven new research projects to receive funding for the next five years.

Research highlights for 2015 include:

- A MnDRIVE funded project on food safety and spoilage led to the development of a color-changing sensor for food that tells individuals when their food is no longer safe to consume. The technology is one million times more sensitive than similar technologies on the market.
- Researchers provided the Minnesota DNR with information to help combat the decline in walleye populations in Mille Lacs Lake and Extension conducted surveys on alternative opportunities for the tourism industry in the area.
- 'Bolles', a new wheat variety released in 2015, shows promise as not only a high-yielding and disease resistant option, but also provides a high grain quality for baking. A key concern of our breeding efforts.
- Researchers at the College of Design collaborated with the local Somali-community to create culturally sensitive sports apparel for Muslim girls.
- A collaboration between the Minnesota Department of Health and researchers at the College of Education and Human Development led to the successful development of a pilot program to screen refugees arriving in Minnesota for mental illnesses that may inhibit their well-being or ability to resettle.
- Turf scientists collaborated with the Minnesota Department of Transportation to develop new salt-resistant grasses to place along Minnesota roadways.

Extension: Summary of 2015 Activities

Service levels: In 2015, Extension program teams delivered programming to over 927,000 Minnesotans. This includes programs funded by federal, state, local and grant sources, as well as nutrition education (EFNEP and SNAP-Education) and Farmer Lender Mediation programs. Indirect contacts are defined differently by each program. They often refer to unique visits to educational web sites, social media sites, listserves or educational outreach. **Note: Extension's direct contact counts reports for adults and youth are typically unduplicated, and indicated actual program contacts that are more likely to achieve**

learning or behavior change.

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 1,230,549 hours of service in 2015, the equivalent of 592 full-time staff. According to the Independent Sector, this services is valued at \$30,554,527. This includes volunteerism leveraged by 4-H programs, the Master Gardener program, the Master Naturalist program, the Regional Sustainable Development Partnerships and other Extension programs.

Outreach to underserved audiences: Minnesota has had the reputation of being relatively racially homogeneous, but that is changing. According to mncompass.com, 19 percent of state residents are now persons of color, compared with 1 percent in 1960.

Five of Minnesota's programs have adapted programming and outreach to engage diverse populations, achieving participation near or above 19 percent being persons of color.

- Health and Nutrition: 43 percent of adults and 58.8 percent of youth
- Building Healthy, Strong Families: 29.4 percent of adults
- Food Safety: 100% participation for Food Safety Careers Certificate program; 21% of Food Safety Training for Minnesota Cottage Food Handling
- Youth Development: 18.45 percent of participants overall; 52 percent of Urban 4H programs
- Leadership and Civic Engagement: 17.8 percent of participants

Among program areas that did not have overall strong percentages, targeted outreach efforts still occurred. A food access programs were brought to tribal communities. The Master Naturalists Explorer program reached tribes and urban populations, with 19 percent of participants being from under-represented participants. Urban pest management had 36% participation from under-represented participants. and an outcome related to a tribal business is reported. The Master Gardener program reached urban and tribal communities for environmental demonstrations (24 percent), Habitat for Humanity education (66 percent), youth programs (23 percent), and food access programs. Finally, horticulture programs, pesticide safety workshops, and small farms programs all recruited participants from minority farming communities such as the Hmong American Farmers Association.

Multi-state engagement: All programs reported some degree of collaboration with Extension in other states, especially in contiguous states that share land and water issues. Eleven of the 15 planned programs reported some participation in eXtension, and Extension's increased use of technology is increasing the amount of shared training across states.

Strategic Plan: The 2012 strategic plan called for greater use of technology to expand reach and enhance outcomes. As a result, videos, Moodle courses, mobile apps, podcasts, WebEx training sessions, lecture captures and online courses with research-informed instructional design are a norm. There were over 1,300 course meetings and consultations on the new WebEx format in 2015, and online training has now replaced face-to-face training for staff orientation processes and key instruction, such as civil rights review processes. As of 2/5/2016, 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. The strategic plan also called upon greater inter-disciplinary efforts. The Avian Flu crisis management work in 2015, reported in Global Food Security and Hunger, is one example of a multi-disciplinary and integrated effort to respond to a critical issue.

Staff expertise: In 2015, 139 (138.5) highly specialized Extension educators delivered planned programs described in this report. In county offices, 31 (29.7 FTE) local educators deliver programming and 181 (171.4 FTE) program coordinators support 4-H, Nutrition Education and Master Gardener programs.

Merit review: Since 2008, an academic promotion process has been in place to monitor and reward educators' performance and scholarship. In 2015, 12 regional educators and two 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 affiliates assure funding or partial funding for 81 faculty (32.7 FTE) with Extension funding. Efforts over the years to improve the scholarship of Extension's program and staff have been successful. Extensions scholar-practitioners produced 151

peer-reviewed publications in 2015.

County positions: Extension offers contracts to each of Minnesota's 87 counties so that local educators can develop, deliver and evaluate county-based programs that align with local priorities. This county system works alongside Extension's regional system, which is funded with federal and state dollars. County investment in 2015 remained strong. All counties with expiring contracts at the end of 2015 elected to renew. Moreover, 70 percent of the 87 counties increased their investment in Extension.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	278.9	0.0	395.2	0.0
Actual	290.1	0.0	446.4	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 2015, five MAES-supported researchers in the College of Food, Agricultural and Natural Resource Sciences were granted promotion. Two were promoted from assistant professor to associate professor with tenure, and three 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 2015, 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 2015, 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 2015,

12 Extension educators were promoted and two local (e.g., county) educators were promoted. Each was promoted after a rigorous review of education, scholarship and outreach. To assist staff through the promotion process, peer learning groups were coordinated and mentors who have successfully navigated the promotion process were assigned to those new to the process.

Reviewers consider seven criteria 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 academic rank (local or county educators). Candidates choose from targeted criteria the primary emphasis of their promotion dossier. Candidate dossiers are reviewed by peers in Minnesota, and from colleagues in other states -- especially those who represent their programmatic discipline. 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

- Use of media to announce public meetings and listening sessions
- 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
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Other (One-on-one interactions)

Brief explanation.

MAES supported research 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 Variety Review Committee, which meets 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. In 2015, Regional Sustainable Development Partnerships managed advisory groups, work groups, social media sites, community meetings and formal surveys. This outreach informed activities of 11 of the 15 federal programs outlined in this report. The Partnership's governing boards are composed of community members (75 percent) and University staff (25 percent) who met throughout 2015 in each region of the state. Work groups set regional priorities and presented ideas. Newsletters delivered updates to opinion leaders, policy makers, students, farmers, business people, media, local government jurisdictions and community members. Facebook pages and the online IDEAS generator solicited direct feedback from all readers. Convening events encouraged stakeholder participation in issues of importance in Minnesota. This year, these included:

- Ten Climate Change Adaptation Convenings that gathered 750 people around the state.
- A meeting that convened food hub operators to share stories and identify opportunities and challenges for this growing industry.
- A formal survey of rural grocery stores that encouraged store owners to discuss primary concerns that might be addressed in future Extension programming or research.
- A Deep Winter Producers' Association gathering farmers who use technology and best practices to extend Minnesota's growing season for fresh food.

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
- Open Listening Sessions
- 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.

Extension. Regional Sustainable Development Partnership (RSDP) board members and staff reach out to communities, constituents and organizations to develop priorities for each region of the state. One venue for soliciting community and University ideas is through RSDP's Idea Form, which

is available on its public website.

When priorities are identified, RSDPs bring together stakeholders with key involvement in prioritized issues. The Climate Change Adaptation convenings are an example of such key stakeholder involvement.

A Statewide Coordinating Committee leads for the Partnerships' coordinated efforts. This statewide committee represents a breadth of interests that can attract individuals and groups to the discussion, including University Colleges, regional staff, regional board members, project partners, friends and other interested parties.

The Partnerships host listening and comment sessions and survey stakeholders to inform project priorities and project designs. In 2015, each regional board also developed a Regional Diversity Action Plan. These plans articulate intention to attract diversity to the RSDP board and work group composition and project partners, outcomes for measuring success, community members and organizations that can serve as resources in diversity efforts, and next steps.

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
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey 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.

Extension. Through personal and professional networks, community members who volunteer on RSDP work groups and boards connect local ideas and projects to the University of Minnesota, especially Extension. This connects Extension to the pulse of local communities across Minnesota. RSDP uses its website, social media networks and newsletter email list to communicate regularly with all University staff and community members and groups throughout the state.

Web-based seminars about particular issues and topics bring together stakeholders with like interests for learning and feedback.

Regional directors convene local boards, work groups and partners to help plan and implement research, education and outreach projects that meet the priorities identified by these same groups. Yearly, RSDP conducts statewide convenings on critical issues. In 2015, the series focused on climate change adaptation.

Finally, Extension faculty and staff are engaged in issue area networks that are convened by the

Office of Public Engagement at the University of Minnesota. This ties Extension and community interests to the work of various colleges and departments and research taking place at the University of Minnesota.

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 supported research has been redirected to high priority areas based on information gained from stakeholders. Key examples of this in 2015 included prioritizing which Rapid Agricultural Response Fund and Small Grains Initiative Fund projects received funding for 2016-17. Research across the University is being impacted by stakeholder and industry input through research funding programs that partner with Minnesota industries like MnDRIVE. In 2015, support from the Minnesota Legislature highlighted several key research areas including HPAI, green innovations in agriculture, and bee research.

Extension. RSDP work groups set programming priorities for regions in the areas of food, tourism and resilient communities, natural resources and clean energy. These priorities drive where staff time is spent and where seed funding is allocated. Priorities are brought to Extension and other University entities for response. Here are some examples of responses:

- Concerns about rural grocers and food access resulted in a statewide survey of over 200 rural grocery stores. Results will be used to develop programmatic responses, and will also be disseminated for awareness to media, policy makers, businesses, nonprofit, government and philanthropic communities.
- Communities and farmers expressed interest in learning about deep winter greenhouses to extend the growing season and limit the use of fossil fuels. This resulted in a statewide campaign to pilot five deep winter greenhouses, and the University developed a web-based landing page that provides one-stop-shopping for information related to deep winter greenhouses.

Brief Explanation of what you learned from your Stakeholders

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, and the increased investment in, research centers that can take a broader interdisciplinary view of key research concerns including invasive pests is a direct result of stakeholder input.

Extension. The stakeholder assessment processes revealed strong citizen interest in supporting local economies -- from local food systems to grocery stores, clean energy, tourism initiatives, workforce attraction, and water quality, community groups are ready to think about the future, and want to partner with the University to create it. These community efforts create perfect partnerships for Extension, which can deliver education, training and applied research that informs these actions and makes them more successful.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
9044879	0	6364076	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8499102	0	5668496	0
Actual Matching	28651599	0	36469204	0
Actual All Other	24057888	0	42382243	0
Total Actual Expended	61208589	0	84519943	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

S. No.	PROGRAM NAME
1	Global Food Security and Hunger
2	Sustainable Energy
3	Climate Change
4	Health and Nutrition
5	Food Safety
6	Water Resources
7	Community Economics and Public Finance
8	Leadership and Civic Engagement
9	Building Healthy, Strong Families
10	Youth Development
11	Natural Resource Management
12	Forestry and Forest Products
13	Housing
14	Horticulture
15	Agricultural Business Management

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	0%		10%	
204	Plant Product Quality and Utility (Preharvest)	10%		5%	
205	Plant Management Systems	10%		5%	
206	Basic Plant Biology	0%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%		10%	
212	Pathogens and Nematodes Affecting Plants	5%		10%	
213	Weeds Affecting Plants	10%		5%	
216	Integrated Pest Management Systems	5%		5%	
301	Reproductive Performance of Animals	5%		5%	
302	Nutrient Utilization in Animals	5%		5%	
304	Animal Genome	0%		5%	
305	Animal Physiological Processes	5%		5%	
306	Environmental Stress in Animals	5%		5%	
307	Animal Management Systems	10%		5%	
311	Animal Diseases	10%		10%	
315	Animal Welfare/Well-Being and Protection	10%		5%	
604	Marketing and Distribution Practices	5%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	44.0	0.0	134.3	0.0
Actual Paid	25.9	0.0	145.4	0.0

Actual Volunteer	0.0	0.0	0.0	0.0
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2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
856695	0	2015640	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2534787	0	11749819	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
954070	0	15387020	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Research in 2015 provided new information and strategies to improve crop and animal production systems in Minnesota. Diseases and pests affecting our crop and animals remain a primary concern for researchers along with exploring new opportunities presented by new agricultural technologies and genotyping.

Research highlights for 2015 include:

- A study looking at the prevalence and size of airborne poultry virus particles found higher concentrations of PEDV compared to HPAI and PRRSV. Study results were shared with government officials and poultry producers that were affected by the HPAI outbreak in Spring 2015.
- Collaborative research between agricultural engineers at several universities on the effect of dietary components of swine on manure foaming and biogas production confirmed that fiber type and size, and lipid composition of the manure appear to be significant risk factors.
- Research on the farm-level risk factors for tuberculosis (TB) in dairy cattle in Southeast Asia identified purchasing cows from dealers and deworming of dry cows as risk factors for TB.
- A study investigating slow growing pigs in group housing situations found that to maintain growth performance and allow enough time for pigs to eat their desired amount of feed, 80 percent feeding capacity should not be exceeded regardless of feed norms and feeder designs.
- A new hairy vetch breeding program was initiated in 2015 in response to a demand for more sustainable agricultural and cover crop options.
- Barley breedings conducted preliminary yield trials for two-row varieties in Saint Paul, Bozeman, MT and Ithaca, NY. Due to increased demand from small craft brewers, this program will be expanded to 20 locations in 2016.
- Research on controlling soybean aphids included the release of Asian parasitoids (*A. glycinis* and *A. certus*) on two farms in the state. Results differed by location with *A. glycinis* dominating in Northfield, MN and *A. certus* dominating in Cottonwood, MN. In an overwintering study, *A. glycinis* was able to overwinter outdoors in St. Paul, MN meaning the species may be able to establish in the state.
- In 2015, University researchers completed the first genome sequence of a wild relative of potato. *Solanum commersonii* is a disease and cold-resistant potato species that can be used to improve the cultivated potato.

- Four general-purpose soybean varieties were released in 2015. All have soybean cyst nematode resistance, high yield, yellow or buff helium, and average or above protein content.
- Research on soil microbial communities confirmed bacteria and fungi respond differently to cropping patterns and specifically plant diversity. Additionally, researchers showed that bacterial and fungal interactions in localized soil communities have significant impacts on antagonistic phenotypes, offering the potential for managing these interactions to enhance disease suppression capacities of agricultural soils.

Extension programs that deliver education and research about livestock, commodity crops and small farms are all described in the Global Food Security and Hunger federal program. Due to high volume programming in agriculture business management in 2015, those impacts are reported in a separate federal program.

Though Minnesota growers enjoyed ideal weather in 2015, volatile market forces brought crop prices to the lowest in recent years. The average corn producer lost money on each bushel of corn produced. Sugar beet, soybean and wheat prices also declined. Livestock producers fared better, but environmental and market forces have increased the pressure on the entire Minnesota agriculture sector to cut costs and farm smart. In response, Extension agriculture programming put an emphasis on managing input costs, educating farmers on the potential of new and innovative farming techniques, and strategies to manage threats to crop yields.

We have reported three significant program impacts related to crop protection, the avian flu crisis and pork production in State Defined Outcomes. In the Evaluation Studies section, we describe other outcomes from findings of program evaluations.

2. Brief description of the target audience

In 2015, agriculture education programming at Extension focused considerable attention on partnerships with turkey producers and their related state and local associations. Together, these partners addressed management of the avian flu crisis. Meanwhile, Extension sustained its relationships with producers of other 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.

MAES. Target audiences for research include crop and livestock producers, industry representatives, local legislators, and fellow researchers.

3. How was eXtension used?

One Extension educator was part of an Organic Agriculture Research Symposium on Organic Markets: Quality and the Consumer Connection

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	210716	2076799	578	0

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

Year: 2015
 Actual: 1

Patents listed

62/186,913 - June 30, 2015 - Haploid Inducer Line for Accelerated Genome Editing

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	58	160	218

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
2015	578

Output #3

Output Measure

- Number of new crop germplasm released to public.

Year	Actual
2015	5

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	Participants of Agricultural and Business Management (AMB) workshops and conference sessions intended to improve business management practices will significantly improve management practices as a result of attending the program. (Percentage of participants that change one or more of their business management practices as a result of attending workshops and conference sessions.)

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

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	82

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

First introduced at the 2013 National Pork Industry Forum and reintroduced at the 2014 World Pork Expo, the Common Swine Industry Audit was developed with input from pork producers, animal scientists, veterinarians, packer representatives, and retail food service personnel. The goal of the Common Swine Industry Audit is to serve as a single, common audit platform for the pork industry to use when assuring consumers of the care in animal well-being and food safety measures taken by farmers and pork processors.

What has been done

Three Common Swine Industry Audit workshops were held in 2015 with a total of 47 people in attendance. Of those 47 people in attendance, 146,340 total sows (female pigs for breeding), 2.68 million grow-finish pigs, and 496 employees were influenced.

Results

As a result of the workshop, 82% of attendees are confident they know what is needed for an audit, impacting the well-being and food safety of over 2 million grow-finish pigs.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	70

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In the spring of 2015, a virulent form of the avian influenza virus hit Minnesota's \$3 billion turkey industry. Extension's economic analyst determined that the related economic impact was almost \$310 million by early May. To protect the industry, producers needed to act to reduce contagion from flock to flock. Clear communication channels and industry education was the key to changing practices and managing the crisis.

What has been done

Extension: 1) developed early communications among partners; 2) focused education on the Danish Entry System biosecurity method, using a demonstration trailer; 3) educated producers on mortality handling; 4) addressed the needs of organic turkey farmers; 5) studied filtration system adaptations to keep dust from transmitting the virus; 6) educated about faster composting to allow restocking; 7) provided financial planning education to producers; 8) determined the economic impact of the emergency to inform policy makers.

Results

Extension efforts responded throughout the crisis. As a result, producers adopted new strategies to protect flocks. A survey showed that of the farms affected by the virus, 70 percent adopted the new Danish Entry System recommended and demonstrated by Extension. Extension's economic impact analysis defined the impact of the problem to the general public, and is now incorporated into the federal record to inform lawmakers.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

With increasing costs for corn production and greater concern for environmental quality, corn growers must make sound decisions about purchased inputs. Good alfalfa stands generally provide all of the nitrogen needed for maximum first-year corn grain yield on medium-to-fine textured soils, yet growers still hesitate to fully accept first year corn nitrogen credits and instead, apply additional nitrogen. As a result, frequent and extreme cases of over-application of nitrogen in corn occur in first and second corn after alfalfa.

What has been done

An Extension crop educator involved Minnesota farmers as active research partners and conducted alfalfa corn rotation research on 15 working farms. The results showed that corn planted in rotation after alfalfa requires less nitrogen than is usually applied a lot less, and sometimes none at all. These findings were shared with agricultural professionals and corn growers managing over 445,000 hectares.

Results

A follow up evaluation revealed that 40 percent of respondents modified future nitrogen fertilizer management for first and second year corn following alfalfa, and 45 percent said they would change their practice somewhat. This will result in reduction of nitrogen fertilizer use by over 880,000 pounds of nitrogen per year without reducing corn yield, an annual savings of over \$378,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

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)

Not Reporting on this Outcome Measure

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 Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Spring wheat is grown on more than 1.5 million acres in Minnesota, making it our third most popular crop. But wheat varieties in the region have become vulnerable to Fusarium Head Blight (FHB), leaf rust, stem rust, and bacterial leaf streak, destructive diseases of wheat and barley that put crops, and thus our food supply, at risk.

What has been done

University wheat breeders are focused on breeding new disease resistant cultivars that remain high yielding and provide a good end-use quality. Genetic studies are being used to identify chromosomal locations and DNA markers for genes influencing disease resistance disease resistance and grain quality.

Additionally, food quality experts at the Department of Food, Science and Nutrition are collaborating with breeders early in the selection process to help select varieties that provide a great tasting end product.

Results

One advanced experimental line, MN08165, was released as 'Bolles' in 2015. Bolles features very high grain protein content, competitive yields, and good straw strength. It has excellent leaf rust resistance and moderate resistance to FHB as well as exhibiting excellent end-use quality characteristics.

Notably, 'Linkert', our last wheat release, is now the third most popular variety in the state and is grown on 13.5 percent of wheat acres planted statewide. Early results show 'Bolles' will also be a top variety -- our seed stock sold out within months of its release.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Highly Pathogenic Avian Influenza (HPAI) was never seen in Minnesota prior to March 2015. The impact was devastating. By the end of the outbreak in early June, 101 poultry premises were affected with the loss of 9 million turkeys & chicken layers.

What has been done

Back in January 2015, University faculty alerted the Board of Animal Health, the Department of Agriculture, and the Minnesota poultry industry about the avian flu threat. University experts had been monitoring the spread of the virus in the Pacific Northwest and pulled together a team to begin response planning.

University faculty across several disciplines worked with state and federal agencies and with industry groups in developing a plan.

Results

During the 2015 legislative session, the Minnesota Legislature approved \$2 million in emergency funding for research and response to combat HPAI in the state. This funding was dispersed to researchers through the MAES Rapid Agricultural Response Fund beginning in fall 2015.

Throughout the outbreak, the University's Veterinary Diagnostic Lab conducted over 18,000 Avian influenza tests and research on the aerosol spread of infectious diseases in animals was quickly expanded to include HPAI.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Participants of Agricultural and Business Management (AMB) workshops and conference sessions intended to improve business management practices will significantly improve management practices as a result of attending the program. (Percentage of participants that change one or more of their business management practices as a result of attending workshops and conference sessions.)

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Competing Public priorities
- Competing Programmatic Challenges
- Other (Crop disease affecting breeding program)

Brief Explanation

Considerable attention was paid to the avian flu crisis in 2015, affecting outputs in other areas somewhat. Increased emphasis on farm bill management programming prompted us to place those program results in a separate Plan of Work program in 2015 and beyond.

MAES. Researchers relocated first generation hybrids of potatoes to isolated fields away from commercial field production due to alarmingly high occurrences of potato virus Y discovered in the breeding germplasm.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension employed pre- and post- workshop evaluations to determine whether education resulted in changed participant behaviors in ways important to farm management, environmental protection, safety or humane practices for animal care. Longitudinal studies examine the long-term effects of disseminating critical information that changes practices.

Besides the impacts described in the State Defined Outcomes, evaluation demonstrated that the Global Foods programs are meeting their goals in the following ways:

Extension continued to educate dairy producer about robotic milking systems options. Follow-up evaluations showed that 66 percent of the participants would fine-tune or completely change their current plan based on what they learned. As noted in the executive summary, an online application now helps producers decide what type of milking system to install.

- Presentations at commercial animal waste technician workshops in 2015 focused on biosecurity related to swine diseases, especially PRRS and PEDv. Changed practices resulted in no PEDv being spread from farm-to-farm by manure applicators.
- The Minnesota Hay Bank, launched in 2012, offers free, temporary feed assistance for qualified horse owners and horse rescuers. The hay bank has raised over \$76,000 and distributed more than 222 tons of hay, that has fed almost 600 horses for 30 days.
- Extension continues to manage the Pesticide Applicator Safety program. Over 1,000 respondents to a follow-up evaluation revealed a higher percentage of adoption of safety measures than national surveys.
- On average, hard red spring wheat yields have increased nearly 15 bushels per year in the last 15 years. These gains could have only been reached if access to improved genetics was matched with other factors, including the judicious use of fungicides and crop nutrient inputs as a result of education. Minnesota also has the highest adoption rate of Fusarium Head Blight resistant varieties, a clear indication that the continued education about the importance of choosing FHB resistant varieties is showing results.
- A 2015 study revealed that Extension's emphasis on science-based approaches to cow

comfort mean that cow welfare is not compromised in large dairy operations. An Extension dairy specialist led a study of 15 dairies with more than 2,500 cows in Minnesota, Wisconsin, South Dakota and Iowa that was completed in 2015. At the time of the study, these herds represented 33 percent of the operations of this size in the four-state region. The results showed low prevalence of lameness and high hygiene.

Key Items of Evaluation

- Education related to technology adoption has resulted in expanded interest in robotic milking systems options.
- Education related to best practices for farm and food safety resulted in changed practices and no PEDv being spread from farm-to-farm by manure applicators, as well as pesticide applicator safety procedures that beat national averages.
- Decisions about crop management increased yields for hard red spring wheat; moreover, Minnesota has the highest adoption rate of Fusarium Head Blight resistant varieties.
- Extension's considerable effort to improve cow comfort in profit-yielding dairy farms were proven to result in a humane and profitable industry in a 2015 study of 15 dairies with more than 2,500 cows in Minnesota, Wisconsin, South Dakota and Iowa that was completed in 2015.

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	10%		10%	
401	Structures, Facilities, and General Purpose Farm Supplies	15%		5%	
402	Engineering Systems and Equipment	10%		15%	
501	New and Improved Food Processing Technologies	5%		15%	
511	New and Improved Non-Food Products and Processes	10%		25%	
601	Economics of Agricultural Production and Farm Management	0%		20%	
605	Natural Resource and Environmental Economics	50%		5%	
610	Domestic Policy Analysis	0%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	8.5	0.0	38.1	0.0
Actual Paid	15.6	0.0	39.4	0.0
Actual Volunteer	1.0	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
295260	0	172296	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2185114	0	3265571	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1197982	0	3142580	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. Sustainable Energy programming from U of M Extension is primarily carried out through the Clean Energy Resource Teams (CERTs). CERTs are 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: Great Plains Institute, Southwest Regional Development Commission and the Minnesota Division of Energy Resources.

In 2015, CERTs demonstrated the significance of its work over time by publishing 151 new stories to its Minnesota Energy Stories blog. These stories included case studies about CERTs seed grant projects, highlighted successful projects, featured interviews with business owners who made changes to energy consumption with CERTs intervention, and summarized tours and events that focused on clean energy options. Continuing its work in public education, CERTs hosted 19 events to highlight energy-saving opportunities through workshops, tours, and forums. Additionally, CERTs connected with Minnesotans directly through 201 other outreach activities, including convening meetings with community-based organizations and presenting and tabling at other events. CERTs maintained two campaigns to change practices across entire industries. "Light Up Your Station and Save" assisted Minnesota 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 16.99 billion BTUs annually.

MAES. Research in this program is providing a better understanding of how best to incorporate opportunities for sustainable energy development while considering agricultural productivity and environmental health.

Research highlights from 2015 include:

- Work continues at the West Central Research and Outreach Center in Morris to create a "net-zero" energy dairy facility. To date, the project has utilized new energy saving equipment, renewable energy production, and best practices to lower energy consumption.
- Research on the polymerization behavior of soybean oil-based nanocellulose composite films discovered that a brief ultra-violet irradiation time of ten seconds is sufficient to cure chemically modified soybean oil into solid films. This represents a significant knowledge gain for future research.
- A three-year project comparing diversified perennial based cropping systems found that willow yielded more biomass than polyculture and more theoretical ethanol yield. Soybean yield was greatest

when planted next to willow, then alley, and then polyculture.

- Researchers developed a web-based decision support system for bioenergy cropping systems. The system called The Crop Enterprise and Environmental Budgeting Tool (CE2T) incorporates significant growth modeling and enterprise budgeting.
- A project comparing genomewide selection and phenotypic selection for discovering high-oil corn inbreds found that a cost-effective strategy in genomewide selection is to genotype the parents with 1000 markers, genotype their progeny at only 50 markers (to save costs), and impute the marker data in the progeny up to the coverage of 1000 markers.
- A study on transitioning land from intensive agriculture to biofuel grasslands found that negative soil legacies from annual crop production or exotic species invasion can be reduced by growing native nurse plants in the initial stages of conversion.
- Researchers studying how plants and bacteria can work together to create a beneficial growing environment successfully sequenced 188 strains of Sinorhizobia that will be used for future experiments.
- In collaboration with the USDA in Peoria, IL, researchers are genotypically and phenotypically characterizing two pennycress variants developed in IL that exhibit reduced seed dormancy (Elizabeth and Kaitlyn). Early tests show Elizabeth has shows promising characteristics for future breeding of varieties with improved agronomic traits.
- A survey sent out to wood energy businesses on how state policies affect their business decisions found that production tax credits, disbursements, and loans were positive predictors of wood energy use. Whereas, investment tax credits, grants, and performance standards had the opposite effect on wood energy development in many states.

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. CERTs empowers communities and their members to adopt energy conservation, energy efficiency and renewable energy technologies for their homes, businesses and local institutions. CERTs works with a wide spectrum of groups including, but not limited to, businesses, civic organizations, economic developers, faith groups, farmers, local governments, residents and neighborhoods, schools, and utilities.

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?

CERTs is heavily using eXtension to research farm energy resources to support public presentations and state-funded dairy research projects, to increase the team's knowledge about specific energy efficient farm technologies, and to gain an understanding of which state Extension programs are the "authority" on given subjects.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12724	145667	2085	7706

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

Patent Applications Submitted

Year: 2015
 Actual: 2

Patents listed

62/113,853 - February 9, 2015 - Production of Biodiesel from Scum
 62/157,676 - May 6, 2015 - Phytate Extraction from Corn Ethanol Coproducts

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	38	38

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.
 Not reporting on this Output for this Annual Report

Output #2

Output Measure

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

Year	Actual
2015	19

Output #3

Output Measure

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

Year	Actual
2015	12196

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.)

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
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Algae biofuels may provide a viable alternative to fossil fuels but this technology must overcome a number of hurdles before it can compete in the fuel market and be broadly deployed.

What has been done

Researchers developed the first principles based growth model of microalgae biomass and lipid production designed for an indoor pond system. The primary factors that affect microalgae growth and accumulation of lipids (solar radiance, temperature species characteristics, uptake rate of nutrients and carbon dioxide) are incorporated into the model.

Taking into account seasonal effects on microalgae growth, the model is able to predict the year-round potential productively for an algae system.

Results

Results show that solar irradiance and maximum specific growth rate are the most significant parameters in microalgae bulk growth. These results will be used to optimize and scale algae systems for efficient production of fuels and chemicals for a variety of algae species and geospatial locations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
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 Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	52

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. Communities, especially, have the opportunity to make energy efficiency possible among their residents. Adoption results from opportunities for business owners, local units of governments and community members to share stories and take a look at options.

What has been done

CERTs hosted 19 events in 2015, reaching audiences from farmers, to small business, to residents, to local units of government and utilities. Each event includes educational content on specific topics ranging from efficient lighting to biomass energy, to major mechanical upgrades, to solar energy, as well as suggested actions Minnesotans can take to advance clean energy.

Results

Of the 19 events, seven were assessed regarding attendees' subsequent actions. As an average weighted to attendance at the seven events, 52 percent of respondents reported they are likely to take action. The events were advancing the following actions: 1) getting multiple government's energy from community solar gardens, 2) offering community solar gardens in their communities, 3) subscribing individually to a community solar garden, 4) obtaining utility rebates and other funding for LED lighting and other energy efficiency upgrades, and 5) numerous self-identified actions to move forward a clean energy priority in their community. If all respondents implement actions, approximately 160 billion BTUs will be saved through renewable energy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
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
2015	16987

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 \$24 billion and consumed a total of 1.860 trillion BTUs of energy (electricity, natural gas, petroleum products, coal and biomass) in 2013 to supply energy needs. Energy use spreads across four main sectors: Transportation (24 percent total use for buses, automobiles), residential (23 percent total use), commercial (19 percent total use) and industrial (34 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 at 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 sales and 1.0 percent of annual gas sales each year.

Results

CERTs quantifies total BTUs of energy saved annually through campaigns, technical assistance, utility support and seed grants. The 2015 total is 17 billion BTUs in annual energy savings or renewable energy offset. Assistance to utilities' conservation programming resulted in 4.3 billion BTUs of energy savings. The "Recycle Your Holidays" campaign resulted in 3.3 billion BTUs saved by upgrading to LED holiday lighting. The 2014 Seed Grant Program saved 1.9 billion BTUs by funding local projects. A program offering funding guidance and technical assistance to turkey farmers resulted in 25 barns being retrofitted with LED lighting, saving 1.9 billion BTUs annually. CERTs assisted three large farm energy projects through the Rural Energy for America program, resulting in 1.5 billion BTUs saved or offset.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Grant cycles)

Brief Explanation

We did not report on the number of seed grants provided because seed grants are awarded every two years. They were identified in 2015, and will be dispersed as grants for recipients' activities in 2016.

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 or assistance for projects. CERTs quantifies total BTUs of energy saved annually through campaigns, technical assistance, utility support and seed grants. The 2015 total is 17 billion BTUs in annual energy savings or renewable energy offset.

Key Items of Evaluation

In 2015, the total number of BTUs saved or offset is 17 billion. This energy conservation is enough to heat 213 Minnesota homes or power electricity for 440 homes annually.

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%		30%	
104	Protect Soil from Harmful Effects of Natural Elements	20%		30%	
123	Management and Sustainability of Forest Resources	20%		30%	
132	Weather and Climate	20%		5%	
605	Natural Resource and Environmental Economics	20%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	13.0	0.0
Actual Paid	0.0	0.0	61.3	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	527680	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	3147385	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	6149503	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Climate change represents the greatest challenge facing resource managers and policy experts today due to the uncertainty in future conditions and the urgency to develop that increase adaptive capacity and minimize ecosystem vulnerability.

Research conducted at University of Minnesota related to climate change takes on this challenge from a number of lenses. From breeding climate adaptive crops and trees to providing farmers with recommendations that increase the long-term profitability and reliability of their farms, researchers are exploring how changes to Minnesota's climate will affect Minnesotans and the world.

Highlights from 2015 include:

- The Minnesota Legislature appropriated \$1 million in special funding in support of the Forever Green program. Seven new cross-disciplinary research projects were funded that focus on protecting the state's natural resources while increasing efficiency, profitability and productivity of Minnesota farmers by incorporating perennial and winter annual crops into existing agricultural practices.
- New guidelines for the amount of nitrogen (N) fertilizer recommended for corn grown in irrigated sandy soil were released and reached an estimated 1000 people in 2015.
- Using a Bayesian inverse modeling approach, researchers demonstrated nitrous oxide emissions are much larger from indirect source categories than both the Intergovernmental Panel on Climate Change and Emissions Database for Global Atmospheric Research models estimate.
- An evaluation of the Community Land Model's ability to simulate energy and carbon fluxes from agricultural ecosystems showed the model poorly represented crop phenology for both corn and soybean. Researchers updated the phenology algorithm in the model, which led to substantial improvement of the models simulations of energy and carbon fluxes.
- A study exploring phenology in Minnesota plant species successfully recorded flowering, fruiting and leafing dates for a total of 11,231 plant specimens representing nine different plant families. A sufficient number of observations for statistical analysis (greater than 25) were obtained for 84 of 123 target species over the three-year project.
- A fourth year of data shows that swamp white oak, hackberry and American elm continue to show the highest rates of survivorship across seedlings planted in Minnesota low-land black ash forests. This project is looking for potential alternatives to ash trees to limit the impact of emerald ash borer in the state's ash forests.
- Research on breeding new trees with climate adaptive traits found that jack pine seedlings survival and growth appears to be controlled in part by epigenetic means (i.e. the height growth in young seedlings can be impacted by the temperature at which the seed initially develops). This has implications for jack pine's inherent ability to adapt to changes in climate, specifically warmer climate.

Extension. In 2015, the Regional Sustainable Development Partnerships of Extension held ten Climate Change Adaptation Convenings attended by approximately 750 people around the state. The convenings were held to inform Minnesotans about the consequences of climate change, and to learn what innovations and strategies they are considering and deploying at the household, farmstead and community level to adapt to a changing environment. Extension Climatologist Mark Seeley provided region-specific climate information.

In addition, Extension's climatologist helped local public television produce the program *Farmers Lead the Way: Climate and Agriculture in Southwest Minnesota*. He helped the Minnesota Department of Health produce a program on climate change implications for public health that aired on cable TV. He also provided two briefings on climate change to the Minnesota House and Senate Committees during the 2015 Legislative Session, and participated in public engagement meetings hosted by state and local

government. These sessions produced some community-based action to improve resilience to severe weather.

2. Brief description of the target audience

Decision makers and leaders responsible for preparing communities for change are invited to discussions hosted by Extension, and are provided educational resources. 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 Climatologist Dr. Mark Seeley is widely quoted in eXtension, particularly in these moduls: Polar Vortex, California Drought, Alaskan Heat Wave, Climate Change: What's with this weird weather?

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	750	20262	0	0

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

Patent Applications Submitted

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	68	68

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Research projects will be conducted to develop information on climate change effects on northern forests.

Year	Actual
2015	4

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	Research will investigate alternative crop species and management techniques that are beneficial for both Minnesota farmers and the environment (Expressed as number of alternative crops currently under advanced testing).

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
2015	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Minnesota's iconic northern forests are undergoing a gradual shift as the climate warms. But more research is needed on the long-term effects of rising temperatures and how plants can and cannot adapt to their changing surroundings.

What has been done

With the B4Warmed project, scientists from the University set out to test the prevailing theory that our boreal forests will disappear as our state warms. The five-year project used infrared lamps to artificially warm eight-by-eight foot plots of forest near Cloquet and Ely by as much as seven degrees Fahrenheit.

Scientists measured how much carbon dioxide the artificially warmed plants released into the air via their leaves. More than 1600 leaves were analyzed for rates of respiration at 20 and 23.4 degrees Celsius. They found, over time, the trees began to acclimate to the new temperatures which led to their carbon emissions increasing less than expected.

Results

Previous in lab research showed plants releasing higher levels of carbon than this study, which led to the prevailing belief that forests, in a warmer climate, would become sources of carbon rather than a source of carbon mitigation. However, this long-term field study saw trees exposed to warmer climates over the cross of the study increased their rates of respiration an average of only 5 percent compared to 23 percent average respiration for "unwarmed" control trees.

The results of this project enhance our ability to manage Minnesota forests in a changing climate

and provide needed information to perfect climate change models as they relate to carbon emissions and plant adaptation in the future.

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

Outcome #2

1. Outcome Measures

Research will investigate alternative crop species and management techniques that are beneficial for both Minnesota farmers and the environment (Expressed as number of alternative crops currently under advanced testing).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is a big different between agricultural productivity and agricultural efficiency. In Minnesota while productivity is often high, the fact that we rely on annual crops, like soybeans, means our agricultural land is only covered a few months of if the year. This means for eight months or more, agricultural land is vulnerable to erosion and precipitation runoff.

What has been done

While the concept of cover crops is nothing new, University researchers have taken things several steps further with the Forever Green Initiative. To date, research has focused on alternative crop species (like field pennycress and intermediate wheatgrass) that work well within the traditional corn-soybean rotation.

But now, to show the overall benefits of such an innovation, researchers are developing

"Landlabs" across the state in an attempt to coordinate the technological, economic and even policy innovations needed to make alternative crops a consistent part of Minnesota farming. Alternative crops included in these tests include pennycress, wheatgrass, perennial sunflowers, and hazelnuts.

Results

In 2015, the Minnesota Legislature approved \$1 million in support of the Forever Green Initiative. Seven new research projects were funded for five years including ones focused on everything from breeding enhanced varieties to optimal land and nutrient management.

Consistent public funding in an essential step to help spawn a new agricultural revolution in the state. Rather than simply looking at how to produce a higher yielding crop, this research represents an integrated approach to dealing with the threat of climate change and the need to diversify on our agricultural land for the long term.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Multi-disciplinary approach)

Brief Explanation

Climate change is changing survival rates and increasing stress on livestock, requiring adjustments to irrigation, tile drainage and shoreline management, changes in storm sewer runoff design and increasing soil erosion, watershed flooding potential and insurance rates. Extension is responding to these challenges with new programmatic shifts in the areas of agriculture, forestry, housing, horticulture, water and natural resource management. Those activities are reported under those Planned Programs in this report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

None.

Key Items of Evaluation

None.

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%		10%	
701	Nutrient Composition of Food	0%		10%	
703	Nutrition Education and Behavior	80%		30%	
704	Nutrition and Hunger in the Population	20%		20%	
724	Healthy Lifestyle	0%		30%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	11.0	0.0	44.5	0.0
Actual Paid	20.5	0.0	38.0	0.0
Actual Volunteer	2.4	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
313877	0	425598	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1409126	0	3547040	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
4113333	0	3247529	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. The research reported under this program covers research efforts focused on improving the health of Minnesotans. This includes studies on diet and nutrition as well as increasing aerobic exercise. Several studies are exploring health, nutrition, and aerobic exercise from the point of view of key populations within the state including seniors, minority, and low-income families.

Research highlights from 2015 include:

- A study on the long-term implications of gastric bypass surgery on nutritional status found that individuals who underwent gastric bypass surgery eight years prior had diminished handgrip strength that was strongly associated with the loss of lean tissue.
- Researchers discovered a prevalence of malnutrition among individuals with head and neck cancer. Furthermore, a strong association was established between malnutrition and diminished quality of life for these individuals.
- A study comparing fifteen fluid thickeners found that fluids with more shear thinning were perceived as less thick, with less adhesive properties. For patients with dysphagia, a thickening that provides greater shear lining would be safe to swallow, yet more pleasant to drink.
- A study on low-income women found that women suffering from depression in low-income communities were more food insecure, consumed more calories, and exhibited more emotional eating than low-income women who were not depressed.
- Focus groups identified whole-grain pasta as an opportunity to incorporate less expensive, nutritious, and versatile dishes into school meals that meet the color, taste, and quality expectations of children. In the future, an integrated, cooperative effort by industry, government, non-profit organizations, and schools will be required to successfully adjust school menus to use more whole-grain pasta.
- A study on food package size showed that consumers purchase volume decreases with smaller package sizes while their purchase frequency increases. Significantly, smaller package sizes might create a win-win situation for food marketers and consumers by helping consumers avoid over consumption while helping marketers increase profits.
- Research was conducted on the emerging middle class in 14 countries and the impact this has on food consumption patterns. In comparison to lower income households, middle-class families' weekly food expenditures were 2.85 times greater for fresh vegetables, 3.19 for fresh fruit, 3.17 for red meat, 2.3 for poultry and 4.55 for dairy. These consumption changes will lead to increased import demand and potential benefits for U.S. agricultural producers.
- Researchers identified a novel signaling pathway that links an LD protein, ATGL, to the activation of sirtuin 1, a major therapeutic target for numerous diseases. This is a significant advancement of our understanding regarding the regulation of a key signaling network that influences metabolic disease risk.
- A long-term study on the safety of green tea extract (GTE) for postmenopausal women at risk for breast cancer found that GTE is safe for healthy people but that there is a small subset of people who may be harmed by its consumption. Further studies are needed to identify individuals who may be harmed.

Extension. Last year, we noted a restructuring of nutrition education programs to align with federal priorities and opportunities. FY 2015 was a year of rebuilding and re-hiring. Now, 66 SNAP-Ed educators and 12 EFNET community nutrition educators are in place. The Health and Nutrition Portfolio Plan was launched one year ago, and after a six-month, staff-engaged design process, the Portfolio Plan serves as a road map for work. Community resources for assessment and planning were expanded to include GIS mapping and environmental assessments. Efforts related to Policy, Systems and Environment dramatically increased, changing the types of partnerships and programming delivered. A new specialist from the University of Minnesota's Department of Epidemiology and Community Health joined Family Development's Applied Research and Evaluation team to work on evaluation of public health approaches,

and a partnership with Iowa State University's Leopold Center for Sustainable Agriculture is being developed to evaluate across the Spectrum of Prevention.

In Outcomes, we report on evaluated outcomes regarding increased fruit and vegetable consumption, as well as physical exercise. In "Evaluation Studies," we summarize research that compared the success of programming across a variety of community settings. This evaluation will inform choices about future partnerships.

2. Brief description of the target audience

For maximum impact, we are redirecting Extension educational approaches so that it can reach:

- communities that present opportunities for impacting systems, environments, and policies so SNAP-Ed participants have every opportunity to put into practice what they learn in classes.
- situations where more than one organization collaborates to bring SNAP-Ed classes to eligible audiences in the community
- parents and other caregivers of low-income children

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?

Educators and Specialists in the Health and Nutrition Program have been connecting to eXtension in a variety of ways -- participating in webinars, becoming members of communities of practice (e.g., network literacy, healthy schools and local, community and regional food systems), and using eXtension for research and source material. Several Extension educators have been accepted into the eXtension i-Three corps.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	11605	109240	7426	310

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

Patent Applications Submitted

Year: 2015
 Actual: 1

Patents listed

62/120,226 - February 24, 2015 - Therapeutic Compounds

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	1	90	91

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
2015	963

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	Professionals, organizations and policymakers will adopt practices, organizational culture and politics that promote food literacy, active living and healthy food access. (Target expressed as number of changes made.)
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 understanding of healthy food choices.
5	Research will collaborate with local communities to encourage and enable aerobic activity among minority populations.
6	Research will uncover ways to increase vegetable consumption among children. (Target expressed as percent increase of vegetable 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

Professionals, organizations and policymakers will adopt practices, organizational culture and politics that promote food literacy, active living and healthy food access. (Target expressed as number of changes made.)

Not Reporting on this Outcome Measure

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
2015	78

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Basic healthful changes in diet and exercise can prevent a host of health concerns, including obesity. As youth and adults make a habit of bringing fruits, vegetables, low fat dairy and calcium, and whole grains into their diet, health outcomes will improve for communities and the nation.

What has been done

Extension SNAP-Ed courses reached more than 8,500 individuals (unduplicated) in FY 2015. The age composition included 2,751 youth, 363 teens and 1,974 adults. The evaluation monitored a change in routine consumption of diet staples and physical activity. Further, the evaluation monitored which community learning settings produced the best outcomes. (See evaluation studies for the analysis of community setting effectiveness.)

Results

Results indicate that adult and teen participants report, on average, increased consumption of fruits and vegetables after SNAP-Ed education. Specifically, the Wilcoxon Signed Ranks test determined significance in changes in outcomes. Statistically significant improvements were noted in reported fruit and vegetable intake for both adults and teens. Fruit and vegetable intake as snacks for adults increased. Physical activity for adults and teens was measured using the Godin Leisure-Time Exercise Questionnaire which creates a composite total physical activity score. Statistically significant improvements were noted in the scores of adults and teens.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #4

1. Outcome Measures

Research will support families, children and youth understanding of healthy food choices.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Childhood obesity is linked to diet habits and food environment, but gaining information about these topics from children can often be difficult.

What has been done

A Photovoice methodology was used with a group of 29 low-income 9--13-year-olds. The children were provided with a disposable camera to take pictures of their home food environment.

A total of 345 usable photos were taken and analyzed and four themes were identified: (1) food characteristics, (2) social environment, (3) kitchen, cooking and dining environments, and (4) food insecurity. The children were also interviewed and encouraged to describe what their photos depicted.

Results

Food insecurity and unhealthy foods were prevalent and many children reported environmental challenges to eating healthy food including non-functioning kitchen equipment. In many households, food stamps and food shelves were used to fill gaps in the home food supply.

Photovoice can be effectively used to engage children in conversation about their food environments. This information can be used to tailor policies and interventions to better reflect the living environments and eating behaviors of low-income populations.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Research will collaborate with local communities to encourage and enable aerobic activity among minority populations.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A local community center built in the heart of Minneapolis' Somali neighborhood was struggling to encourage athletic activity among the young girls in the community. Simply put, traditional dress for Muslim girls and sports do not mix.

What has been done

Researchers at the University collaborated with the Girls Initiative in Recreation and Leisurely Sports program along with local coaches, community members and the girls themselves, to create practical sportswear for Muslim girls and women that would allow them to participate in sports while maintaining their religious and cultural values of modesty.

Researchers incorporated ideas from the girls into concept designs that were then voted on by their families and community members. Four prototypes were created that featured long sleeves, athletic pants, knee-length skirts and a more form-fitting version of the hijab headscarves worn by Muslim women.

Results

The girls were thrilled with the results and modeled the creations at a fashion show attended by their families and community members. The new uniforms allow them to practice and participate in team sports without being encumbered by their clothing and thus play to their full potential. Beyond allowing these girls to play unencumbered, this project has the potential to drastically impact the physical and psychological health of Muslim girls in Minnesota and around the world.

Significantly, the design is a uniform version of clothing traditionally worn by Muslim girls and women. It can be easily adapted to use team-appropriate colors, logos and design elements making it an excellent option for other communities with large Muslim populations.

A licensing agreement with startup company is in the works to produce the garments on a national scale.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #6

1. Outcome Measures

Research will uncover ways to increase vegetable consumption among children. (Target expressed as percent increase of vegetable consumption).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	430

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Obesity levels are increasing among children, particularly among those of lower socioeconomic status levels. One approach to preventing obesity among children is to implement healthier eating in school cafeterias.

What has been done

A previous study had shown that increasing fruit and vegetable portion size in cafeterias led to some students eating more vegetables but many students were declining to eat fruit and vegetables entirely.

Researchers conducted a field study to see if offering vegetables before other meal components would increase the overall consumption of vegetables at a local elementary school. K through 5th graders were served a small portion of raw carrots while they waited to enter the line for lunch. They then had the choice to take more carrots, another vegetable, or no vegetable with their main meal.

Results

Serving carrots as a first course greatly increased the number of students eating them and increased overall vegetable consumptions by 430 percent (later studies with broccoli and cauliflowers showed increased consumption as well). Significantly, students that typically turn down all vegetables generally ate the initial portion provided which accounted for the majority of vegetable consumption on the test days.

Presenting vegetables on their own rather than alongside preferred foods is a viable strategy to increase vegetable consumption among elementary students that typically refuse them. Additionally, the cost of providing a vegetable sample is minimal compared to many other strategies being implemented.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges

Brief Explanation

As noted in "evaluation studies", a major effort of the SNAP-Ed program in 2015 was to understand which community settings create the most compelling change with SNAP-Ed education. This information will be used to determine which community partnerships are the most effective for health and nutrition programming, and which professionals are the

most effective conduits of nutrition education. These findings are a precursor to accomplishing goal number 2 regarding professional training, but those outcomes are not yet achieved.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A 2015 study of SNAP-Ed outcomes compared program outcomes from education delivered in four community settings: 1) community food resources, 2) community organizations and agencies serving low-income clientele, 3) healthcare organizations, and 4) schools and other organizations serving youth and their families. Adults who participated through healthcare organizations showed the highest percentage of people who increased their behaviors in key message areas. Moreover, the percentages of difference were 18 - 37 higher than the next highest setting. We intend to analyze the data further to understand more fully why there was such a dramatic difference among contexts. A higher percentage of teens participating through community organizations serving low-income clientele increased fruit intake and engagement in physical activities than teens participating through schools and other youth-serving organizations. Of the youth who completed pre-post surveys, fewer than 50 percent reported making at least one positive change in fruit or vegetable intake or engaging in physical activity. We are analyzing the results further to determine whether issues such as seasonal differences in physical activity may be a factor -- and an educational opportunity.

Key Items of Evaluation

A 2015 study was designed to determine whether the setting in which adults and teens receive SNAP-Ed education makes a difference in behavior outcomes. The study determined a profoundly better effect among adult recipients when they receive the education in health care settings. For teens, best results were found community organizations serving low-income clientele. While we will examine data and its context more closely, this information will be critical to future choices about program partnerships.

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	0%		40%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		40%	
504	Home and Commercial Food Service	100%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	8.7	0.0	7.8	0.0
Actual Paid	15.3	0.0	11.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
513578	0	196716	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1753120	0	1108599	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
567140	0	721885	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. University researchers are committed to assuring a safe food system for consumers while also addressing the increasing demand from consumers for high quality and flavorful food.

Research highlights for 2015 include:

- A new study looking at the chicken processing chain in Thailand finished collecting data at three processing plants and thirty backyard slaughterhouses. While data is still being analyzed, early observations included that backyard-processing facilities did not follow current good marketing practices.
- Recent outbreaks of Salmonella caused by peanuts led researchers to study the connection of Salmonella to peanut plants, particularly whether or not Salmonella can be internalized into peanut seedpods and plants. Early results indicate that Salmonella can be internalized from soil into peanut pods directly and it can be detected in stems of plants where contaminated soil contains bacterial populations greater than 6 log CFU/g.
- Researchers working to create beneficial proteins from food substrates were able to further engineer a *Lactococcus lactis* strain to include the *lanRI* gene. Such breakthroughs could have a huge influence on the food production industry by leading to a way to maximize production of key metabolites.
- A study exploring the growth and survival of *L. monocytogenes* in queso fresco found that a combination of antimicrobials could be effective in controlling the pathogen.
- Researchers working to modify food proteins in order to decrease their allergenicity have managed to reduce the allergens by 84 percent. In order to be recognized by the FDA as hypoallergenic this number must hit 90 percent.

Extension.

Extension Food Safety programming in 2015 reflected the needs of a diverse food industry, and responded to trends in consumer food consumption. Its long running and successful training program for restaurant food servers and food managers continued, but in 2015, Extension was also heavily engaged in responding to new audience needs. Extension food safety educators helped community festival managers, aquaculture food producers, farmers markets producers, and other niche food producers establish and improve their food handling practices. Results of Extension's impact on food safety in the Minnesota cottage food industry is reported under Outcomes. Some examples of results in 2015:

- All licensed food establishments in Minnesota are required to have a certified food manager. Certified food managers need four hours of continuing education every three years to be re-certified. Since 2003, 5,283 Minnesota certified food managers have attended Extension training, and over 4,000 have taken the online course. This training is also offered in Spanish. In a follow-up evaluation of online course participants, 42 percent of respondents implemented a minimum of three safe food handling practices since taking the course.
- Online training in food safety for festival and event managers was offered, and 78 percent of respondents to a post evaluation said they will use what they learned to train staff or change their food safety practices to prevent a food-borne illness.
- Over the past five years, an Extension food safety educator has worked with a local trucking business to help them implement new food safety regulations for fruit and vegetable producers. As a result the trucking business easily passed the first farm food safety audit in 2014. In 2015, this trucking business served as a model of food safety best practices, was the site of an Extension Good Agricultural Practices food safety training for other produce farmers from Minnesota and Wisconsin. Post evaluations showed that as a result of the program, all of the attendees planned to implement Good Agricultural Practices on their farm, including creating farm food safety record keeping systems, getting their well water tested, conducting employee food safety training, and improving their cleaning and sanitizing practices.
- There are 176 farmers markets in Minnesota, with approximately 2,000 vendors. In 2014, Minnesota

safe food sampling legislations allowed vendors to sample their food and set up rules to keep it safe. Extension began training upon the request of the Minnesota Farmers Market Association, and initial results were reported last year. Extension educators have developed and taught this curriculum state-wide and is the only organization conducting this training. To date more than 375 participants have learned how to prepare and serve food and beverage product samples safely at farmers markets.

2. Brief description of the target audience

Audiences for Extension food safety programs include food industry, restaurant managers, persons interested in working in the food service industry, consumers and producers for locally-grown food markets, home food preservers, high-rise audiences such as seniors, caregivers and daycare providers, local producers and school districts engaged in farm-to-school initiatives, and volunteers who cook for a crowd. Six percent of program participants are persons of color, largely due to the team's outreach to food service workers and Minnesota's growing Latino population.

MAES. Research audiences also include other researchers working in the field of food safety.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	7182	836038	0	0

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

Patent Applications Submitted

Year: 2015
 Actual: 2

Patents listed

62/121,863 - February 27, 2015 - Detection Assays and Methods
 62/240,764 - October 13, 2015 - Selenium Nanomaterials and Methods of Making and Using Same

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	12	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops or other educational events conducted.

Year	Actual
2015	73

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.)

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 Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Each year, foodborne illnesses cause approximately 48 million U.S. residents to get sick, resulting in 128,000 hospitalizations and 3,000 deaths. Additionally, 31 percent of the food supply in the U.S. went uneaten in 2010, approximately a \$160 billion loss.

What has been done

In an effort to reduce these problems, University researchers developed food packaging technology that changes color to indicate when food goes bad. An indicator on a gallon of milk, for example, changes from blue to red to signal when the milk starts to spoil.

Results

This invention is one million times more sensitive than previous technologies and is capable of detecting even a few harmful bacteria or viruses in food.

It promises not only to help reduce the risk of foodborne illness but also can cut down on food waste by alerting food industry workers to fungi and other threats that may come into play during processing or packaging, allowing those workers to immediately take action and prevent further spoiling.

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

Outcome #2

1. Outcome Measures

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

Not Reporting on this Outcome Measure

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.)

Not Reporting on this Outcome Measure

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 Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Minnesota 2015 Cottage Food Exemption legislation was established in part to better understand the scope of the Minnesota cottage food industry. It allows Minnesota residents to manufacture and store particular foods in an unlicensed kitchen and sell them from home, farmers markets, farm stands or at community events. Producers do not have to buy a license for total sales under \$5,000, but they are required to complete an online food safety course accredited by

the Minnesota Department of Agriculture. Producers who have between \$5,000 and \$18,000 in sales are required to take advanced food safety training for cottage food sales.

What has been done

The Minnesota Department of Agriculture asked Extension to review the content of the online course and to design and deliver the eight-hour advanced training. The training covers how to produce baked goods safely in a home kitchen, safe acid and acidified canning processes, and best preservation practices for making and selling homemade jam, jelly, preserves, fruit butter, and dehydrated food products. Extension partnered with the Minnesota Farmers Market Association to offer the advanced training at eight academies across the state. Requests for information resulted in development of further educational tools such as FAQs, checklists, videos, and online tools.

Results

Before the educational efforts on this group, the Department of Agriculture had less than 100 registered producers, and now there are over 500 Minnesota cottage food producers registered with the state. The collaboration between Extension and the Minnesota Department of Agriculture also opened the public conversation on related food safety concerns, such as food allergen issues. With better food safety practices, the industry can have more pride in its products, which contributes to the industry's growth and maturation. Because of the visibility of Extension's training efforts, new groups, such as Hmong farmers, have been asking for training. All of this helps consumers have confidence in the products of cottage food producers, which in turn is good for sales.

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
2015	85

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Preventing foodborne illness resulting from poor practices in retail food settings create a public health problem and is also bad for the reputation and commerce of the industry. Certification is known to decrease the number of these outbreaks.

What has been done

From January through December 2015, 433 ServSafe® exams have been given by University of Minnesota Extension to first time class members, retest participants, TAP online certification course participants and individuals who took the course from another provider but needed to find their own exam site and proctor.

Results

Of these exam takers, 366 (85%) had a passing score.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The long term success of Extension's ServeSafe program was tested in a new format with a new audience: Through a partnership established between the Extension Food Safety program and adult basic education in a local Minnesota Public School District, a sustainable, eight-week Food Safety Careers Certificate Program for persons of all languages was created.

The pilot certificate program was designed and led by Extension food safety educators. An evaluation of this pilot test of the program showed that seven students completed an eight-week pilot series and six of the students started new jobs after working with a career navigator and participating in the ServSafe program.

As a result of the evaluation, a second pilot series was approved by school administrators and the class format was changed: two-hour class periods were expanded to three hours based on student recommendations.

Key Items of Evaluation

A collaboration with Adult Basic Education programs brought Food Safety Careers Certification to person speaking any language. The training resulted in increased job skills and greater access to new employment among participants.

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%		15%	
112	Watershed Protection and Management	60%		25%	
133	Pollution Prevention and Mitigation	20%		30%	
135	Aquatic and Terrestrial Wildlife	0%		10%	
403	Waste Disposal, Recycling, and Reuse	0%		10%	
605	Natural Resource and Environmental Economics	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Paid	15.9	0.0	24.3	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
534521	0	806083	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1801304	0	1713835	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
492461	0	1773397	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Water has been a key identifying factor for the state of Minnesota since it was a territory. However, threats in the form of aquatic invasive species, land use and climate change are all affecting Minnesota's water. MAES research related to water resources examines water from a number of perspectives and takes on water quality issues related to erosion, agricultural runoff, aquatic invasive species and quality drinking water.

Research highlights for 2015 include:

- A new aquatic invasive species, starry stonewort, was discovered for the first time in Minnesota in August 2015. Researchers are working with the Minnesota DNR on a management plan.
- Fieldwork was completed evaluating 55 onsite systems and the wastewater from rest stops, weigh scales and truck holding facilities across Minnesota. Research findings will be used to assist with future design and management decisions at similar facilities in Minnesota and throughout the U.S.
- A new project looking at reduced levels of dissolved oxygen (DO) in Minnesota streams successfully collected field results from 36 streams.
- Twenty-seven species and 2,517 additional Trichoptera specimens were added to the University of Minnesota Insect Collection. Trichoptera are important components of freshwater ecosystems and the U houses one of the most important collections of Trichoptera in the world.
- A rural stream hydrology handbook aimed at local conservation staff for use with homeowners was completed and published electronically as "Fields to Streams: Managing Water in Rural Landscapes."
- A study exploring the causes of increased streamflows in Northern Minnesota found that most increases were due mainly to increased precipitation (additional 50-100 mm per year), which is consistent with the principles of increased runoff at higher soil moisture conditions.
- An airborne lidar analysis of the rivers in Blue Earth County showed that bank erosion is the primary source of sediment in local rivers. Furthermore, researchers found that multitemporal lidar scans are a useful tool for estimating bank erosion over large areas and for riverbanks that are not easily accessible for conventional surveying equipment.
- A model for the infiltration of overland flow, direction precipitation, and routing of access water has been developed. The model will assist the Minnesota Department of Transportation and county highway departments to effectively use drainage ditches to meet stormwater control requirements.
- Early season endothall treatments in Lakes Susan and Riley were effective in reducing curly leaf in both lakes with no noticeable adverse effects on native plants. But, overall, poor summer water quality in both lakes inhibited native plant recovery and expansion.
- Plants in Lake Starring responded rapidly to carp removal in 2015. Plant coverage increased greater than 40 percent in the littoral zone and thirteen species were found.

Extension. In 2015, Extension Water Resource Programs helped Minnesotans tackle water issues at the local and state level, formed new collaborations with farmers, local water resource professionals, and citizens, and increased the capacity of local communities to address their water issues.

The Interactive Watershed Game was designed by Extension water resource educators, and has been used effectively to engage local community leaders in developing water management strategies. Success of the game led to requests for a version for youth. In 2015, Extension developed and released the youth version and designed a train-the-trainer program for 11th and 12th grade teachers and informal science educators who will use the new Watershed Game in youth education settings. More than 100 educators have been trained, and approximately 100 classroom version kits were distributed. The Watershed Game: Classroom Version has already been used in informal learning environments such as after school programs, 4-H events and environmental field day education programs.

Stormwater runoff is considered to be the number one water resources issue in the U.S. because it carries nutrients, bacteria and other pollutants to lakes, rivers and wetlands. In Minnesota, many public waters do

not meet minimum clean water standards due to water quality issues. One small but effective local effort to reduce runoff pollutants through the use of rain gardens is reported under Outcomes. The learning outcomes evaluated routinely within water programs are described in Evaluation Studies.

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, 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. In 2015, a project targeted youth educators.

Target audiences for MAES research include 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?

Minnesota Extension educators developed a Stormwater Practices and Maintenance curriculum that is delivered through eXtension.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	27254	107957	0	0

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	1	24	25

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 weblinks, 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 shoreline structures.

Year	Actual
2015	111

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research will provide management strategies to the Minnesota DNR to assist with managing Minnesota's declining walleye population.
2	Number of landowners who agree to have rain gardens installed in order to reduce water pollution.

Outcome #1

1. Outcome Measures

Research will provide management strategies to the Minnesota DNR to assist with managing Minnesota's declining walleye population.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Walleye is native to most of Minnesota. Its popularity as a game and food fish makes it a favorite for anglers throughout the state but pressures from pollution, loss of habitat and over harvesting are all threatening Minnesota's native populations.

In 2015, in a historic first, walleye fishing was closed on Mille Lacs Lake midseason as sport fishing limits were surpassed. This decision hurt the local tourism industry.

What has been done

The DNR reached out to the University of Minnesota and experts at other Universities in the U.S. and Canada to provide an independent review of their management of walleye populations in Mille Lacs Lake. The review, which was released in 2015, confirmed that low survival of young walleye is most likely responsible for the continued decline in the lake's walleye population.

Extension conducted a four-season visitor profile study to gain a comprehensive understanding of the characteristics and spending patterns of visitors to the Mille Lacs Lake Tourism Council's service area at different times of the year.

Results

The reviewers recommended several management techniques for the DNR to consider including adjustments to annual harvest levels, increased study and management of fish and birds that prey on young walleye, and continued monitoring and data collection. Notably, the panel recommended against walleye stocking as natural reproduction in Mille Lacs Lake is already high. The DNR will continue to heavily monitor walleye levels in the future with annual adjustments to fishing regulations and limits based on their findings.

Extension's visitor profile and economic data will be used to assist local businesses to diversify their offerings and sustain and grow their businesses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Number of landowners who agree to have rain gardens installed in order to reduce water pollution.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	18

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Climate change has been increasing heavy rain events, and the danger of water pollution from runoff is increasing interest in using simple prevention opportunities, such as rain gardens to control runoff.

What has been done

Extension partnered with the Crow Wing Soil and Water Conservation District to educate community members on the uses and advantages of rain gardens. The Extension Master Gardener county coordinator trained Master Gardener volunteers on storm water best management practices and rain garden design, installation and maintenance.

Results

Eighteen landowners agreed to have rain gardens installed on their properties, thereby reducing pollution of Little Buffalo Creek and subsequently the Mississippi River by filtering polluted runoff. The 18 rain gardens divert at least 15,000 gallons of stormwater in each one-inch rain event. Landowners have agreed to maintain these rain gardens for a minimum of eight years following two years of mentoring by the Master Gardener volunteers.

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)

Brief Explanation

MAES. Large rainfall events in 2015 caused several research groups to hold back on publishing their field results. Most plan to repeat studies in 2016 to verify their findings.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension Water Resources programs routinely monitor learning and action outcomes with pre- and post- evaluations. In 2015, Extension water resource education results included the following:

- Nonpoint Education for Municipal Officials (NEMO) programs assured that local and elected appointed officials made sure that Minnesota Minimal Impact Design Standards for stormwater are incorporated into redevelopment plans, and that more water best management practices are incorporated into street reconstruction plans. 100 percent reported they felt more confident carrying out Stormwater Practices Maintenance, and 88 percent said that after attending the class they plan to incorporate their learning into their job.
- Post evaluation of Shorelines and Clean Water workshops showed that 71 percent of participants planned to change their practices based on what they learned. These changed practices included establishing shoreline buffers, using native plants in landscaping and installing rain barrels and rain gardens to decrease runoff.

Key Items of Evaluation

Routine evaluation of water resource programs demonstrate that community leaders can prevent water resource problems with information from Extension. They are incorporating stormwater design standards into redevelopment plans, and water best management practices are incorporated into street reconstruction. Minnesota residents who live along shorelines are establishing shoreline buffers, using native plants in landscaping and installing rain barrels and rain gardens to decrease runoff.

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	50%		25%	
608	Community Resource Planning and Development	50%		75%	
Total		100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	15.1	0.0	2.9	0.0
Actual Paid	20.5	0.0	2.3	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
466385	0	48920	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2404640	0	378402	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
500653	0	73430	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. Work in communities is achieved through the efforts of Extension Educators and campus Extension faculty, researchers at the Department of Applied Economics, and the staff of the University of Minnesota Tourism Center. Extension educators conduct and deliver applied research with and for communities, with the primary purpose of informing decisions about how communities develop economies and support businesses. Educators also deliver educational workshops on topics that support the success of the entire business community in communities, including customer service, festival and events management, and internet adoption.

Outcomes reported for 2015 measure the ways that communities used the applied research provided by Extension, as well as the ultimate effect of the information in enhancing community capitals.

MAES supported community economics and public finance research in 2015 focused on the impact of public policies on financial wellbeing and economic development.

Several new research projects began looking at the growing trend of young adults relying on their parents for financial support. Researchers are hoping to uncover factors that promote or inhibit financial capacity among young adults in the U.S.

Research highlights for 2015 include:

- Researchers working to implement professional development for K-12 teachers on economic issues related to NIFA's five priority areas were able to provide distance training to 588 elementary and secondary teachers in 2015.
- A research project comparing income between single mothers and fathers over three decades was completed. Results reveal that single mothers are more likely to be in poverty at far greater rates than single fathers and a contributing factor to this disparity is that single mothers were penalized for having more children while single fathers were not.

Note: In the 2017 POW, this planned problem has been renamed and combined with and Civic Engagement and Leadership #8. The new name is Community Vitality and Public Finance (#7).

2. Brief description of the target audience

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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8140	69700	43	0

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

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	10	2	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2015	152

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
2015	88

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 strengthen 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	Communities engaged in community economics and tourism development programming will report positive effects on the capitals that are essential to the vitality of communities, including human, social, civic, financial, built, health, cultural and natural. (Target expressed as the average number of effects identified by communities during evaluation sessions.)
4	Percentage of communities who use applied research reports in economic development planning decisions.

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 strengthen 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.)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Communities engaged in community economics and tourism development programming will report positive effects on the capitals that are essential to the vitality of communities, including human, social, civic, financial, built, health, cultural and natural. (Target expressed as the average number of effects identified by communities during evaluation sessions.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	49

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Community capitals can be leveraged to increase the vitality of communities. As described by Flora and Flora, community capitals include social capital, human capital, civic and political capital, built capital, financial capital, cultural capital, health and natural environment. Community

development programs are in a position to create connections and grow community capitals as they work together, decide about their future, and invest in community development planning.

What has been done

In 2015, four communities engaged in a long-term tourism assessment program that engaged experts, peer communities, and community volunteers. Specialists and Extension educators facilitated community meetings, managed expert reviews of community opportunities, and organized "secret shopper" visits from peer communities. A final report and presentation summarized findings and offered a list of opportunities that might be seized. In addition, an eMarketing cohort convened a business community in a small city to examine opportunities to tap online marketing opportunities.

Results

Ripple Effect Mapping sessions were conducted among the five communities that received community development programming. These sessions used focus group methodologies to uncover programs effects. The groups reported a total of 243 effects. Most of the effects connected people within the community and outside the community (n=89); built capital effects were second (n=55); new capacity building was the third effect (n=54); followed by new political capital (n=42) and financial capital (n=40).

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Percentage of communities who use applied research reports in economic development planning decisions.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	94

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Economic development decisions, especially in rural areas without resources for consultation or professional staff, can be based on assumptions, fears, and antiquated information. The dynamics of local economies can be explained through applied economic research so that community leaders can act on stronger information as they invest in the local economy.

What has been done

The community economics team uses demonstrated economic research methods to analyze local economies and inform local decisions. Examples of applied research offered include: 1) IMPLAN economic impact analysis, 2) sales tax analysis, 3) business retention and expansion strategies community studies, and 4) Retail Trade Analysis (Pull Factor Analysis, Location Quotient, etc.)

Results

We identified 16 Community Economics program offerings to evaluate and determine direct changes to local economic development decisions or education for the local business community. Of the 16 follow-up interviews conducted, 15 (94 percent) responded that the applied research program they engaged had: 1) supported an existing economic development decision already made (n=5); 2) led the community to change a decision (n = 5); 3) informed a new decision for action or investment (n=9); or 4) strengthened the local business community (n = 6).

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Evaluation strategy changes)

Brief Explanation

Outcomes were changed to reflect a new evaluation strategy that more effectively captures community impact.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A new evaluation strategy to interview key leaders successfully uncovered the degree to which Extension community economics information informed economic development decisions. Community leaders were able to directly relate Extension economic impact analysis and other applied research to economic development planning.

Key Items of Evaluation

Examining how economic decisions were influenced showed that, of fifteen targeted communities, five supported an existing decision, five led the community to change a decision, nine made a new decision for action or investment, and six said the program had strengthened their business community.

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: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	14.7	0.0	1.0	0.0
Actual Paid	17.5	0.0	4.6	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
543358	0	100114	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2015024	0	404746	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
526298	0	158347	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Leadership and Civic Engagement programs use multiple interventions to improve the quality of community leadership, the productivity of public meetings, and the value of civic engagement processes in the State of Minnesota and beyond. Because long-term cohort groups are proven to strengthen program outcomes, outreach efforts encourage their implementation throughout the state. In 2015, twenty leadership education cohorts were conducted. Outcomes and impacts reported here are focused on these leadership and civic engagement cohorts. Outcomes include successful community meetings, more leadership contributions among program participants, and tangible community improvements driven by graduates of Extension's leadership and civic engagement cohorts. Leadership and Civic Engagement programs are informed by research 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 research tracked to this planned program. Specifically, this money goes to research projects related to community leadership, restorative justice and social work related to youth achievement and participation in community service.

Minnesota has one of the highest academic achievement gaps in the U.S. Several new research studies approved in 2015 address this growing concern in our state.

Research highlights from 2015 include:

- Based on his work in mediation and restorative justice and Islam, Dr. Umbreit and his international colleagues are assisting the Turkish Ministry of Justice to implement national legislation to develop victim-offender mediation services throughout the country.
- In an effort to increase youth volunteerism and participation, researchers worked closely with City of St Paul Parks and Recreation management to offer training for Directors and staff of local recreation centers.
- Researchers began the design of a wearable chemical-sensing alert system that converts color change to a tactile alert for first responders, health professionals and industrial workers. Initial prototypes were produced and will undergo testing in 2016.

Note: In the 2017 POW, this planned program has been renamed and combined with Community Economics and Public Finance #7. The new name is Community Vitality and Public Finance (#7). This adjustment was made to streamline our reporting process.

2. Brief description of the target audience

Leadership and civic engagement programs are sponsored by organizational partners who collaborate to bring programs to their community to help them achieve their own goals. Of the 20 leadership and civic engagement programs sponsored in 2015, eight were based in cities or counties; four were focused on regional leadership to protect waterways; three were focused on Extension leadership (including two statewide cohorts for Extension volunteers and partners, and one North Central Extension Leadership Development cohort); two were regional programs focused on rural leadership; two were statewide programs for agriculture and rural leadership; finally, one cohort targeted public health leaders.

3. How was eXtension used?

Leadership and Civic Engagement educators used eXtension to gather information about community development topics, and were represented on the Enhancing Rural Community Capacity community of practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5852	69700	344	0

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	7	12	19

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
2015	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
2015	183

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 led by program alumni are more productive. (Target expressed as percentage of program alumni who report in follow-up surveys that participation in a Leadership and Civic Engagement cohort program helped them make public meetings, planning sessions or committees more effective.)
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	Alumni of Leadership and Civic Engagement programs will apply their new knowledge to make tangible improvements in their communities or to address public problems facing their communities. (Target expressed as percentage of participants in community leadership or civic engagement programs who report in follow-up surveys that they have followed through with action steps they committed to at the end of the program.)
5	U of M researchers will collaborate with the Minnesota Department of Health to provide best practices regarding mental health screening for incoming refugees. (Target expressed by the number of incoming refugees successfully referred to mental health specialists between 2013-2014.)

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 led by program alumni are more productive. (Target expressed as percentage of program alumni who report in follow-up surveys that participation in a Leadership and Civic Engagement cohort program helped them make public meetings, planning sessions or committees more effective.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	100

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. More likely, a number of meetings. That makes leading productive community meetings critical. It is not practical or affordable for communities to hire professional facilitators for every meeting, so knowledge of effective meeting facilitation is critical to the vitality of communities.

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 that good meetings are critical to success, to pass on practical tools for success, and to make skilled facilitation a habit among community leaders.

Results

An online survey was sent to alumni of leadership education cohorts that ended in 2015. Of respondents, 100 percent (94 or 94) reported that participation in the leadership education cohort helped them make meetings, planning sessions or committees more productive, at least to a slight extent. Well over half (57.4 percent) reported to a great extent. Graduates of programs brought these skills back to positions that supported community groups, faith communities, schools and youth programs, water and environment initiatives, and more.

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
2015	57

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Extension Research Fellow Ben Winchester has sought to understand the demand for leadership in Greater Minnesota. He considered the number of board and elected positions needed by government, civic and nonprofit entities in Greater Minnesota, and estimates that one in every 34 rural Minnesotans must serve in a leadership position. In comparison, one in every 143 urban 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 programs. Through these Extension-led programs, program sponsors are actively encouraging new people to serve, and to commit to more leadership in their communities and organizations. In

2015, 20 such cohort groups were sponsored.

Results

In 2015, we collected data about changes in leadership roles from 178 graduated program participants as they concluded their participation in Extension programming. Of the participants, 57.3 percent had increased their level of involvement in at least one of the organizational roles -- either a new role, an increase from "in active" to "active" or "leader" roles, or an increase from "active" to "leader."

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

Alumni of Leadership and Civic Engagement programs will apply their new knowledge to make tangible improvements in their communities or to address public problems facing their communities. (Target expressed as percentage of participants in community leadership or civic engagement programs who report in follow-up surveys that they have followed through with action steps they committed to at the end of the program.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	85

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A 2014 study conducted by the Bush Foundation considered questions about Minnesota's civic life. The foundation learned that only half of those surveyed felt their community was strong when it comes to working on problems together. Almost 13 percent didn't think people in their community work on problems together at all. Moreover, almost 22 percent disagreed or strongly disagreed that they themselves can "make a difference in improving the quality of life in my local community."

What has been done

Leadership and civic engagement programs focus on community leadership and the role individuals can play in working on teams and leading teams that make a difference. Curriculum content includes leading others, creating effective teams, creating bridges to other groups, and the importance of leading communities to face and create change.

Results

In the online survey of program alumni, 85 percent of respondents said they had applied their new knowledge to tangible community improvements at least to a slight extent; and of these, 47 percent reported to a moderate or great extent. Highlighted examples that were reported include: 1) more intentional relationships among government jurisdictions; 2) stronger mentorship and empowerment of employees; 3) a river bank park restoration; 4) more civic engagement to improve the local 4-H program; and 5) a 25+ acre solar garden.

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 #5

1. Outcome Measures

U of M researchers will collaborate with the Minnesota Department of Health to provide best practices regarding mental health screening for incoming refugees. (Target expressed by the number of incoming refugees successfully referred to mental health specialists between 2013-2014.)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	67

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many refugees arriving in Minnesota have mental health issues due to their loss and trauma experienced overseas. However, to date, there is no standard for mental health screening or referral during the Refugee Health Assessment (RHA) in Minnesota.

What has been done

Since 2013, researchers at the College of Education and Human Development have partnered with the Minnesota Department of Health to discuss the implementation of routine mental health screening for refugees.

Initial meetings revealed the need to investigate effectiveness and barriers to care and identify interventions to improve the current mental health service delivery system for refugee trauma survivors. Researchers conducted a survey examining both successful and unsuccessful past referrals and what barriers existed within the system. The study confirmed barriers found in previous research and provided new insights into the dynamic relationships existing between refugees and care providers.

Results

Between 2013-2014, 2,591 refugees from the war-torn areas of Burma, Bhutan, Somalia, Ethiopia and Iraq arrived in Minnesota and went through RHA. Of those, 67 were successfully referred to a mental health specialist for further evaluation and follow-up.

Based on these initial results a pilot mental health-screening program has been developed and will be tested at six clinics in Minnesota beginning in January 2016. While not diagnostic, the screening will consist of five questions designed to identify individuals whose mental health concerns could disrupt their well-being or ability to resettle.

The study's findings have also been developed into pocket guides that are used statewide for screening newly arriving refugees.

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 (Evaluation priorities)

Brief Explanation

Knowledge changes were not reported because resulting action and impact outcomes were available to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

To evaluate the impacts of leadership and civic engagement programs, Extension draws from research on community capitals (Flora, et. al., 2008¹) and public value (Kalambokidis, 2004; Chazdon & Paine, 2014²). Program participants and other community stakeholders

are invited to participate in Ripple Effect Mapping sessions, where they reflect on the chain of effects that happened as a result of Extension programs in their communities³. Though Extension programs may not be the sole cause of all the reported outcomes, participants in these sessions were able to name specific contributions that the Extension program made towards most of these outcomes. The outcomes are categorized into "community capitals" that are known to create thriving communities. In 2015, ripple effect maps were created to report community effects of the Southeast Minnesota Civic Engagement Cohort, as reported by participants and community stakeholders.

The study showed that in just one leadership cohort, the community reported 30 changes or enhancements in the civic or political connections the community had; 27 improvements in social capital; 26 improvements in human capital; 17 effects on natural resources; 3 financial benefits, 1 health-related improvement, and 1 built capital improvement.

Key Items of Evaluation

The effects of civic engagement are accomplished well after program participants have been trained with tools and skills they need to engage groups in solving problems. In a program that educated water quality leaders in civic engagement skills, they ultimately reported their new skills leading to 30 civic and political outcomes; 20 improvements in social capital (connections among people); 26 effects related to improving human capital, and 17 natural resource impacts.

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%		30%	
802	Human Development and Family Well-Being	40%		50%	
806	Youth Development	20%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	24.2	0.0	7.3	0.0
Actual Paid	29.3	0.0	10.0	0.0
Actual Volunteer	0.3	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
695278	0	191258	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2118186	0	650735	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
3944214	0	842153	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. 2015 research on building strong, healthy families focused on social and economic issues facing a growing number of Minnesotans and their families. The effect of new technologies on the family unit remains a key concern for researchers along with focusing on challenges being faced by key populations including the elderly, youths and military families.

Research highlights from 2015 include:

- A study of children who are not biologically related to their parents successfully collected data from 250 families with a child conceived using donor gametes. An analysis is underway.
- A research survey exploring how parents use new information and communication technologies found that parents who had positive attitudes toward technology were likely to use social network sites to communicate with their children's friends but less likely to communicate with the parents of their children's friends.
- Researchers looking at the prevalence of parents with disabilities in on the child welfare system developed a map of all state statutes on parental disability as it relates to child welfare. Early results of their national research show at least 19 percent of foster children have a parent with a disability.
- Work continues on the Putting Research to Work (PRTW) for Military Families series, which includes reviews of peer-reviewed articles that focus on emerging issues for military families. In 2015, the team completed 367 PRTW reviews and posted an additional 1000 abstracts on the web.
- A study investigating events that disrupt family businesses found that spousal expectations and social support are critical determinants in new venture creation for entrepreneurs.
- Researchers reviewing federal and Minnesota state policy regarding the inclusion of siblings in cases of child maltreatment handled through the child welfare system found that non-maltreated siblings are not mandated for inclusion on the front end of investigations. However, they are more readily included in the later stages of the investigation, particularly in investigations where parental rights are terminated.
- A national survey of 3,000 married individuals explored the concept of "divorce ideation" or what people are thinking about and doing when they are having thoughts about divorce. Overall, the survey found that one in four spouses had thoughts about divorce in the last 6 months. But most of this group had been thinking about divorce only a few times, rather than a lot. About half had been thinking about divorce for more than a year.

Extension. The Building Healthy, Strong Families program area continues to invest heavily in responding to the changing demographics in Minnesota. In 2015, approximately 29 percent of total adult participants were from minority populations. This is due to an intentional effort to target highly under-resourced communities. Recent demographic data reflects that there are 18.6 percent residents of color across the state. Responsive programming continues to emerge, targeting groups with special needs such as military families, families facing natural disasters and families with an incarcerated parent. In Outcomes, we report on changed parenting behaviors, success in creating positive co-parenting relationships, and improved financial planning among offenders in five of 11 Minnesota correctional institutions. Evaluation results have determined that non-custodial parents benefit from education on co-parenting more profoundly than divorcing parents.

2. Brief description of the target audience

Building Strong, Healthy Families programs serve professionals in collaborating agencies such as mental health professionals, parent educators, schools, courts, family service agencies, health care settings, organizations and businesses. The program also serves parents and caretakers. In 2015, we are reporting on a partnership that brought financial literacy programming to five of the 11 Minnesota Corrections facilities for adult males.

Youth and money programs reach adolescents moving into independent living directly or through their

educational resources. Family development programs are highly effective in attracting low-income, minority and immigrant families through partnerships with trusted community organizations.

MAES. 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 with eXtension in a variety of ways, including extensive involvement in the Military Financial Learning Network (a collaboration with USDA and Department of Defense) which uses eXtension WordPress Learn Event pages and webinars. Educators and specialists attended eXtension webinar sessions and used its public relations arm as a platform to advertise their own educational curricula and teaching events.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	14474	150046	889	0

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

Patent Applications Submitted

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	22	18	40

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of professionals trained to educate and support families.

Year	Actual
2015	6621

Output #2

Output Measure

- Number of workshops and classes held -- face-to-face or online.

Year	Actual
2015	451

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	Divorcing or unmarried parents will make co-parenting plans that are known to be effective in supporting positive child outcomes. (Outcomes expressed as percengage of participants who report plans.)
4	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.)

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.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	95

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Military families face increased risk factors for stress, divorce and mental health challenges related to the many transitions they experience in deployment and reintegration.

What has been done

The Military Family Learning Network (MFLN) supports professionals who work with military families by distributing best practices and evidence-based information. Extension educators led the MFLN with regard to improving professionals' skills as they support self-reliance and successful navigation of multiple family transitions. Webinars led by the team in 2015 covered resiliency, communication during transitions, social media options, financial transitions and using outdoor recreation for restoration and resilience.

Results

The Quantitative outcome above summarizes the percentage of improved skills across all programs. The MFLN led five webinars for professionals over the course of 2015. Across the five webinars, 96.4 percent of participants reported they had applied the information from the webinar to their work; 93.5 percent reported they were prepared to teach clients the webinar's content; and 68.2 percent reported the content of the webinar was not easily obtained from other sources.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Positive and consistent parenting behaviors are especially important as parents navigate divorce or separation from a partner. Positive and consistent parenting can be particularly difficult in those times due to emotional and financial stress.

What has been done

The Parents Forever 8-hour online program, provided to parents who are facing contentious divorce, teaches and reinforces important parenting skills concepts in this critical period of transition.

Results

Parents were asked to complete a pre-survey before taking the online course, and a post-survey after the 8-hour course. They were asked a series of questions about parenting behaviors that could affect child well-being. Three important practices were shown to improve after the program. Parents reported that they "talk with children about their feelings" more (+.31 mean change), and that they encourage time with the other parent (+.17 mean change).

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Divorcing or unmarried parents will make co-parenting plans that are known to be effective in supporting positive child outcomes. (Outcomes expressed as percentage of participants who report plans.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	49

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 into 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 2015, a special evaluation was designed to determine whether the on-line version of this program was achieving intended outcomes. Findings support the value of the online program. With statistically significant findings, the evaluation showed that online program recipients reported: 1) encouraging time with the other parent; 2) reduction in conflict with the other parent; 3) a decrease in incidents where they put children "in the middle"; 4) successful communication with the other parent about parenting issues; and, 5) reduced incidents of feeling angry or upset due to communication difficulties with the other parent.

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 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.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	98

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Former offenders face multiple barriers to self-sufficiency upon release from prison, and often return to neighborhoods where employment opportunities are scarce. Healthy finances diminish the chance that individuals will re-offend. Knowing how to manage money effectively is the first step to achieving financial health. Addressing these deficits and issues through education assists offenders in gaining the tools and strategies they need to promote healthy personal finances after release.

What has been done

From January to June, 2015, a team of six Family Resiliency Extension educators conducted Financial Capability workshops in five of Minnesota's 11 state correctional facilities for adult males. Educators worked closely with transition coordinators at each site to assess needs and interests so that they brought the most useful and interesting topics to offenders in a timely way. The materials and topics that were reported by offenders as most relevant and helpful were integrated into the resource library of the facility.

Results

In the evaluation, offenders provided both process evaluation information (sharing which topics were most relevant and helpful for their transition back into communities) and information about knowledge and impact gains. Nearly one-third of participants were able to identify long-term financial goals for financial self-sufficiency, reliable finances and better life choices. Institutionally,

the program design process resulted in new resources left behind for the facility for future inmates, as well as increased capacity to coach offenders on financial literacy topics among transition staff. The positive outcomes of this program have motivated the Family Resiliency team to look for new partnerships to bring programming to newly released offenders.

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

- Other (none)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Parents Forever program, a program with well-established outcomes in reducing conflict and increasing parent cohesiveness among divorcing or never-married parents, HAS added an online-only format in response to societal trends and funding considerations. In 2015, we conducted an in-depth analysis of data from all parents TOOK the course from 2012 through 2015 and completed pre and post surveys (n -1095).

The results showed effectiveness for the online course, but also revealed an interesting trend. Never married parents reported significantly more improvement with increasing positive coparenting (e.g., communicating successfully with the other parents) and decreasing negative coparenting (e.g., feeling angry or upset due to communication difficulties with the other parent) over divorcing parents. Never married parents reported significantly more improvement in positive coparenting.

Key Items of Evaluation

The Parents Forever online course had a positive impact on never-married parents that was significantly greater than the positive effect on divorcing parents. This indicates the course is useful for a variety of family formations in transition, and will inform future partnerships for bringing the program to address needs.

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, Health, 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: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	49.8	0.0	0.0	0.0
Actual Paid	55.4	0.0	0.0	0.0
Actual Volunteer	475.1	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
1764915	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
3612506	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
8668618	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

4-H and Youth Development programs at the University of Minnesota Extension are managing youth programs using best practices in youth development and volunteer supervision. Youth development programs train youth workers in Minnesota and beyond in using those best practices.

In 2015, Extension met its stated goal that youth participation reflect the diversity of Minnesota's population. Currently 19 percent of Minnesotans are persons of color, and **18.45% of youth participation are youth of color**. This is a point of pride as it reflects very intentional outreach and integration of urban populations, specific programs for immigrant youth, and more.

In rural Minnesota, STEM programming addressed a real-world grand challenge. Minnesota's agriculture business community is concerned about its future workforce. In response, STEM programming is integrating projects that can attract and prepare 4-H youth for careers in the science of agriculture.

The leadership team set three benchmarks for programmatic impacts in 2015, with the expectation that these will be reached by September, 2019.

1. Higher Education: 70 percent of youth participating in 4-H Youth Development will go into higher education.
2. Cultural Diversity: Program participants in long-term programming will reflect the racial, ethnic, and socioeconomic diversity of the statewide community served by 4-H Youth Development.
3. 21st Century Learning Skills and Workforce: 80 percent of youth participating in 4-H Youth Development will be prepared with 21st Century learning skills -- communicating effectively, building connections, making positive choices, and making contributions) that help them excel in their education and in the workplace.

We have reported the evaluated impacts of the 4H program in relation to strengthening 21st century life skills, as well as the success of an online education program for 4H professionals who manage volunteers in Minnesota and other states. In Evaluation Studies, we describe process evaluation findings with regard to college enrollment, first year participant satisfaction, and the roll of youth ambassadors in representing 4H to the state.

2. Brief description of the target audience

Youth leadership programs target young learners who are working in the context of their neighborhood or community to make a difference. **In 2015, 18.45 percent of youth participants were youth of color.**

Through adult learning efforts, we serve 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. At the institutional level, the Center delivered training to youth development leaders who integrate and ensure quality assessment throughout youth development programs.

3. How was eXtension used?

Five Youth Development staff reported using the eXtension web site. Two contributed information to eXtension.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	10671	367218	67433	367218

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

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	9	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
2015	103

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
------	--------

2015 79

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
2015	4014

Output #5

Output Measure

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

Year	Actual
2015	102

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Youth participating in 4-H Youth Development who go on to higher education.
2	Youth participating in 4-H Youth Development who are prepared with 21st century learning skills; e.g., communicating effectively, building connections, making positive choices, and making contributions to their community.)
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.)

Outcome #1

1. Outcome Measures

Youth participating in 4-H Youth Development who go on to higher education.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Youth participating in 4-H Youth Development who are prepared with 21st century learning skills; e.g., communicating effectively, building connections, making positive choices, and making contributions to their community.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	96

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The future of society's workforce and quality of life in communities relies on the development of youth today. Youth who are prepared for education and for life must, according to research, make positive choices, communicate effectively, build strong connections to adults and to friends, and contribute to groups that are making a difference in their community.

What has been done

Nationwide, Extension has set goals to prepare 4-H youth with 21st century skills. Extension in Minnesota has adopted those goals, and evaluates its success in achieving those goals in several focused 4-H statewide initiatives such as an evaluation of the Central Region middle school youth and the Science of Agriculture Challenge event.

Results

In a targeted evaluation, a total of 167 youth grades 4-12 responded. Results demonstrate that youth built 21st century learning skills through involvement with 4-H. Among the results, 95 percent of youth agreed or strongly agreed that they don't let their friends talk them into something they don't want to do; 98 percent agreed or strongly agreed they can work things out

when others don't agree with them; 97 percent agreed or strongly agreed they have friends who care about them; and 94 percent agreed that they like to work with others to solve problems.

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.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	96

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Novice and experienced Extension professionals working with are critical to working with youth to develop 21st century skills, and to creating safe and healthy environments for youth. Responsible training and support of youth workers improves volunteer management, quality volunteer recruitment, and a strong philosophical base for youth development programs.

What has been done

With leadership from U of M Extension's Center for Youth Development, an online course was developed for and delivered throughout the twelve states in the North Central area. Course content was designed and piloted with 50 Extension professionals. During the six-week course, members participated in pre-recorded sessions, readings, activities and three live webinars.

Results

Evaluations indicated that 96 percent indicated that their understanding of how to work with volunteers was enhanced. One professional noted that it was the most useful professional development experience they had had in 18 years of working with Extension.

4. Associated Knowledge Areas

KA Code	Knowledge Area
805	Community Institutions, Health, and Social Services
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges

Brief Explanation

As college enrollment was analyzed for 2015, we found that 4-H alumni had a 59 percent college enrollment rate. This is, in fact, lower than the 69 percent enrollment reported among the general population in Minnesota (Minnesota Statewide Longitudinal Education Data System). Obviously, this is not accomplishing a programmatic goal. It is also a decrease from past studies of 4-H, which showed 65 percent in 2013. This negative finding resulted in the establishment of a system-wide goal to increase graduation rates to 70 percent by September of 2019. Staff development, marketing and programmatic decisions will be aligned to that goal.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of youth development is conducted for specific pilot projects, and to measure the progress toward specific strategic goals that have been established. Minnesota 4-H is also collaborating with 4-H nationwide to discuss specific indicators shared across the country.

In 2015, evaluation studies included:

- An examination of post-secondary enrollment among 4-H Alumni.
- A survey of parents of first year members to determine satisfaction with the experience, as well as retention factors in 4-H.
- An examination of 21st century skills at the Science of Agriculture Challenge.
- A report on the contributions of 4-H Ambassadors

Key Items of Evaluation

Key findings from these studies included the following:

- The survey of first year members showed that 79 percent of first year 4-H members were mostly or very satisfied with their child's experience. (See output measures.)
- The examination of 21st century skills showed positive youth development co-related to 4-H membership. (See outcomes.)
- 4-H Ambassadors contributed 7,750 hours to 4-H youth in 2014-15 in activities ranging from planning programs, implementing outreach strategies, promoting 4-H, and other activities. The program evaluation demonstrated that youth ambassadors understand the breadth and diversity of Minnesota 4-H; are able to represent and share about 4-H with the larger community; feel they have made a meaningful contribution to Minnesota 4-H; and have developed 21st century leadership skills individually and in group settings.

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Natural Resource 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
111	Conservation and Efficient Use of Water	10%		5%	
112	Watershed Protection and Management	10%		5%	
133	Pollution Prevention and Mitigation	10%		20%	
135	Aquatic and Terrestrial Wildlife	20%		40%	
136	Conservation of Biological Diversity	20%		20%	
605	Natural Resource and Environmental Economics	10%		5%	
903	Communication, Education, and Information Delivery	20%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	14.7	0.0	51.0	0.0
Actual Paid	13.9	0.0	23.6	0.0
Actual Volunteer	36.7	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
431681	0	402865	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1779796	0	2365614	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
567689	0	2817622	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supported research related to natural resource management spans several academic departments. Natural resource management research focuses on environmental stewardship, maintaining the diversity of ecology in Minnesota and protecting and improving wildlife habitats.

A new project for 2015 is developing methods to restore Monarch butterfly habitats and establish protocols for monitoring their numbers and movement.

Research highlights for 2015 include:

- Researchers discovered a new way to image insects and neurons labeled with silver. This finding could lead to a rebirth in using silver- and gold-based cell labeling protocols and impact how all neurons, including those obtained from humans, are viewed in 3D.
- Interviews conducted on the potential impact of invasive species on tourism revealed theoretically significant visitation changes in areas affected by a terrestrial invasive species. Specifically, one-quarter to one-third of visitors would change locations if emerald ash borer impacted their original destination.
- A census was conducted on the abundance of the American White Pelican in Minnesota and several fledged juveniles were photographed. Data is being analyzed to determine the pelican's statewide numbers and distribution.
- Researchers working to evaluate the importance of environmental and social factors on ecological restoration outcomes surveyed sixty restoration sites completed in Minnesota over the last twenty years. This study will be used to develop statewide guidance for selecting projects for future restoration funding.
- A research project on habitat management of ruffed grouse found that grouse inhabiting aspen habitats had a higher theoretical rate of population increase than those inhabiting conifer habitats. But also found that grouse will use conifer habitats for breeding when aspen habitats are nearby. Test sites were distributed throughout the state allowing results to be broadly applied from Minnesota to the northeastern US and southern Canada.

Extension. Extension programming in natural resources in 2015 focused on increasing skills in citizen science among adults and youth. Its signature programs included Monarchs in the Classroom, Schoolyard Ecology Explorations, as well as the White Earth Reservation Academy, which helps White Earth students improve their math and science performance while honoring traditional practices and values. A major effort of natural resource Extension education is the Master Naturalist program, which reached its 10-year milestone in 2015. Leveraging of volunteer hours for natural resource management is reported in Outcomes. In 2015, a comprehensive evaluation of the Driven to Discover youth citizen science program was conducted and results are discussed under Evaluation Studies.

2. Brief description of the target audience

Extension programs reach concerned citizens and volunteers who are trained and served in a variety of roles. Minnesota Department of Natural Resources, Soil and Water Conservation Districts, U.S. Fish and Wildlife Services, Health and Human Service Departments and Environmental Sciences and public schools are some of the important partners in Extension.

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?

A Minnesota Extension educator participated in the national "Ask an Expert" program.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5459	281489	0	0

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

Patent Applications Submitted

Year: 2015
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	11	40	51

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Master Naturalists trained and supported in Minnesota.

Year	Actual
2015	250

Output #2

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 #3

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
2015	102

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	Community decision-makers, leaders and professionals will increase their knowledge related to approaches to water planning, water conservation and water quality improvement. (Outcome expressed as a percentage of participants.)
5	Using knowledge gained from research and water resources education programming, community groups will create and/or implement existing local plans to protect and improve water quality and/or conserve water resources. (Outcome is the number of plans developed or revised in part due to this programming.)
6	Water resource professionals will apply skills and resources learned by participating in programs to address specific water management responsibilities and implementation goals. (The outcome is a percentage of professionals who said they are applying skills to meet implementation goals or requirements met by using skills gained at programs.)
7	Research on invasive species management in the northern boreal forests will positively impact consumer behavior. (Target expressed as the percent likelihood of consumer behavior adjustment).

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
2015	207211

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Minnesota is a diverse state, rich with natural resources that need attention and continued support on both private and public land. Enormously valuable support can be provided by concerned citizens at the local level if they are mobilized and know the science they need to know to care for natural resources.

What has been done

The Master Naturalists program trains community members who, in turn, agree to offer 40 hours a year in support of natural resource projects in their communities. As of fall of 2015, the program has educated over 250 instructors and reached more than 1,700 active users. There are trained Master Naturalists in 82 of Minnesota's 87 counties, and nine local Chapters convene volunteers to learn and get more involved. On its 10th anniversary, 9/26/15, the program mobilized its volunteers for one day of conservation service.

Results

On the 10th anniversary day, staff worked with 13 sites across the state to host 319 volunteers who provided 1,577 hours of volunteer service. On that day, over 26,000 trees were fitted with bud caps to protect them from hungry deer over the winter. In another area, volunteers collected native seeds and removed invasive species. Over the course of 2015, Master Naturalists conducted 61 invasive species removal projects. These events managed invasive species on 1,715 acres of land. The total acreage of land impacted in activities such as buckthorn removal has now reached 1 million acres.

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.)

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Community decision-makers, leaders and professionals will increase their knowledge related to approaches to water planning, water conservation and water quality improvement. (Outcome expressed as a percentage of participants.)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Using knowledge gained from research and water resources education programming, community groups will create and/or implement existing local plans to protect and improve water quality and/or conserve water resources. (Outcome is the number of plans developed or revised in part due to this programming.)

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Water resource professionals will apply skills and resources learned by participating in programs to address specific water management responsibilities and implementation goals. (The outcome is a percentage of professionals who said they are applying skills to meet implementation goals or requirements met by using skills gained at programs.)

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Research on invasive species management in the northern boreal forests will positively impact consumer behavior. (Target expressed as the percent likelihood of consumer behavior adjustment).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Humans can unwittingly play a key role in the spread of invasive species by allowing a species to spread more rapidly through their own movements and actions. European earthworms are a key example of this. This invasive earthworm threatens the long-term productivity of northern forests where improper disposal by anglers is the primary cause of their spread.

What has been done

An interdisciplinary team of researchers first looked at how anglers dispose of their earthworms and if they were aware of the risks of improper disposal. Results showed earthworms were disposed inappropriately 18.5 percent of the time and 16.5 percent of these anglers believed their disposal was correct.

Results

Results revealed anglers were twice as likely to dispose of their bait containers when the container was labeled compared to unlabeled. Additionally, environmental labels had no effect on the sales of bait in shops.

This is the first demonstration that an ecolabel can be a powerful and direct way to mitigate the environmental harms of an invasive species by reducing dispersal by humans. Similar techniques could be effectively used for other invasive species that can be spread by human activity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Report changes)

Brief Explanation

Goals related to Water Resources were not addressed in this report as Water Resources was brought back in as a federal program for the 2015 report. This was done to acknowledge the federal attention to water issues currently, as well as the significant work done by Extension and MAES in Minnesota.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension evaluated the Driven to Discover program, which trained adult leaders to engage middle school youth in citizen science projects. The settings in which adults engaged youth included nature centers, middle school summer and after school programs, and youth club settings. An evaluation was conducted to assess how youth engaged in inquiry through citizen science with the help of their adult leaders. It combined quantitative and qualitative data collection, with youth pre-and-post program surveys and adult leader post-training surveys. Adult leader focus groups were held, and to obtain a deeper understanding of youth impacts, group youth interviews were conducted with scientist leaders at science fairs.

The evaluation revealed that Driven to Discover succeeded in affecting view of themselves as "scientists". It also found that the most successful adult leaders had the ability to mentor youth through the process of science inquiry. Adult leaders with moderate understanding of science, but a lower ability to engage youth team members in science inquiry, struggled to meet program goals. The findings of the evaluation has major implications for selection of adult leaders for future programs. Adult leaders who come into the training program with a background in formal education or natural science education can mentor their youth through the inquiry process more easily than those with a background only in leading youth clubs or activities.

Also, the evaluation showed that program setting or situation had a major effect on the program's sustainability. Programs that show the most potential for long-term sustainability include school/teacher-associated programs, community centers and natural resource education centers. Because the youth dropout rate between the first and second year of the program was high, the evaluation highlighted the need for Driven to Discover to find ways to challenge and create incentives for returning youth.

The evaluation also revealed that Driven to Discover is well-suited for girl-friendly science education. It consistently attracted more middle school girls than boys. The results of the evaluation suggest that Driven to Discover could be adapted for use with other subject matter and citizen science programs.

Key Items of Evaluation

An evaluation of the Driven to Discover program revealed positive outcome for youth and their relationship to science, but it also discerned which adult leader skills are most important to creating those outcomes. Adult leaders need to be able to mentor children through the entire process of science inquiry. This affects what skills and qualifications should be in place among future adult leaders who are trained.

The evaluation also determined which types of youth settings create the most success and program sustainability, and saw greater attraction of girls than boys in the program.

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	25%		50%	
124	Urban Forestry	25%		30%	
125	Agroforestry	25%		10%	
133	Pollution Prevention and Mitigation	25%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	7.1	0.0	33.9	0.0
Actual Paid	16.1	0.0	14.1	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
520883	0	100962	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1698511	0	1103191	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
716009	0	1305063	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. With over 17 million acres of forests and a \$8.9 billion forest products industry bolstering the state's economy, Minnesota is a significant location to study forestry and forest products. Research in this area focuses on protecting this vital resource from pests, diseases, and a changing climate.

Research highlights from 2015 include:

- Researchers working to integrate new forest-based economic development opportunities with existing forest industries and environmental objectives successfully consulted with the Minnesota Department of Natural Resources (DNR). Based on these consultations the Minnesota DNR is now committed to using detailed analysis that explicitly compare multiple forest scenarios and use economic measures in their planning.
- A research project exploring the effect of the stumpage payment method on timber sales found that timber payment method did not significantly influence a bidder's willingness-to-pay for timber or the overall gross timber sale revenue generated. Also, the consumer-scale payment method cost approximately \$323 more per timber sale compared to those sold on an appraised volume stumpage payment method.
- A new tree disease, *Heterobasidion irregulare*, the cause of serious root rot in red and white pines, has been discovered for the first time in southeastern Minnesota. A regional survey is underway to find other infected locations in Minnesota that will then lead to a management plan for controlling the diseases spread.
- Research on the native tree disease Golden Canker has shown the fungus causing the disease is genetically different than other similar fungi leading researchers to place this fungus into a new genus.

Extension. The forest products industry contributes 60,000 jobs and more than \$9 billion in value to Minnesota's economy. One-third of the state is covered in forest land, with enormous impact on Minnesota's clean water, air and quality of life. Extension forestry education in 2015 focused on the health and sustainability of this important resource in the face of climate and societal pressures. Educational efforts included forest invasive species, agroforestry and bioenergy. The Wasp Watchers program continued to engage citizen scientists in bio-surveillance efforts to detect Emerald Ash Borer infestations. An innovative new effort to increase communication with forest landowners and professionals through an online Siviculture Library is reported under Outcomes.

Minnesota is unique in its diversity of biomes including grassland, deciduous forest and coniferous forest. They have been shaped by difference in temperature and precipitation, from north to south and east to west, creating a tension zone and causing many Minnesota forest plants and wildlife to be at the edge of their range. As climate changes occur, their ranges are shifting north and east.

Results of Extension Forestry programs in 2015 included:

- A workshop on forest ecosystem health for natural resource managers emphasized wildlife habitat, fire risk and managing for future uncertainties. Attendees indicated their interest in adopting methods learned in the workshop into their organizations.
- Participants of Extension's silvopasture tours reported that they used the information to plan to include silvopasture as one of the prescriptions in their forest stewardship plan. One Extension project to address the stresses this creates on Lake Superior's North Shore forests is reported under Outcomes.

Note: In the 2017 POW we have removed Forestry and Forest Products as a future program area. Projects currently funded by this program will be reported under Climate Change, Water Resources, Natural Resource Management or Sustainable Energy in the future. This adjustment was done to streamline our reporting process. Several projects have already been moved to their new program areas.

2. Brief description of the target audience

Primary audiences: Extension education and support in forestry issues reached forest landowners, natural resource 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. Because the Minnesota forest industry has shifted over the past ten years from large wood product industries to smaller private landowners and noncommercial forests, Extension is responding to new audience needs.

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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8525	278634	0	0

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

Patent Applications Submitted

Year: 2015
 Actual: 2

Patents listed

62/214,291 - September 4, 2015 - Compositions Including Ligninsulfonate, Compositions Including Un-Alkylated Lignin, and Methods of Forming

62/215,017 - September 6, 2015 - Compositions Including Ligninsulfonate, Compositions Including Un-Alkylated Lignin, and Methods of Forming

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	9	16	25

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
2015	114

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.)

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
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In managing complex forest ecosystems, it's never clear what might work, and the 100 year growing cycle makes finding out a major problem for forest managers and landowners. For example, those who want to grow red pine have a more complex task than agricultural growers because foresters manage a complete ecosystem. Until now, there has been no way for forest managers to share information, making every project a reinvention. This is inefficient, and it loses great ideas and strategies in forest management.

What has been done

Extension's forest specialists led 20 public and private organizations, representing the majority of forest landowners, in creating an online Siviculture Library. The Library is a platform for natural resource managers to share information. Funding came from the Great Lakes Forestry Alliance and Ontario Ministries. This new repository of forest management information includes 44 case studies covering nine important forest types in Minnesota --aspen/birch, ash, central hardwoods, mixed woods, northern hardwoods, pine, peatlands and spruce. In 2015, the Siviculture Library was launched with a public symposium and field day.

Results

To date, 436 users have accessed the data base, and online searches have led to pivotal connections and follow-up discussions between professionals. These connections allowed them to share innovations and troubleshoot forest management practices. It has created efficiencies from those collaborations. As one example, a Minnesota Department of Natural Resource Manager was contacted about an aerial seeding project by a forest service siviculturalist because she saw the case study on the Library website, resulting in a sharing of strategies and methods.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
124	Urban Forestry
125	Agroforestry
133	Pollution Prevention and Mitigation

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 Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	800

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The North Shore of Lake Superior, appreciated for its beauty, is experiencing a disturbing die-off of trees. As the conifer population dies off, this triggers cascading detrimental effects to the entire ecosystem and the species that rely on this habitat, including bald eagles and large raptors who use white pine for nesting and wildlife. About 1,500 private landowners are stewards of 80 percent of the shoreline. Many of these landowners do not have the expertise to manage their own forest restoration. The scope of the restoration needed on the North Shore to ensure a healthy and resilient ecosystem is extensive and will require the efforts of all landowners.

What has been done

In a collaborative effort with the North Shore Stewardship Project, Extension forestry educators designed, promoted and delivered over 51 hours of customized instruction to private forest landowners with holdings in the coastal area. The goal of the project was to provide landowners with knowledge they need to restore Lake Superior coastal forests.

Results

The landowners represented holdings of more than 800 acres of forest land in the coastal area. Following the training, they are undertaking restoration efforts to plant or protect white pine, white cedar and white spruce. One participant reported plans to build a gravel bed nursery to buffer tree

planting. Another is using clearing and enclosure techniques to protect saplings from deer. This model of in-depth landowner education has proven its effectiveness, so there are plans to partner with the Nature Conservancy for two additional rounds of training in 2016 and 2017 if funding is found.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (none)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

None.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 13

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: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	3.1	0.0	1.7	0.0
Actual Paid	10.2	0.0	2.0	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
372565	0	48878	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1511062	0	217779	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
449933	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. Extension reduced its emphasis on housing programming in 2015 due to shifting

priorities and increasing demands for resources from other emerging needs. One full-time housing specialist retired in 2015 and was not replaced. Other economic and social trends also influenced this direction -- such as development of public information sources in other arenas and involvement in the building and construction industry in public communication and research.

Nevertheless, we can report housing outcomes in 2015 related to radon mitigation training conducted previously, and a program that helped to address the growing bedbug problem in residential housing and the hospitality industry.

MAES research in housing spans several departments and research areas, including the work of researchers in social science, community economics, design and public policy.

Access to safe, affordable housing has always been a key issue. Recent studies show that (1) one in four renters in the US use half their pay for housing costs and (2) workers and employers are becoming increasingly burdened by low-income housing shortages in the state. Many researchers are also focusing on underserved populations who are often at risk for housing issues including minority groups and seniors.

Research highlights for 2015 include:

- A study on green technologies in multi-family housing released data obtained through interviews with a selection of owners, architects, property managers and residents. The data showcased the competing interests of short-term cost savings versus the potential long-term cost savings offered by new greener technologies. Notably, residents were generally not cognizant of upgraded technologies or green features in their buildings.
- Research on recreational housing in rural communities discovered that over half of the second homeowners surveyed in three counties intend to convert their recreational homes into year-round retirement homes. This conversion has the potential to significantly impact local revenue generation (via lower property taxes), demand for basic public and health services and the local environment in the near future.
- In an on-going study regarding the impact foreclosures have on Minnesota's "built environment", fieldwork was completed in Rice County, Minnesota. Additional fieldwork is planned for a variety of urban, suburban, exurban and rural neighborhoods.

Note: In the 2017 POW Housing has been removed as a planned program. Housing projects and activities will be reported under Community Vitality and Public Finance (Program #7), Building Strong, Healthy Families (Program #8) and Health and Nutrition (Program #4). We did this to streamline our reporting process and to allow us to more effectively highlight how housing can affect family life and our community as a whole.

2. Brief description of the target audience

The overall target audience for this information is builders, remodelers, contractors, mitigaters and others involved with avoiding and resolving problems in homes. Another 2015 audience was home owners and prospective home buyers interested in innovation and energy efficiency in new home construction, and energy retrofit options for existing homes.

Extension's leadership in addressing this emerging problem has led to a 2015 request by the EPA Region 5 for Minnesota to assess their bedbug educational tools and improve them. As a result, Minnesota Extension educators will be working with different groups of stakeholders in each state, including officials from each state's Department of Health, public health workers and housing officials.

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?

A Minnesota Extension educator added content about energy efficient housing.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4468	1709537	0	0

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

Patent Applications Submitted

Year: 2015

Actual: 1

Patents listed

14/733,233 - June 8, 2015 - Composition for Detection and Treatment of Bed Bugs

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	2	3	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Educational courses will be delivered to the target audiences.

Year	Actual
2015	102

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.)
3	Bedbugs eradicated in a hotel that drives the economy of a Minnesota tribal community.

Outcome #1

1. Outcome Measures

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

Not Reporting on this Outcome Measure

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

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	30000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Radon is a radioactive gas found in nearly all soils and can move up through the ground and into homes through cracks and holes in the foundation. There, the gas is trapped and can build up. Radon is the second leading cause of lung cancer. In 2014, the Minnesota Legislature passed legislation requiring the seller to disclose any knowledge of radon concentrations in residential real estate transactions. Minnesota has the fourth highest proportion of homes with elevated indoor radon concentrations in the nation.

What has been done

As a result of the radon disclosure law, testing is increasing in Minnesota, and there is increased radon testing and mitigation in large buildings. Extension takes the lead in radon testing education as the U of M houses and manages the Midwest Universities Radon Consortium. Introductory measurement and mitigation courses produce high national proficiency exam pass rates. Advanced courses include measurement and mitigation in large buildings, chemical vapor intrusion mitigation and new soil mitigation standards.

Results

MURC-trained professionals have completed tens of thousands of radon measurements, and

mitigated well over 30,000 buildings. Instructors have written EPA measurement protocols and national standards of practice; they have testified before Congress on radon policy, and have written World Health Organization radon guidance. The most significant measure of the impact of radon training is lives saved due to the number of homes that training graduates mitigate. Using U.S. Environmental Protection Agency metrics, this radon training has saved about 5,000 lives due to reduced lung cancers associated with residential radon concentration reductions.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Bedbugs eradicated in a hotel that drives the economy of a Minnesota tribal community.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

When insecticides that once eradicated bedbugs were outlawed and resident mobility increased, bedbug infestations re-emerged. In 2000, the Minnesota Department of Health reported that new immigrant housing in Minneapolis had 100 percent infestation rates. Minnesota property owners are required to provide pest control for their housing, but they don't have to provide successful pest control, and bedbugs are difficult to eradicate. Current insecticides are not effective in killing bed bugs, and they require multiple applications. The best treatment is the use of specialized heat treating equipment to raise room temperature to 145 degrees Fahrenheit, but the use of this equipment requires trained professionals.

What has been done

In 2011 and 2012, Extension educators conducted workshops to inform and educate housing audiences about bedbug control. Following a workshop, Indian tribal leaders contacted Extension for help addressing a bedbug infestation in its casino hotel. Because so much of the reservation income came from its hospitality industry, tribal leaders were concerned about the threat to their

economy. In 2015, Extension held two days of training with casino and hotel management and community members about treating and controlling bedbugs.

Results

Based on Extension education, the hotel decided to purchase their own heat treating equipment, train staff and establish protocols to eliminate bedbugs. Taking control of the process themselves eradicated the bedbug infestation in the hotel, and also allows them to act when necessary to quickly treat any re-occurrence. Due to privacy concerns, the tribal officers have not shared the percentage of hotel rooms invested with bedbugs, but they now report good control of the problem.

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

- Other (None)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

None

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 14

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	20%		20%	
132	Weather and Climate	20%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		25%	
204	Plant Product Quality and Utility (Preharvest)	0%		10%	
205	Plant Management Systems	20%		15%	
211	Insects, Mites, and Other Arthropods Affecting Plants	20%		15%	
213	Weeds Affecting Plants	20%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	14.0	0.0	59.6	0.0
Actual Paid	19.1	0.0	53.9	0.0
Actual Volunteer	69.1	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
614600	0	404939	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2017640	0	5077661	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
807055	0	4565570	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supports horticultural research includes fruit and ornamental crops, forages and grasses. Research in this area in broad including breeding new cold-hardy and disease resistant plants as well as exploring new opportunities for growers like high tunnels and organics.

Research highlights for 2015 include:

- Construction began on a new Bee and Pollinator Research Lab. The \$6 million, 10,500 square foot lab will open in fall 2016 and will bring the Bee Lab's research and outreach programs together under one roof.
- The Science of (the) Green® initiative took an additional step forward in 2015 by announcing an official partnership with the United States Golf Association (USGA). The initiative aims to renovate the Les Bolstad Golf Course, just across the street from the St. Paul Campus, to make it a working model for the industry that will pave the way for a new kind of interaction with golf personally, communally, and generationally.
- Ten garden chrysanthemum genotypes from the University of Minnesota and South Korea breeding programs were tested in four temp and light environments to determine the extent of heat delay for visual bud date and other key traits. Such tests assist researchers in selecting the best parents for future breeding.
- In 2015, seven new pear selections and three sweet cherry selections were sent to commercial test sites in Minnesota for further testing.
- Two new dwarf tomato varieties have been sent for further in field testing and will be releases in 2016. Ground Jewel (aka MTX097) averaged 104 fruits per plant during trials. Ground Dew (aka MXT104) averaged 98 fruits per plant. Both offer short growing seasons (40-45 days) and only occupy one square foot of land.
- Research on adjusting consumer behavior around lawn maintenance found that reading the information rather than watching a video was more effective in influencing an individual's intent to do beneficial lawn maintenance.
- Bee researchers used novel metabolic fingerprinting methods to identify tree species from which honey bees collect resins around the U of M Saint Paul campus. They then compared these resins to samples taken from other parts of the US and against serious bacterial pathogens of honeybees. In total, six novel antibiotic compounds were identified in samples of resins collected in Nevada.
- A study exploring how to improve quality and reduce losses during fruit storage found a correlation between senescent browning and juice glucose and fructose content. This change in knowledge will help discover a possible mechanism for the development of senescent breakdown.
- Research on how plants respond to stresses discovered thirty metabolites of interest that differed

significantly from controls during testing. These included amino acids, tricarboxylic acid cycle intermediates, sugars and other plant metabolites. This indicates that significant aspects of the plant's metabolism were modified by exposure to different abiotic stress conditions.

- Over 650 differently expressed genes (DEGs) were identified for 'Honeycrisp' during gene sequencing and 1048 for 'MN1764'. These results will be used to focus future breeding efforts and will help to identify the quantitative trait loci used by breeders to select apples based on crispness retention.

Extension. Efforts in this planned program maintain and improve the green spaces of Minnesota, give pleasure to urban gardeners and increase the understanding of the benefits and importance of consumer and commercial horticulture in Minnesota. More than 2,300 volunteer Master Gardeners bring research-driven knowledge to the communities they serve and teach. These volunteers leave a large imprint as they address new concerns of growers, are on the front lines of water conservation and quality, and team with local partners to combat invasive plant species and safeguard the natural habitats of Minnesota. In 2015, Master Gardeners shepherded efforts to build rain gardens that help protect ground water and aquatic life while preventing erosion. They guided projects to establish community gardens so that seniors and underserved populations have better access to food.

Last year, we reported increased collaboration between Extension horticulture programs and the Minnesota Landscape Arboretum with the naming of a new leader stationed at the Arboretum. In 2015, Extension increased that connection by developing plans to build a new physical home for Master Gardeners at the Minnesota Landscape Arboretum.

We report on one outcome in 2015, focused on a joint outcome related to new chemistries for use on sweet corn crops. In addition, activities this year expanded the work of the Bee Squad model, increased traffic to the horticulture web site by 47 percent, increased growers' interest in extended season low tunnel strawberry production, brought new programming to urban Latino communities and urban housing developments, and brought new technology to Minnesota's growing number of hops growers.

2. Brief description of the target audience

Targeted 2015 audiences included the growing number of hops producers, urban Latino communities, St. Paul Public Housing, strawberry producers, and more. Audiences for horticulture programs always include:

- 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) Community volunteers who can educate and act to keep yards, gardens and green spaces healthy.

3. How was eXtension used?

An Extension horticultural specialist developed a website for nine webinars that have been given on eXtension for the NCIPM consumer working group. Each topic has a video, quiz and a final IPM certificate. In 2015, two new webinars were produced, one on "Managing Invasive Species with IPM" and another on "Mitigating Pollen Decline with IPM." The new website that links to eXtension is <https://ncipmhort.cfans.dl.umn.edu/>

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	480848	7948686	0	0

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

Patent Applications Submitted

Year: 2015
 Actual: 2

Patents listed

62/167,447 - May 25, 2015 - Antimicrobial Compositions, Articles and Methods
 62/167,447 - May 28, 2015 - Antimicrobial Compositions, Articles, and Methods

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	21	29	50

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.

Year	Actual
2015	17934

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
------	--------

2015 143728

Output #3

Output Measure

- Number of new horticultural crop varieties/genotypes sent out for additional industry testing.

Year	Actual
2015	19

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 new horticultural crops' growth.
4	Research will support alternative tree species to help maintain Minnesota's urban tree landscapes (Target expressed as number of new tree varieties releases either bred or studied at the U of M).
5	Research will provide new methods and techniques to increase bee colony health.
6	Research will assist government agencies to update their recommendations for salt-resistant roadside turfgrasses.
7	Acres of sweet corn benefitting from a weed management protocols.

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.)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Research will support new horticultural crops' growth.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Research will support alternative tree species to help maintain Minnesota's urban tree landscapes (Target expressed as number of new tree varieties releases either bred or studied at the U of M).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Over the years, tree diseases and pests have dramatically changed the landscape of Minnesota's streets and parks. New pests and diseases are threatening our landscapes every day and alternative tree species and varieties resistant to disease are needed to protect our state's natural beauty.

What has been done

Emerald ash borer (EAB) is one key threat that concerns researchers and conservationists. University researchers are working to find alternative tree species that can step in to replace ash trees in both our ash forests and urban settings. A variety of trees are being tested and bred as potential replacement species.

The dutch elm disease (DED) resistance program collects cuttings from potentially resistant elm varieties throughout the state and inoculates them with the disease in the lab as well as in field tests. To be successful in the program, varieties need to show tolerance to DED as well as the ability to grow at an incredible pace.

Results

In 2015, a new Kentucky coffeetree (True North) was released. It represents a great alternative to ash trees in urban areas due to its cold-hardiness and ability to adapt to a wide variety of soil conditions.

Additionally, St. Croix Elm, was released to nurseries in 2015. This American elm, discovered and released by a U of M alumni, is the first elm to successfully complete the University's vigorous DED resistance program. Cuttings from the tree are being used to breed future DED resistant varieties.

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
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #5

1. Outcome Measures

Research will provide new methods and techniques to increase bee colony health.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Honey bees, as social insects, rely on collective behavioral defenses that produce a social immunity, which in turn impacts the immune response of individuals. One behavioral defense is the collection and deposition of antimicrobial plant resins in the nest. In natural tree cavities, bees line the inside of the cavity with propolis, but in manmade boxes, they do not apply propolis to the smooth walls of the box.

What has been done

U of M bee researchers tested the effect of a naturally constructed propolis-envelope within standard beekeeping equipment on the strength, pathogen and parasite load of large field colonies, and immune system activity, virus and storage protein level of individual bees over the course of a year.

Their aim was to examine the relative immune and health benefits of the natural propolis envelope from the scale of the individual bee to the level of the entire colony.

Results

Results showed that colonies induced to build a natural propolis envelope inside the bee boxes had increased survivorship through the winter, larger colony population sizes, and their immune systems were down-regulated due to the presence of fewer microbes in the nest, compared to colonies without the propolis envelope.

These results highlight a simple and powerful method to increase bee colony health in the U.S. by encouraging bees to build a propolis envelope within manmade beekeeping equipment. Extension educations and the Bee Squad will share this new information with beekeepers in the field.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #6

1. Outcome Measures

Research will assist government agencies to update their recommendations for salt-resistant roadside turfgrasses.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Road salt is an important tool for keeping Minnesota's roads clear of ice and snow during the winter months. However, salt also causes stress to the sod that is planted along roadsides. This not only negatively impacts roadside appearance but can also hurt water quality, as damaged sod does not absorb stormwater runoff as effectively.

What has been done

The Minnesota Department of Transportation (MnDot) reached to University researchers to provide recommendations for a new roadside turfgrass optimized for Minnesota's conditions that incorporate new knowledge gains from turfgrass research.

Researchers tested many types and mixes of turfgrass to identify varieties that are best able to withstand salt and other roadside stresses. In total, 75 turfgrass cultivars from 14 species were tested to measure their winter survival rates under three distinct levels of salt exposure, soil types and runoff patterns. Additionally, 51 turfgrass mixes were tested to determine which cultivars would work best together.

Results

As a result, of this research, new standard specifications for sod mix components were developed (20 percent slender creeping red fescue, 20 percent strong creeping red fescue, 20 percent Kentucky bluegrass, and 40 percent hard, sheeps and/or chewing fescue).

MNST-12 is now available for producers and is being planted on roadsides across Minnesota. Additionally, a Local Research Board project is developing recommendations for management techniques during establishment to increase sod survival rates.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Acres of sweet corn benefitting from a weed management protocols.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	120000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Herbicide resistance threatens crops and profitability.

What has been done

A joint Extension/MAES project compared herbicides in sweet corn to determine fit of newly labeled products for Minnesota, carryover potential of corn/soybean products, fit of new chemistries and expansion of labels with existing products in part to address herbicide resistance in Minnesota weed populations.

Results

The sweet corn research is the only Minnesota-based data from which processors and fresh market growers can determine the potential fit of new chemistries for use on their crops, impacting management decisions on approximately 120,000 acres of processed sweet corn (100 percent of acres planted according to Minnesota Agriculture Statistics) and 12,000 acres of fresh market sweet corn, with an estimated contribution of \$120 million to Minnesota's economy annually.

4. Associated Knowledge Areas

KA Code **Knowledge Area**
213 Weeds Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Reporting priorities)

Brief Explanation

Knowledge gains were unreported as action and condition impacts were available.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

None.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 15

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%		70%	
602	Business Management, Finance, and Taxation	50%		30%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Paid	14.9	0.0	16.0	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
575506	0	226547	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1810783	0	1738827	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
552433	0	2198144	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Due to distinct efforts and significant outcomes focused on agricultural business management in 2015, we have changed our mind about taking this planned program out of the federal report. It is also named in the plan of work for 2016.

Three conditional impacts were demonstrated through business management education delivered to Minnesota farm managers in 2015. 1) Education about the farm bill resulted in strong utilization of the bill's Ag Risk Coverage and Dairy Margin Protection Programs. 2) Mobilizing local farmer marketing groups resulted in positive revenue streams for farm operations; and 3) Education about transfer and estate planning, as well as long-term health care planning, resulted in the protection of farm assets for rural economies.

In addition to these activities, new fact sheets helped farmers navigate new policies affecting trusts, landowner liability, water rights and drainage, mitigating counter-party risk, labor law and the Affordable Care Act. Moreover, 44 statewide workshops focused on fair farmland rental agreements. This was necessary because average corn and soybean budgets for cash-rented farmland were predicted to be unprofitable in 2015. Based on participant responses, the total value of farmland rented in 2015 with information from Extension would be \$164,823,060.

MAES. Research in 2015 focused on improving the profitability of Minnesota agriculture and assisting farmers as they adapt new technologies. Niche markets including organic dairy and transitioning to organic production were also important areas for researchers.

Research highlights in 2015 include:

- A first of its kind study exploring ways to reduce worker injuries in dairies was completed in 2015. Most employers (87 percent) appreciated the stockmanship training provided by the study and said their learned something new. Of these (90 percent) said they implemented useful stockmanship tips from the training in their daily work.
- The stockmanship best practices study also showed that cattle handling in the pen did translate to cow behavior in the holding pen and parlor. Specifically, researchers noted fewer escape behaviors of cows, which led to less defecation in the parlor and higher milk production in some herds. This is the first study to quantify that good cattle handling can positively impact the milk production on dairy farms within a short time period.
- A five-year project following the transition of several farms from traditional to organic production was completed in 2015. In total, 47 farms participated in the study representing 4,708 acres in transition, 1,761 recently certified organic acres, 7,418 acres that had been certified for three or more years and an additional 4,995 acres of conventional land.
- Two new publications, available on the web and in print, were published in 2015. "Organic Transition: A Business Planner for Farmers, Ranchers and Food Entrepreneurs" is a guide for farmers transitioning to organic. "Making the Transition to Organic: Ten Farm Profiles" is a collection of farm profiles providing insights on the challenges and rewards of transitioning to organic.
- Research on optimizing forage use in horse diets completed a two-year study on optimal grass mixes. The study found mixtures containing tall fescue, perennial ryegrass, Kentucky bluegrass and timothy should be planted in Midwestern US horse pastures, but, in time, pastures will be dominated by tall fescue and Kentucky bluegrass.
- A project on reducing horse bodyweight found that the use of a slow-feed hay net coupled with a limited diet was an effective method of decreasing body weight and managing hormones in adult overweight horses.
- The Center for Farm Financial Management worked closely with farm business management educators in partner states to support their educational efforts in farm business management and to make the National Farm Business Management Benchmarking Database accessible. In total, complete financials for 3,448 farms in nine states were added to the database.

2. Brief description of the target audience

Agricultural Business Management education was targeted at agriculture businesses most affected by public policy. In 2015, this included: crop and dairy farmers, renters and landowners, small farms owners, and aging landowners needing to plan for estate transfer and long-term health care options.

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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	17722	152648	0	0

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	32	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational events conducted to reach agricultural business managers most affected by public policy and business trends.

Year	Actual
2015	199

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Farm bill education will inform choices in order to maximize the viability of food production. (Qualitative results show percentage of enrollments.)
2	Local farmer marketing groups will enhance their positive revenue stream as a result of studying successful marketing strategies. (Outcome expressed as the total dollars in positive revenue stream of farm operations involved in these groups.)
3	Participants in Agriculture Business Management Programs will protect their business assets proactively by addressing land transfer and long-term health planning. (Outcome expressed as total dollar value of assets protected, as gathered in follow up evaluations.)

Outcome #1

1. Outcome Measures

Farm bill education will inform choices in order to maximize the viability of food production.
(Qualitative results show percentage of enrollments.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

About 90,000 Minnesota farmers, land owners and dairy producers had to make complicated decisions about farm bill program enrollment by 4/7/15, impacting the financial viability of farming operations and the entire Minnesota farm economy. Minnesota is the fourth largest recipient of farm program payments in the nation. In 2015, farmers needed to understand new choices and sort through options, knowing there would be a huge penalty in not deciding, or making the wrong choice.

What has been done

Extension targeted education to crop farmers who had to choose among three new risk management options. Extension cooperated closely with the Minnesota Farm Service Agency and focused education more on decision strategies than program rules. In December and January alone, Extension delivered 73 meetings and reached nearly 15,500 people. Extension education helped dairy farmers determine which insurance programs were best for their operations. Online training courses were developed to increase education on the most popular topics. These reached over 2,300 individuals.

Results

Recent enrollment data on commodity program choices showed that, with Extension guidance, Minnesota crop farmers overwhelmingly chose the Ag Risk Coverage-County Program -- 76 percent of program acres. As a result, Minnesota Farmers received \$600 million in payments in October, 2015. Regarding the Dairy Margin Protection Program, Minnesota had the highest participation of dairy producers in the Midwest, and one of the highest of all dairy states. Of 3,800 dairy producers in Minnesota, 60 percent signed up; 50 percent signed up for higher than \$4/cwt support. By comparison, Wisconsin, Iowa and Michigan had less than 30 percent at the higher rate. This choice was the result of education helping them make careful decisions to protect the financial health of their dairy operations.

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

Local farmer marketing groups will enhance their positive revenue stream as a result of studying successful marketing strategies. (Outcome expressed as the total dollars in positive revenue stream of farm operations involved in these groups.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3368256

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The most recent production season gives ample insight into why planning matters. Though 2015 welcomed ideal growing weather, volatile market forces brought crop prices to the lowest in recent years. Even savvy farmers may not profit in such a tough year. Farm profits flow through farmers' cities and towns. When farmers lose money, whole communities lose out on employment, sales and tax revenue that don't materialize.

What has been done

Extension educators developed and supported local farmer marketing groups. These groups meet monthly to study commodity marketing on virtual farms that are designed to replicate real-life decisions they face when bringing crops to market.

Results

The success and impact of these groups was measured by the successful marketing of crops, such that they generated the revenue in surplus of income to meet expenses and cover the costs of family living by an average of \$70,172 per farm. With 48 farm operations involved with these groups, the total positive revenue stream would be \$3,368,256.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Participants in Agriculture Business Management Programs will protect their business assets proactively by addressing land transfer and long-term health planning. (Outcome expressed as total dollar value of assets protected, as gathered in follow up evaluations.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	48500000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A 2015 study of the Minnesota State Demographic Center concluded that the average Minnesota farmer is 55 years old. Farming reflects aging trends. At least two needs arise for farm management as farmers age: 1) farm transfer and estate planning needs to be proactive; and 2) long-term health care planning is needed.

What has been done

Agriculture Business Management programs in 2015 offered a host of online tools, programs and resources focused on land transfer and estate planning and health care decisions, especially in light of the implications of the Affordable Care Act.

Results

A follow up evaluation of participants of farm transfer and estate planning workshops showed that \$28.6 million of assets were protected and available for transition to the next generation because participants had developed and implemented a business transition and personal estate plan. A similar follow-up evaluation of the long-term health care planning programs revealed that participants protected \$19.9 million of assets against long-term health care costs because they had developed and implemented a long-term health care plan.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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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
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Implementation of the 2014 Farm Bill, and the aging demographic of Minnesota farmers, affected program focus in 2015.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Agriculture Business Management team routinely conducts follow up evaluations of participants to monitor how education impacted their farm management decisions. As dollar value impacts are assessed, program managers are assured that farm outputs continue to affect the wealth or rural areas. In 2015, there were the following findings.

- Programming focused on farmland rental agreements affected roughly \$164,823,060 in business exchange.
- With 48 far operations involved in farmer marketing groups, the total positive revenue stream affected is estimated at \$3,368,256.
- A follow-up evaluation of participants of farm transfer and estate planning workshops showed that \$28.6 million of assets were protected.
- Farmers educated in long-term health care planning protected \$19.9 million in assets.

Key Items of Evaluation

In 2015, agricultural business management education -- provided in a variety of forms -- protected or attracted approximately \$216,700,000 in assets to rural economies in Minnesota.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
2	Number of new crop varieties, animal breeds, and genotypes with climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	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)	
2	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.