2017 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 2017. Twelve programs provide the organizing structure to report. Two 2016 programs, Housing and Forestry, have been merged with other programs. Housing outputs and outcomes are described in Health and Nutrition, acknowledging the small but important radon education efforts. Forestry outputs and outcomes are described in Natural Resource Management, allowing us to more easily describe the efforts of Master Naturalists in protecting Minnesota's forests and woodlands. Other planned programs are unchanged since 2016.

Extension reports on programs and initiatives as defined by its structured program areas and NIFA priorities. MAES describes its research on topics related to these planned programs. In many cases, MAES research informs Extension programming. Of the 46 impacts reported in 2017, 19 describe efforts funded jointly by Hatch and Smith-Lever funding.

MAES. Summary of 2017 Activities
This report summarizes the effort and results of 391 research projects conducted by 298 principal investigators (PIs) at five University of Minnesota colleges: College of Food, Agricultural and Natural Resource Sciences (CFANS), College of Biological Sciences (CBS), College of Veterinary Medicine (CVM), College of Education and Human Development (CEHD) and the College of Design (CDES). While the research efforts are reported under program areas, the majority of this research is broad-based and interdisciplinary and has impacts on multiple programs areas.

Though Hatch funding accounts for only 7 percent of the annual funds for research, we have reported on outcomes from all projects connected to PIs receiving non-discretionary funding. NIFA non-discretionary funds support general-use infrastructure, including our greenhouses and research fields, to ensure researchers have the basic requirements to start their projects and generate impacts and outcomes. Notably, these funds are also used to assist early career faculty as they are starting up their research programs.

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 2017, 74 projects (up from 52 in 2016) 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 Funding Opportunities and Partnerships Push Research to New Heights
MnDRIVE continues to be a driving force behind interdisciplinary research at the University--including creating partnership opportunities across the Twin Cities, Duluth and Morris campuses. During the first six months of 2017, researchers involved in MnDRIVE work disclosed 28 inventions for patents or licensing and received more than $25 million in funding from external sources.

Other key opportunities:

- Marla Spivak received a new grant from USDA-NIFA, which includes a honey bee breeding program in collaboration with USDA-ARS Bee Breeding Lab in Baton Rouge, LA.
- Turfgrass researchers received a $5.4 million grant from USDA-NIFA to help create more sustainable lawns. For the study, they will partner with other northern U.S. institutions.
- The Stakman-Borlaug Center for Sustainable Plant Health received a $721,000 grant to study the long-term effects of agricultural projects abroad. Known as the Food for Progress Post-Project Sustainability Assessment, the study will take place in three countries.
- Bee researchers received $1.7 million to fund a five-year study on bee habitats in southwest Minnesota. To date, researchers have received 150 applications from landowners interested in taking part in the study.
- CFANS launched the Artemisia Leadership Initiative, which focuses on inspiring and empowering female scientists by addressing gender-based barriers in the fields of food, agriculture and natural resources. The initiative includes a mentoring and networking, professional and leadership development and a seminar series.
- "Forever Green" is a multi-disciplinary initiative to advance traits of perennial and annual cover crop traits to complement row cropping systems in support of ecosystem services such as soil health, water quality and pollinator habitat. This also includes research by food scientists and bioproduct engineering to develop and evaluate bio-energy, bio-polymers and food products to create market demand for the crops.
- International Agroinformatics Alliance is being developed as a data analytics platform to support researcher utilizing advance measurement sciences to improve crop and livestock genetics and evaluate field based performance, in addition to evaluating landscape level environmental and economic outcomes. MnDRIVE has invests approximately $600,000 per year in this platform that has both national and international, private sector, university, government and NGO partners.
- A third interdisciplinary platform is related to microbiome research for understanding of soil, plant, animal and human health relationships to improve productivity and health. Aligning with multi-collegiate relationships in the College of Biological Sciences, College of Veterinary Medicine, CFANS and the University of Minnesota Medical School, we have the potential to be a leading institution in creating this ecology of Microbiome research.

Research highlights for 2017 include:

- A partnership between a University microbiologist and gastroenterologist has led to a new treatment for Clostridium difficile. The new treatment was 89 percent effective in a University study with 49 patients.
- An audit conducted by the Center for Restorative Justice and Peacekeeping at the University led to a series of public listening sessions regarding the St. Paul Police-Civilian Internal Affairs Review Commission and, ultimately, to the St. Paul City Council voting to remove police officers from the commission.
- A research project funded by the Minnesota Invasive Terrestrial Plants and Pests Center has led to a new tool that determines if oak wilt fungus is present in less than 30 minutes.
- A 2005 discovery of a migratory pheromone in sea lamprey helped lead to a major research project by the Great Lakes Fisheries Commission (GLFC). As of 2017, the GLFC sea lamprey control project has led to an average decrease of 86 percent of the sea lamprey populations across the Great Lakes basin.
- A three-year study on the fatty acid profile in milk from cows fed a 100 percent forage-based diet revealed forage-fed cows had a healthier balance of omega-6 and omega-3 fatty acids compared to conventionally and organically raised dairy cows.
- Researchers with the Minnesota Aquatic Invasive Species Research Center (MAISRC) discovered that common virus in Koi may be effective in challenging invasive common carp to aid in controlling their spread.
- Maize research in relation to genotype by environment interaction has shown that selection of modern

temperate cultivars have reduce genome by phenotype interaction which has implications for breeding strategies in the face of increasing abiotic stressors due to climate change.

• Research in Forest Resources discovered that reduced chilling of trees from winters are warmer impacts the timing of budburst of leaves demonstrating that rising global temperatures will likely have diverse impacts on tree species and competition interactions that will potentially impact forest ecologies.

• Market research analysis demonstrates that eco-label related to pollinator friendliness on plants were correlated positively with customer purchases suggesting potential value for horticulture industry.

Extension: Summary of 2017 activities

Though non-discretionary USDA funding provides just 14.4 percent of Extension's annual funds, the University of Minnesota reports on outcomes from all programmatic activities because of the critical nature of those funds. NIFA non-discretionary funding assures that centralized services, including human resources, accounting, communications, information technology and bricks-and-mortar offices, are available. These critical expenditures meet the needs of program teams that make a difference in Minnesota.

Service levels: In 2017, Extension programs delivered programming to over 571,000 Minnesotans. This includes engaged participants of programs funded by federal, state, local and grant sources, as well as nutrition education (EFNEP and SNAP-Ed), Farmer Lender Mediation programs and outreach from Regional Sustainable Development Partnerships that support stakeholder relationships statewide. Extension strives to deliver unduplicated counts in its reporting of direct contact for adults and youth, referring to actual program contacts that are more likely to achieve changes in knowledge, action or condition, rather than casual readers or learners.

Program teams reported over 15 million indirect contacts that brought information to the public. Indirect contacts are defined differently by each program. They often refer to unique visits to educational websites, social media sites, marketing or educational outreach.

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 1,351,896 hours of service in 2017, the equivalent of 649.95 full-time staff. This is a 4.8 percent increase from 2016. According to the Independent Sector, this service can be valued at $35,690. Strong volunteer training and support programs are managed by Extension's youth development team, the Master Gardener program (Horticulture), the Master Naturalist program (Natural Resource Management), and Regional Sustainable Development Partnerships.

Outreach to underserved audiences: According to Minnesota Compass (www.mncompass.org), 19 percent of Minnesota's total population are residents of color. Percentages vary greatly by age. In fact, 31 percent of Minnesota's youngest residents (age 0-4) are of color, compared to 6 percent of oldest residents (age 65+). While Minnesota continues to have a smaller share of residents of color than many other states, this population is growing quickly. In fact, the state has seen 20 percent growth in its population of color since 2010--10th highest among states. Eleven percent of Minnesotans have a disability. That amounts to about 600,000 residents, an increase of more than 100,000 residents since 2008. This rapid growth in diversity has stimulated key initiatives in Extension to adapt outreach and design. For example:

• **The Minnesota 4-H First Generation Initiative** is a major 4-H initiative that directs clubs to embrace first generation participants. "First generation" is defined as youth and families not previously engaged in 4-H. The initiative acknowledges that in many cases, 4-H will need to intentionally engage communities and populations historically shut out and left behind. Staff and volunteers are changing practices, developing new local and state partnerships, and creating new 4-H experiences that engage non-white youth, LGBTQ youth and low-income families. Twenty-one percent of Minnesota's youth are youth of

color. With 19 percent of 4-H program participants being youth of color, 4-H programs are now close to parity.

• In 2017, all Extension employees were required to complete a training called **"Beyond Civil Rights."** This online training provides a thorough review of civil rights laws and resources. Lessons include: 1) Civil Rights History and Laws; 2) Terms and Concepts; 3) Documentation, Notification, Protection and Reasonable Effort; 4) Equal Employment Opportunity and Affirmative Action; and, 5) Equal Program Opportunity. As of January 2018, 96 percent of Extension staff have completed this five-hour training.

• Beginning in 2015, Extension began conducting thorough **"Beyond Civil Rights" program audits** in each Extension region. The regional audits convene teams of educators, program leaders and regional directors to review local demographics and compare with current participants. The review allows regional teams to share successful practices that engage diverse communities in Extension programming. In addition, educators and staff develop a better understanding of the demographic trends in the region as they relate to programs. The process also accomplishes a better understanding of the legal frameworks and obligations we have under federal law. In 2017, the third regional program review was completed in Northwest Minnesota.

• In 2017, communications teams across Extension mobilized to conduct a **redesign of www.extension.umn.edu.** An explicit goal for this web redesign is to increase accessibility for users who use the internet differently due to disability.

• Planned programs conduct explicit outreach efforts to underserved audiences. These are described in the activities and audience sections of Planned Program reports.

Multi-state engagement: All programs report collaboration with Extension in other states, especially with contiguous states that share land and water issues. Seven of 12 reporting programs in 2017 described some participation in eXtension, and Extension's investment in online learning is increasing the degree to which the U of M shares staff development training opportunities among states. Multi-state programming is encouraged by North Central Region partnerships with Ohio State, Michigan State, Purdue, the University of Illinois, University of Wisconsin, Iowa State, University of Missouri, North Dakota State, South Dakota State, the University of Nebraska and Kansas State. Extension associate deans meet regularly with their counterparts in these universities to plan programming across state lines. Mini-grants, joint professional development opportunities, shared reporting metrics and joint positions among contiguous states are just a few outcomes of these partnerships.

Strategic plan: The most recent strategic plan guided a few critical 2017 initiatives. The call for "One Extension" was supported by the 2017 convening of communicators across centers and units to redesign a more user-focused website. The technology unit continues to support innovative uses of the Internet to deliver content, including apps for mobile users. A primary focus of professional development offerings, as well as the annual program conference, was diversity and inclusion in Extension.

Issue area grants continued to support cross-center initiatives that address social challenges, especially clean energy, food systems and equity in educational success. Among activities committed to these cross-center initiatives were the establishment of a community of practice that deepens the use of an equity lens in Extension work. The food systems issue area promoted the alignment of Extension food systems work with the Minnesota Food Charter to strengthen outcomes. The Clean Energy team strengthened their collaboration with other centers to reach new audiences, as described in Sustainable Energy.

Staff expertise: In 2017, 140 (136.3 FTE) highly specialized Extension educators delivered planned programs described in this report. In county offices, 28 (26.4 FTE) local educators delivered programming and 205 (189.8 FTE) program coordinators supported 4-H, Nutrition Education and Master Gardener programs.

Merit review: Since 2008, an academic promotion process has been in place to monitor and reward

educator performance and scholarship. In 2017, 13 regional educators and three local educators were promoted after rigorous peer review of their scholarship, teaching and program leadership, as described in "Merit Review Processes."

Academic and scholarship ties: Partnerships with six academic affiliates assure Extension funding or partial funding for 84 faculty (34 FTE). Efforts over the years to improve the scholarship of Extension's program and staff have been successful. Extension's scholar-practitioners produced 200 peer-reviewed publications in 2017, a 42 percent increase from 2016.

County stakeholder relationships. Extension offers a memorandum of understanding 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. In 2017, county investment increased by 4.6 percent, with 73 of Minnesota's 87 counties increasing their Extension investment. Extension-related staff time increased in counties by a total of 4.55 FTEs. The retirement of local Extension staff is affecting local investments and decisions as counties reconsider programmatic investments.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	267.7	0.0	329.5	0.0
Actual	247.0	0.0	450.8	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 includes an evaluation of research quality and impact. In 2017, three 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 one was 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 shared 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 2017, 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 has an academic promotion process for educators working in local and regional offices, and specialists working in the Extension college. In 2017, 13 regional Extension educators were promoted and three local (e.g., county) educators were promoted. Each was promoted after a rigorous review of their educational outcomes, scholarship and outreach to communities. After review of the promotion process in 2016, a revised plan was implemented in 2017 to provide Extension faculty with greater clarity about the process, and to support educators with examples of past promotion dossiers that align with expectations of significance and distinction. Criteria for promotion was clarified, indicators for success were added and an appeal process was described. Language was standardized across the two sets of guidelines.

To assist Extension staff through the rigorous promotion process, peer learning groups are managed by Extension's Professional Development unit, and mentors who have already successfully navigated the promotion process are assigned to mentor 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 their primary emphasis from the targeted criterion and focus on that criteria in 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 at U of M Extension, there are clear expectations that academic professionals will be recognized for attaining a higher academic rank.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Survey of traditional stakeholder groups
- 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. The five colleges that receive MAES funding help define the research priorities and their 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. MAES manages both of these funds. 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 (ROC) across the state, supported by MAES funding, has an advisory committee which reflects the composition and interests of the local area. Also, at the ROCs, there are other specific stakeholder groups advising on particular programs. For example, the Southwest ROC has a program guided by an Advisory Committee of conventional and organic farmers, researchers and educators. Research advisory boards also exist in several academic departments in 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 the research agenda of the University. Many researchers volunteer to serve on national review panels so they can better understand issues and priorities at the national level.

Extension. Over 650 local stakeholders serve on county Extension committees in Minnesota's 87 counties. In addition, Extension's dean and director convenes 22 Minnesota citizens who serve on Extension's Citizens' Advisory Committee. The local advisory committee reviews, promotes and supports county-based programs and determines what investments should be made at the local level. Regional directors convene county committees in their area and recruit participants from a broad spectrum of local interests. The Citizens' Advisory Committee is a network of citizens who believe in the mission and values of Extension, reflect the diversity of Minnesota's communities and are willing to advise Extension administration at the big picture level. Members serve a three-year term. Members are encouraged to provide honest, constructive input for continuous improvement while building support and advocacy for Extension.

Regional Sustainable Development Partnerships (RSDP) manage and solicit direct stakeholder input through a statewide network of community boards, work groups, issue convenings, social media sites, webinars and formal surveys. RSDP is part of the Extension system, and their stakeholder involvement process informs the University of Minnesota, as well as 11 of the 12 federal programs outlined in this report. RSDP's governing boards are composed of community members (75 percent) and University staff (25 percent) who met throughout 2017 in each region of the state. Work groups set regional priorities and presented ideas. Newsletters, webinars and research reports delivered updates to opinion leaders, policy makers, students, farmers, business people, media, local government jurisdictions and community members. In 2017, RSDP convened stakeholders on issues of importance in Minnesota, including:

• The University of Minnesota's first assembly of faculty, staff and researchers to explore supply chain development. They explored opportunities and barriers to move the University's agricultural innovation from research to farmers to consumers (February 2017).

• RSDP's 20th-anniversary public statewide event gathered present and past community partners, University of Minnesota students, faculty, staff and concerned citizens. Attendees provided input about RSDP's first 20 years of fostering community-University partnerships, as well as future directions.

• A survey invited partners from the past decade to give input about their experience working with Extension, and the impacts on communities. Respondents also were asked to comment on the most important sustainability issues for the University of Minnesota to address in the next 20 years. The survey was completed by 55 past partners in fall 2017.

• In focus groups with five regional boards of directors, which include both community volunteers and University faculty/staff, facilitators asked for input on lessons learned during RSDP's first 20 years of fostering partnerships between communities and the university, as well as on future vision.

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 External Focus Groups
- Needs Assessments
- Use Surveys

Brief explanation.

MAES maintains ongoing relationships with the main agricultural and natural resource stakeholder groups formally by inviting them to take part in 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. County Extension Committees and Citizens' Advisory Committees are drawn from groups of local leaders, volunteers and program participants. They are identified as candidates because they have knowledge or experience with Extension, an interest in the future of Extension education and outreach, and can commit the time required to attend meetings and participate in relevant projects. Extension calls for nominations and memberships, and recruits viable participants.

Regional Sustainable Development Partnership (RSDP) board members and staff engage individuals, communities and organizations who develop priorities for Extension and the University in each region of the state. One venue for soliciting community and University ideas is through the Idea Brief form. In 2017, RSDP asked its board how the Idea Brief could be more accessible to diverse audiences. The new Idea Brief is simplified and is available as a postcard that can be handwritten and mailed in, or an online form on Extension's public website. Community members are also encouraged to call or email their RSDP regional executive director to discuss their idea. Regional executive directors work hand-in-hand with community members to develop an initial idea into a proposal for board consideration.

RSDP hosts listening and comment sessions and conducts surveys of stakeholders to inform project priorities and project designs. RSDP board and work group members serve as local ambassadors, learning about local priorities and needs at community meetings, events, and

gathering spaces throughout Greater Minnesota.

RSDP encourages new and underserved audiences to share their ideas. Each regional RSDP has a Diversity Action Plan that articulates intention to attract diversity to the RSDP board and work group composition and project partnerships, outcomes for measuring success, and community members and organizations that can serve as resources in diversity efforts. In 2017, RSDP worked with members of Minnesota's tribal communities on an eXtension Issue Corps project to advance priorities identified in these Diversity Action Plans. The Idea Brief and Project Partnering Criteria reflect diversity and inclusion goals. RSDP's revised partnership criteria were reviewed by the University of Minnesota assistant vice provost, Office for Equity and Diversity.

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 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. County Extension Committees and Citizens' Advisory Committee meetings are held at regular intervals throughout the year and include programmatic as well as administrative updates. Committees engage in discussion that results in decisions about Memorandums of Understanding, program investments, recognition of quality programming and projects, and advocacy for Extension to other public bodies, such as the state legislature.

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 community and University stakeholders with like interests for learning and feedback. Regional executive 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. Each project involves University faculty, staff, students and/or other resources.

Yearly, RSDP conducts statewide convenings on critical issues. In 2017, these convenings focused on sustainable tourism and resilient communities, supply chain issues, and lessons learned from RSDP's first 20 years of fostering partnerships among the community and University and future vision.

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 Action Plans
- To Set Priorities

Brief explanation.

MAES research funds have been redirected toward high priority areas and on the development of breakthrough technologies based on feedback from stakeholders in recent years. A key example of this is the research and extension work being conducted on invasive species at two research centers at the University--the Minnesota Aquatic Invasive Species Center and the Minnesota Invasive Terrestrial Plants and Pests Center.

This year we engaged with other AES, regional private sector partners and farm organizations to advance a collaborative strategy to develop an Agroinformatics Alliance that seeks to develop partnerships to combine public and private landscape level data for improving crop productivity, environmental outcomes, quality policy and farm profitability. This has already facilitated new research projects and grants from public and private partners.

Extension. Priorities established through RSDP's networks are brought to Extension and other University entities for response. Here are some examples of responses:

• Needs of rural grocers were identified through a statewide survey of over 200 rural grocery stores. Survey findings informed educational efforts, including developing tool kits for small grocery settings (e.g., food safety) and consultation on energy-efficiency upgrades and resources (i.e., sustainable energy). Survey results also informed a successful USDA Agriculture and Food Research Initiative (AFRI) proposal to pilot a new model for connecting small and medium-sized farms to existing wholesale markets through back hauling from rural grocery stores.
• Local farmers and University researchers expressed a need to develop the supply chain connections necessary to bring new crops to the market. This resulted in creation of a full-time new crop market integration specialist position within RSDP.
• Communities and farmers expressed interest in learning more about Deep Winter Greenhouses that extend the growing season and limit the use of fossil fuels (see horticulture). This resulted in a

statewide initiative to pilot research and outreach at five prototype Deep Winter Greenhouses, as well as the first Deep Winter Greenhouse research convening at the University of Minnesota.

- Board members expressed interest in water issues, and RSDP brought on a Conservation Corps member to support regional natural resources work groups with a focus on water issues.

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, colleges and even campuses. The development of new, and increased investment in, research centers that can take a broader interdisciplinary view of key research concerns, like invasive pests, is a direct result of stakeholder input.

Increasingly, landowners are being asked to address both productivity and environmental sustainability. We are increasingly asked both scientifically evaluate methods and outcomes of policies (e.g., buffer strips, pesticide application, etc.) and practices (e.g., cover crops, tillage methods, drainage type) and their implications for both advancing goals of sustainability as well as impacts on profitability. The goal becomes to inform both farmers and agribusinesses for policy makers so that outcomes align with goals. These requests have led to the development of the Agroinformatics Alliance described earlier.

Extension. The stakeholder assessment processes revealed strong community member interest in strengthening local food systems, support for rural grocery stores, research and outreach around Deep Winter Greenhouse technology, and development of local supply chains for emerging crops. Community members also expressed strong interest in supporting local economies and safeguarding natural resources through sustainable tourism initiatives, workforce attraction, attention to water quality issues and clean energy initiatives.

Stakeholders also expressed a strong commitment to continuing to diversify RSDP boards, work groups and project partnerships. This led to a revised Idea Brief and Project Partnering Criteria, a new email orientation series for board and work group members, work on an eXtension Issue Corps diversity and inclusion project, and consultation with the University of Minnesota assistant vice provost, Office for Equity and Diversity.

Community groups are thinking 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
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	10262891	0	6164793	0
Actual Matching	26843594	0	35942891	0
Actual All Other	27879678	0	45285307	0
Total Actual Expended	64986163	0	87392991	0

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		10%	
204	Plant Product Quality and Utility (Preharvest)	5%		5%	
205	Plant Management Systems	15%		10%	
206	Basic Plant Biology	5%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%		5%	
212	Pathogens and Nematodes Affecting Plants	5%		5%	
213	Weeds Affecting Plants	5%		5%	
216	Integrated Pest Management Systems	5%		10%	
301	Reproductive Performance of Animals	5%		5%	
302	Nutrient Utilization in Animals	5%		5%	
304	Animal Genome	5%		5%	
305	Animal Physiological Processes	5%		5%	
306	Environmental Stress in Animals	5%		5%	
307	Animal Management Systems	5%		5%	
311	Animal Diseases	5%		10%	
315	Animal Welfare/Well-Being and Protection	15%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	37.7	0.0	110.2	0.0
Actual Paid	25.5	0.0	174.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1059407	0	2197988	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2643807	0	13011540	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1002076	0	19968484	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Research related to this program includes a broad range of efforts to support the viability and success of Minnesota's crop and animal production systems, including developing responses to new pests and pathogens and tracking animal diseases. 2017 highlights include:

- Researchers identified new sources of rust resistance in wheat and barley and the characterization of the genetic basis for rust resistance.
- Researchers identified over 32 Pythium or Phytopythium species on root systems of soybean plants growing in Minnesota. Of these, 21 reduced soybean root growth of infested soybean seedlings and ten reduced root growth over 20 percent.
- Results from the first year of a three-location study looking at optimal nitrogen fertilizer rates for intermediate wheat grass, found a rate of 60-80 pounds/acre is biologically optimal.
- Researchers generated large RNAseq datasets to understand cold-tolerance of Solanum commersonii genotypes. Results revealed key sets of genes involved in the cold acclimation process and cold tolerance, which should help with the improvement of cold responses in potato and related species.
- Researchers found bedding type has a much larger impact on the prevalence and severity of footpad dermatitis in turkey hens than rearing density.
- Researchers generated eight vaccine candidates against H5 and H7 avian influenza viruses that are now ready to be tested for vaccine immunity in animals.
- A study of the effect of tail docking on sows in confinement housing found raising pigs without tail docking can increase incidence of tail biting and tail damage, resulting in higher morbidity, reduced value and compromised welfare of pigs.
- A study of 82 dairy farms in Minnesota compared top the 25th percentile farms for milk production with other farms and found factors including stall comfort, pen design, dry matter intake, forage management, cow time budget, milking frequency, use of bST, footbath management and cow grouping differed between the two categories. Improving these factors on dairy farms could have a positive impact on both profitability and animal welfare.

Extension education programs respond to Minnesota's crop and livestock producers as they cope with numerous stresses--from economic pressures to crop management dilemmas to conservation concerns. For example, dicamba injury to non-target soybeans was widely reported in Minnesota during the 2017 growing season. Non-tolerant soybeans were extremely sensitive to this herbicide. In response, Extension provided regular updates through its Minnesota Crop News blog and in-person educational sessions conducted throughout the state during the growing season. Extension scientists provided

technical assistance to the Minnesota Department of Agriculture as public services were aligned to address the issue. The Extension weed scientist helped to formulate the Minnesota Commissioner of Agriculture's recent 24c label amendments for Minnesota, which were announced in December 2017. The weed scientist also served on an ad hoc Weed Science Society of America committee, charged with providing rapid responses to US EPA inquiries and as a member of the Minnesota Soybean Research and Promotion Dicamba Task Force. With regulations now in place, Extension's key effort will be to address dicamba injury in its Pesticide Safety Education Program.

Outcomes reported in 2017 focus on addressing problems with weed resistance, adopting research to increase wheat yields, support adoption of cover crop technology to improve soil health, preventing nitrogen runoff, and continuing efforts to secure the profitability of the pork industry.

2. Brief description of the target audience

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

In 2017, Extension also intentionally reached out to immigrant livestock producers. The team developed two online Poultry Biosecurity webinars specifically for Somali Facebook TV, resulting in 1,430 views.

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

3. How was eXtension used?

Extension educator Dean Herzfeld led the creation of the National Pesticide Safety Education Center (NPSEC) and fostered the Center's partnership with eXtension. NPSEC is utilizing the eXtension online educational platform to:

1. Support development of educational courses and materials by state Extension pesticide safety education programs; and,
2. Cross-list educational materials and course offerings among states. This reduces duplication while increasing the quality and availability of Extension education materials, fostering a stronger national system of Extension pesticide safety education programs.

This effort led a growing number of states develop new or host existing online education courses via the NPCES/eXtension platform. It also led to the development of a major seed treatment manual, in cooperation with the EPA-funded Pesticide Educational Resources Collaborative, which is based at University of California Davis and Oregon State Extension. NPSEC also assisted eXtension's development of a winning proposal to secure a competitive US EPA national grant to distribute US Congressional mandated funds from US EPA pesticide registrant company fees to state Extension pesticide safety education programs.

When NPSEC hired an executive director in 2017, Dean Herzfeld stepped down from his leadership role, but remains co-chair of the NPSEC board.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	77547	2732541	3563	0

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

Patent Applications Submitted

Year: 2017
Actual: 10

Patents listed

Senecavirus a Antigens and Methods of Use: 15/684,358 - Aug, 23, 2017
Methods and Compositions for Improving Growth and Performance: 62/572,732 - Oct. 16, 2017
Plants Having Increased Oil Capacity: 62/451,467 - Jan. 27, 2017
Early Flowering Plants: 62/547,668 - Aug. 18, 2017
Systems and Breeding Methods for Pest Control: 62/581,220 - Nov. 3, 2017
"Shelly" Wheat: 201700119 - Mar. 6, 2017
GEMSOPEN: 87/713,807 - Dec. 8, 2017
Integrated Remote Sensing Tools for Timely Predictions of Crop Quality and Yield: 15/663,112 - July 28, 2017
Microbial Inoculants and Methods: 62/536,193 - July 24, 2017
Lang-MN: New Hard Red Spring Wheat Variety - PVP Protection

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	92	153	245

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Extension publications and presentations.

Year	Actual
2017	351

Output #2

Output Measure

- Number of Extension learning opportunities.

Year	Actual
2017	413

Output #3

Output Measure

- Number of new crop germplasm released to the public.

Year	Actual
2017	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of Extension program participants that significantly change one or more practice as a result of attending classes and conference sessions intended to improve participant practices.
2	Number of changes in condition reported each year.
3	Number of acres affected by new livestock and crop production to increase production, efficiency, or conservation.
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	Research on new cropping systems will help farmers adapt to changing conditions in the Upper Midwest.

Outcome #1

1. Outcome Measures

Percentage of Extension program participants that significantly change one or more practice as a result of attending 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
2017	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The number of weed species with resistance to herbicides has risen dramatically in recent years, and more time and money is spent on weed control. Farmers face lower yields and profits unless they change weed management practices. According to a 2016 survey of over 1,100 farmers in Southern Minnesota, 44 percent are dealing with SOA14 (e.g., Flexstar) resistance and 76 percent are dealing with SOA 9 (e.g., Glyphosate) resistance. A 2016 infield waterhemp sampling and resistance-testing study support these survey findings.

What has been done
The "Are You Resistance Ready" program was initiated in 2017 to help farmers and agricultural professionals develop a better understanding of weed biology, non-chemical weed control tactics and herbicide resistance to develop effective and robust weed management programs for the long-term. The program was held at six locations across southern Minnesota from January to March, 2017.

Results
In an evaluation of the events, all but one attendee agreed that "I will change at least one of my practices based on what I learned from this program." There was an average increase in committing to specific practices from before to after the workshop. Greatest increases were shown in a decision to: 1) map herbicide SOA/Group Number and demonstrating herbicide diversity in fields; 2) walk fields before spraying; 3) identify primary and secondary weeds and create a weed control plan with effective herbicides by March 15th. Of those attending the workshop, 74 percent were crop producers with 28,955 total acres and 36 percent were agricultural professionals where 40 percent manage or provide advice for over 20,000 acres.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nationally, Minnesota ranks second in the value of its hog sales, and third in hog numbers. Minnesota marketed 19 million hogs last year, trailing only behind Iowa and North Carolina. In 2013, Minnesota pork producers earned $2.6 billion in gross income from sales. Profitability is affected by marketing trends, including demand for attention to well-being and environmental protections.

What has been done
The Extension swine team works with several departments and research and outreach centers at the University of Minnesota to bring research to producers, processors, industry and consumers. Training, certification programs and seminars on topics such as nutrition, facilities, animal welfare and manure management support the industry. Examples include: PorkBridge and SowBridge, distance learning programs; Pork Quality Assurance Plus certification; Transport Quality Assurance certification; and guidance on using distiller grains by-products in feeds.

Results
Pork team offerings are reaching pork producers, training and certifying them for quality assurance, and instigating new management processes that are being adopted in farms. In 2017, the program is known to have affected the production of over 11,066,000 pigs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
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

Number of acres affected by new livestock and crop production to increase production, efficiency, or conservation.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	5278550

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Managing farmland demands research-driven information to address issues, conserve the quality of the acreage and the environment, and take full advantage of productivity. Land managers make calculated decisions yearly about conservation tillage, monitoring for disease, treating disease and preventing nitrogen runoff. Science informs these decisions.

What has been done
The 2017 Research Update for Agricultural Professionals was held at six locations with attendance by independent crop consultants, crop protection retailers and seed company employees. The Conservation Tillage Conference provided producers hands-on information in nearly every aspect of conservation tillage. Nine Nitrogen Smart training workshops shared fundamentals for maximizing economic return on nitrogen investments while minimizing nitrogen losses. Updated research regarding nitrogen levels influenced best practices.

Results

As a result of the Conservation Tillage Conference, 26 percent use cover crops in a standing cash crop. Another 19 percent either reduced tillage or use no-till; 28 percent evaluate soil health in fields. These Extension offerings affected almost 5 million acres of farmland. Also, 328 people attended Nitrogen Smart training, managing a total of 278,550 acres. The program led 17 percent to reduce their N rate by an average of 25 lb/acre, translating into a savings of $4.1 per attendee; 23 percent changed from all-fall application to all-spring, resulting in an estimated increase of 267,648 bushels of corn. Almost 9 percent stopped using fall urea, which converted an estimated 13,120 acres of land and led to reduction of 262,400 ob. of nitrogen to the environment. 78.3 percent of attendees changed at least one practice. The number of acres affected is roughly a quarter of all Minnesota acres utilized for food production.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soybean aphid (Aphis glycines) has been wreaking havoc on Midwest soybeans since it was first discovered in 2000. While careful management practices have helped keep yields up, the possibility of aphids having resistance to insecticides remains a key concern.

What has been done
The first documented cases of soybean aphid insecticide resistance in North America took place in 2015 but the method for determining resistance was time consuming and costly.

In 2017, Robert Koch and his team developed and validated a more efficient glass-vial diagnostic concentration bioassay for two pyrethroid insecticides (lambda-cyhalothrin and bifenthrin).

Results
With this new method, a multistate team of researchers quantified the susceptibility of 23 populations of soybean aphid from Minnesota, Iowa, South Dakota, North Dakota and Manitoba. This work has shown that soybean aphid insecticide resistance has persisted over three years and is now widespread.

In response to this new threat to soybean production, a multistate insecticide resistance program for soybean aphid has been established and will assist in developing a regional management plan.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #5

1. Outcome Measures

Development of new crop varieties will help Minnesota growers improve profitability

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota wheat farmers need new high yielding and disease-resistant wheat varieties and education and outreach aimed at specific locations within the state to help them improve profitability.

What has been done
James Anderson, Jochum Wiersma and their team study the strengths and weaknesses of new wheat varieties at more than 5,000 yield plots per year, seeking the best candidates for release. In particular, they look for yield, disease resistance and baking quality. Trials take place at ROCs and farms across the state to determine which varieties work best in each location.

Results
Over the last five years, the University has released four new varieties of wheat, Linkert, Bolles, Shelly and Lang-MN, which account for over 50 percent of the wheat acreage planted in Minnesota, the highest proportion in three decades.

Additionally, despite being planted on less acreage, wheat harvest hit a nearly record-breaking 67 bu/acre in 2017 and average wheat yields in Minnesota have approximately doubled over the past 25 years, increasing at a rate of 2.7 bu/acre per year. Linkert and Bolles, the two leading varieties in Minnesota in 2017, both have high grain protein and are valued for their exceptional end-use quality.

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
206	Basic Plant Biology

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Despite decades of research on porcine reproductive and respiratory syndrome (PRRS), outbreaks of emerging and reemerging PRRS virus strains are not uncommon and frustrate swine producers and veterinarians.

What has been done
Dr. Andres Perez and his team compared the incidence of PRRS as recorded in the Swine Health Monitoring Program from 2009 to 2016 to geographical factors (including land elevation and land coverage) and then developed a Poisson regression model to study various factors affecting outbreak levels.

Results
In the final multivariable model, farms located on highly inclined terrains were associated with fewer PRRS outbreaks. Being in an area with shrubs and trees, compared to cultivated areas, was also associated with fewer outbreaks.

This study shows the influence of terrain characteristics on the spread of airborne diseases, like PRRS, may assist in predicting disease risk and could help in the design of effective measures to mitigate and prevent the risk of infection.

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

Research on new cropping systems will help farmers adapt to changing conditions in the Upper Midwest.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasing climatic variability is likely to increase financial and environmental risks for US farmers growing row-crops. More information is needed to assist farmers to choose management strategies that will help them adapt while maintaining crop yields.

What has been done
Nicholas Jordan and his team participated in a multi-year and multistate experiment on soil functional zone management (SFZM) in corn and soybean systems took place from 2011 to 2016 in MN, IL, PA, and MI. The experiment examined both ridge-till and chisel-plow tillage systems both with and without a rye cover crop and compared plant growth, yield, nutrient status, soil attributes and greenhouse gas emissions.

Results
The experiment showed SFZM with cover cropping improves soil fertility and carbon stocks, enhances early soil warming and drying for an extended growing season, and increases mid-summer storage of "green water," while maintaining the high crop yields necessary for food security.

These results indicate that a cropping system redesign with SFZM-based management is a relatively inexpensive, scalable intervention that has potential to substantially improve production of food and other bioproducts, environmental health, and the agricultural economy associated with US row-crop farming

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (none)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension's global foods educational programs are routinely evaluated to understand the degree to which educational efforts are providing new knowledge and are guiding producers and ag professionals to change practices. Follow up evaluations determine whether actions were taken, and whether those actions affected a portion of Minnesota's agricultural economy.

In 2017, education focused on the farm productivity, weed control and management for conservation are known to have affected at least 5,278,550 acres of production ag farmland, or roughly a quarter of all Minnesota acres utilized for food production. Programming to support the pork industry affected production behavior for 11,066,000 pigs. (According to the Minnesota Pork Producers Association, Minnesota marketed 14 million pigs in 2013.)

Key Items of Evaluation

Extension. In 2017, education focused on the farm productivity, weed control and management for conversation are known to have affected at least 5,278,550 acres of production ag farmland, or roughly a quarter of all Minnesota acres utilized for food production. Programming to support the pork industry affected production behavior for 11,066,000 pigs. (According to the Minnesota Pork Producers Association, Minnesota marketed 14 million pigs in 2013.)

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: Rapid Agricultural Response Fund, MnDRIVE and the MN Population Systems Planning Guide.

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	10%		5%	
402	Engineering Systems and Equipment	5%		10%	
503	Quality Maintenance in Storing and Marketing Food Products	5%		2%	
511	New and Improved Non-Food Products and Processes	5%		3%	
601	Economics of Agricultural Production and Farm Management	5%		10%	
604	Marketing and Distribution Practices	5%		5%	
605	Natural Resource and Environmental Economics	5%		13%	
607	Consumer Economics	5%		8%	
608	Community Resource Planning and Development	5%		7%	
610	Domestic Policy Analysis	5%		10%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	5%		10%	
805	Community Institutions and Social Services	5%		2%	
901	Program and Project Design, and Statistics	5%		3%	
903	Communication, Education, and Information Delivery	20%		2%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890

Plan	8.1	0.0	49.8	0.0
Actual Paid	16.4	0.0	35.3	0.0
Actual Volunteer	0.8	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
580043	0	194118	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2146575	0	2427491	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1425457	0	3563964	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Research on sustainable energy is providing a better understanding of how we can use renewable energy sources and technologies in ways that are both economically and environmentally friendly. 2017 highlights include:

- Researchers improved the wet performance of xylan-based polymeric films using citric acid as a biobased, polycarboxylic crosslinker. Based on a 24-hour soaking test, crosslinked films contained 40 percent less water than the control.
- A new three-year study began at the Rosemount ROC looking at the potential of using waste ash as a fertilizer for corn and soybeans.
- As part of their effort to create a net-zero farm, researchers at the West Central ROC in Morris developed a solar powered heat pump system that circulates cool water under metal floors mats in farrowing stalls. They hope be a more efficient way to keep mother pigs cool.
- An Aspen Hysys model was developed that can study the effect of various process parameters on the productivity and efficiency of biofuels manufacturing. Such a model could play a vital role in the future success of the bio-economy.
- Since the 1950s, it has been believed lignin polymer chains are crosslinked or hyperbranched, which negatively influences rigidity leading to weak and brittle lignin-banded polymeric materials. Researchers at the U of MN have established that the hydrodynamic compactness of macromolecular lignin species arise from powerful noncovalent interactions between the aromatic units in individual lignin components. This discovery led to the creation of the first functional polymeric materials with lignin-derivative contents of 85-to-100 percent.
- Researchers have isolated over 30 phototrophic strains (algae) that thrive on dairy wastewater and display high potential for producing biofuel. These stains are now being analyzed for lipid, carbohydrate and protein content to assess nutritional value for future animal feeding studies.

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 communities to resources so that they choose and implement community-based clean energy projects. CERTs activities in Extension are carried out with the following partners: University

of Minnesota Regional Sustainable Development Partnerships, Great Plains Institute, Southwest Regional Development Commission, and the Minnesota Department of Commerce, Division of Energy Resources.

In 2017, CERTs demonstrated the significance of its work by publishing 124 new stories to its Minnesota Energy Stories blog. These stories included case studies about CERTs seed grant projects, interviews with business owners who made changes to energy consumption, and summaries of tours and events that featured clean energy options. CERTs hosted 26 events to highlight energy-saving opportunities through workshops, tours and forums. Additionally, CERTs connected with Minnesotans directly by convening meetings with community-based organizations and presenting at 181 other events. CERTs awarded $100,000 in seed grant funding for 30 local clean energy projects, piloted new campaigns and tested new models to scale-up sustainable energy impact.

Overall, CERTs programming is saving or offsetting 34.2 billion BTUs annually. This is equivalent to heating 429 Minnesota homes for an entire winter or powering the electricity for 1,095 homes for an entire year.

2. Brief description of the target audience

Extension programming through Clean Energy Resource Teams is delivered in seven regions spanning the state of Minnesota. CERTs focuses its outreach on the following audiences: small businesses, farmers, governmental units (cities, counties, schools, tribes) and low-income communities.

In 2017, CERTs conducted specific outreach to tribal and low-income communities. The Fond du Lac Band of Lake Superior Chippewa co-hosted a clean energy tour of both Fond du Lac Band's Resource Management Division building and the Black Bear Casino Resort. The tour included a 1MW solar PV installation, LED lighting, a wood pellet biomass system and other clean energy technologies. CERTs also convened Leech Lake tribal members at a meeting called Increasing Access to Solar: An Exchange of Ideas, Approaches and Lessons Learned. It was not a public event, because the goal was to create an honest conversation about how to encourage broader adoption of solar for tribal members.

CERTs convened an initiative called CLICERS (Connecting Low-Income Communities to Efficiency and Renewable Sources). The initiative mobilized three working groups to provide insights and prioritize actions to reduce energy poverty and increase access to solar energy in low-income communities. CERTs worked with the project lead, Minnesota Department of Commerce, to ensure representation of communities affected by energy burden, as well as service providers who work directly with those communities.

In partnership with Extension's Urban Research and Outreach Center and SNAP-Ed program, outreach efforts offered 76 free in-home energy audits to low-income households in North Minneapolis.

MAES research reaches agriculture and natural resources industry representatives, biotechnology company representatives, policymakers, state and federal agency representatives, private citizens and entrepreneurs.

3. How was eXtension used?

CERTs is using eXtension as a go-to source. Staff go to eXtension to research farm energy resources. This research informs presentations for public and state-funded research and projects. eXtension increases the team's knowledge about specific energy-efficient farm technologies. Content in eXtension helps CERTs staff discern which state Extension programs are the "authority" on given subjects. eXtension also helps substantiate best practices and verify vendor claims.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12270	449292	531	1114

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

Patent Applications Submitted

Year: 2017
Actual: 5

Patents listed
Oilseed Plants Having Reduced Pod Shatter: 62/547,684 - Aug 18, 2017
Electrochemical Removal of Sulfide Species and Phosphorus Species: 15/814,889 - Nov. 16, 2017
Production of Biodiesel from Scum: 9,745,530 - Aug. 29, 2017 - ISSUED
Lignin-degrading Methods: 9,796,993 - Oct. 24, 2017 - ISSUED
Genetically Modified Diazotrophs and Methods of Using Same: 9,796,957 - Oct. 24, 2017 - ISSUED

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	56	56

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2017	27139

Output #2

Output Measure

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

Year	Actual

2017	26

Output #3

Output Measure

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

Year	Actual
2017	13151

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	Number of participants who report they are likely to take action in their homes, businesses and communities for energy efficiency and renewable energy
3	Number of BTUs (in billions) saved as the result of annual energy savings, either through energy efficiency or by offsetting current energy sources with renewable energy

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
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Scum, a dark, muddy substance produced during wastewater treatment, presents a significant waste disposal challenge but a potential energy source.

What has been done
Roger Ruan and his colleagues at the Center for Biorefining have been working on developing a system to turn scum into biodiesel. Their aim is to streamline the disposal process of scum, while maximizing biodiesel output, moving toward complete utilization of liquid and solid wastes.

The team developed a pilot system and tested it using scum from the St. Paul wastewater treatment facility at the Rosemount ROC.

Results
The pilot system found 68 percent of the dried and filtered scum could be converted to biodiesel. This is equivalent to approximately 140,000 gallons of biodiesel and $500-600 thousand in profit per year using all the scum from the St. Paul wastewater treatment plant.

Notably, this patented process not only converts scum to biodiesel but also reduces environmental pollutants in both landfills and water systems.

4. Associated Knowledge Areas

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

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

Outcome #2

1. Outcome Measures

Number of participants who report they are likely to take action in their homes, businesses and communities for energy efficiency and renewable energy

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of BTUs (in billions) saved as the result of annual energy savings, either through energy efficiency or by offsetting current energy sources with renewable energy

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	34244

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 $19 billion and consumed a total of 1,770 trillion BTUs of energy (electricity, natural gas, petroleum products, coal and biomass) in 2015 to supply energy needs. Energy use spreads across four main sectors: Transportation (25 percent of total use), residential (21 percent) commercial (20 percent) and industrial (34 percent).

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 with Minnesota's Next Generation Energy Act. The law requires Minnesota utilities to produce 25 percent of energy using renewable resources by 2025 and established a statewide energy

conservation goal of 1.5 percent of annual retail electric and natural gas sales.

Results

The 2017 total is 34.2 billion BTUs in annual energy savings or renewable energy offset. This includes the following results: 1) Forty-four businesses completed energy efficiency and solar projects (15.8 billion BTUs). 2) A 1.3 MW community solar garden broke ground in 2017 (\5.8 billion BTUs). 3) Local energy efficiency and renewable energy projects were developed with seed grant funding (2.9 billion BTUs). The remaining energy savings achieved in 2017 were from: a newly launched Saving Watts and Drops campaign; conservation programming for utilities; farmers who adopted solar energy; energy efficiency at rural groceries; a wood biomass heating project for a poultry farm; and transitions to electric vehicles.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
402	Engineering Systems and Equipment
503	Quality Maintenance in Storing and Marketing Food Products
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics
607	Consumer Economics
608	Community Resource Planning and Development
805	Community Institutions and Social Services

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The CERTs evaluation plan tracks the intentions and follow-through of those who are educated by or receive seed grants or assistance from the CERTS program. CERTs quantifies total BTUs of energy saved annually through campaigns, technical assistance, utility support, and seed grants.

In 2017, the total number of BTUs saved or offset is 34.2 billion. This energy conservation is enough to heat 429 Minnesota homes or power electricity for 1,095 homes annually. This energy-savings amount is the result of 386 new household or institutional (business, government, utility and farm) changes that significantly save or offset energy use.

Key Items of Evaluation

In 2017, the total number of BTUs saved or offset is 34.2 billion. This energy conservation is enough to heat 429 Minnesota homes or power electricity for 1,095 homes annually. This energy-savings amount is the result of 386 new household or institutional (business, government, utility and farm) changes that significantly save or offset energy use.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: Renewable Development Fund, MnDRIVE, Minnesota Department of Agriculture, U of MN Grant-in-Aid, Environmental Defense Fund and U of MN Department Start-up Funds.

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	10%		20%	
104	Protect Soil from Harmful Effects of Natural Elements	10%		10%	
123	Management and Sustainability of Forest Resources	10%		20%	
125	Agroforestry	20%		10%	
131	Alternative Uses of Land	20%		20%	
132	Weather and Climate	20%		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: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	27.2	0.0
Actual Paid	0.0	0.0	32.6	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	343549	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1765499	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3237439	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. University of Minnesota researchers are committed to uncovering new information and developing conservation plans to assist with adaptation strategies. Breeders are working to discover trees and crops that can withstand antibiotic stress and researchers are developing models to help prepare for changes in climate and land use. 2017 highlights include:

- Researchers working on new management strategies to decrease the impact of climate change developed a new program called The Adaptive Watershed (TAW). TAW assists decision makers, managers and community members in developing and implementing an ecosystem approach at the watershed scale.
- Using an inversion model, researchers examined the inter-annual variability of nitrous oxide emissions. Their results suggest a high sensitivity of emissions to climate suggesting it will be more difficult to mitigate nitrous oxide emissions when it is wetter and warmer.
- The Minnesota Phenology Network has recruited 1150 citizen scientists (up from 140 in 2015). Minnesota now has the second most registered observers in the country.
- Researchers are partnering with the Nature Conservancy to help protect Minnesota's boreal species in a changing world. The group has identified 30 locations, totaling 400 acres, to plant seeds they believe may be better for cold-loving tree species.
- Researchers produced the first high-resolution global maps of plant traits based on the measurements of 45,000 individual plants from 3,680 species. These maps will be useful for global ecology and as input parameters for land surface models.
- MAES supported researcher Peter Reich has partnered with the University of Minnesota Libraries to share his climate related work with a worldwide audience. Since 2015, his University Digital Conservancy collection has surpassed 10,000 file downloads and averages 500 downloads per month.
- A tree survey is northern Minnesota has revealed that one-third of Minnesota's mature tamarack trees have been killed or damaged by the eastern larch beetle, an insect native to Minnesota. Warmer winters and earlier springs have shifted the insect's reproductive cycle and winter survival percentages making their numbers explode in northern Minnesota.
- Researchers looking at how mercury and sulfur in northern Minnesota peatlands will be affected by climate change are working on the Spruce and Peatland Responses Under Changing Environments (SPRUCE) project site in the Marcel Environmental Forest and have collected samples that are currently undergoing analysis.

The Climate Change initiative is a multi-disciplinary program mobilizing available and relevant Extension programming and research in areas such as forestry, environmental science education, water, crops, horticulture and more. Extension FTEs are not formally aligned with the Climate Change planned

program area. Outcomes and outputs are likely to be described in other program areas. Volunteer hours will be monitored and reported.

Priorities are to conduct and synthesize adaptation research, develop resources and pathways to increase climate literacy in target audiences, and train decision-makers in new practices to ensure communities are prepared. As climate change affects conditions in planned programs across Extension, including Forestry, Agriculture, Horticulture and more, research from MAES and other sources will be consulted in order to determine a response.

2. Brief description of the target audience

As programming is developed, audiences will be targeted. Targeted audiences must be those with whom we can make a difference, and who can benefit from research-based information. Many will be those audiences targeted by other program areas, as described in those plans of work. Primarily, we will choose audiences whose decisions will be influenced by climate change, as well as those who consult or influence the decisions of these growers and producers, including volunteers. Other audiences include decision-makers and leaders responsible for preparing communities for change, including preparing infrastructures to manage extreme weather. This includes local government jurisdictions, state and local elected officials, producers and environmental groups, human health services, FEMA, and Extension educators working in food and nutrition, family and community life issues.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	227	221123	0	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	61	61

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
2017	12

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	Percentage of participants who self-report changes in decisions and behavior after educational events.
3	Participation in national events on climate adaptation will allow Minnesota researchers and Extension specialists to share information with a broader audience (reported as the number of attendees).

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To develop global carbon cycling models, scientists require accurate information regarding sources of carbon dioxide release.

What has been done
Scientists, including researchers from the University of Minnesota, used data from the comprehensive GlobResp database, which houses over 10,000 measurements of carbon dioxide plant respiration from plant species around the globe. By merging this data with existing computer models of global land carbon cycling they found that plant respiration has been a potentially underestimated source of carbon dioxide release.

Results
The study shows that across the world, carbon release by plant respiration may be around 30 percent higher than previously predicted. As mean global temperature increases, the researchers estimate that respiration will increase significantly. Such increases may lower the future ability of global vegetation to offset carbon dioxide emissions caused by burning fossil fuels.

Incorporating this new knowledge on plant respiration will be essential to developing accurate climate models.

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

Percentage of participants who self-report changes in decisions and behavior after educational events.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Participation in national events on climate adaptation will allow Minnesota researchers and Extension specialists to share information with a broader audience (reported as the number of attendees).

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1065

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Developing solutions that allow for adaptation to climate change is of national and even worldwide interest but sharing information and effective solutions across regions and national borders can be challenging.

What has been done
In 2017, the annual Minnesota Climate Adaptation Partnership Conference (MCAP) was held in collaboration with the 3rd Annual National Adaptation Forum. The three-day event took place in St. Paul and attracted participants from 48 states, the District of Columbia, two territories, three

Canadian provinces and five additional countries.

Results
In total, 1065 participants attended including 227 from Minnesota. The forum provided an excellent opportunity for professionals from the private and public sectors to get together and share information and new solutions around how to best prepare for and respond to the effects of climate change.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
125	Agroforestry
131	Alternative Uses of Land
132	Weather and Climate
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Other (Degree of climate change)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

N/A

Key Items of Evaluation

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: Minnesota Legislative and Citizens Commission on Natural Resources, National Science Foundation and Minnesota Environment and Natural Resources Trust Fund.

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	15%		20%	
701	Nutrient Composition of Food	15%		10%	
703	Nutrition Education and Behavior	15%		10%	
704	Nutrition and Hunger in the Population	15%		20%	
721	Insects and Other Pests Affecting Humans	15%		10%	
722	Zoonotic Diseases and Parasites Affecting Humans	15%		10%	
724	Healthy Lifestyle	10%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	9.6	0.0	32.0	0.0
Actual Paid	17.6	0.0	25.9	0.0
Actual Volunteer	2.2	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**
594413	0	1079943	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1663298	0	2385310	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5460645	0	1362304	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension Health and Nutrition programs are expanding their efforts to promote positive outcomes for families while preventing negative outcomes. New efforts are focused on accessibility and cultural adaptation. In 2017,

- Extension completed the adaptation of I Can Prevent Diabetes studies for Latino and Somali participants.
- Methods of providing direct education are now adapting to the increasing role of technology and social media in modern life. For example, the Nudging to Health program uses texting to promote health behaviors for food shelf clients. For example, there are online exercise guides, and participants will soon be able to share their responses to healthy food recipes online. This technology helps low-income Minnesotans become more self-directed in their health and nutrition activity.
- The SNAP-Ed Train the Trainer program is making the most needed curricula more available to community partners and classroom teachers who can provide nutrition education in their community settings. This follows last year's research demonstrating that community settings create the best outcomes for SNAP-Ed participants.
- Extension is now engaged with 35 community networks that engage 617 organizations across Minnesota. These networks work together to make a difference, ultimately creating better local policy, systems and environmental approaches. These systemic changes affect how people eat, exercise and adopt healthy behaviors. Through these place-based approaches, it is easier for low-income people to make the healthy choice.

This year's reported outcomes focused on strong adoption of healthy behaviors in eating and exercise, as well as the number of community actions that were stimulated to improve health and nutrition because of Extension programming.

MAES. Research reported under this program focuses on improving the health and dietary practices of Minnesotans and the public. Particular focuses include uncovering barriers pertaining to nutrition in children and Native American health. 2017 highlights include:

- As part of a study on how children perceive their body, researchers found children preferred the Figure Rating Scale over the Children's Body Image Scale because the body parts and facial features were more detailed and the image was clothed.
- A study looking at the effect of package size on consumption found that on average smaller package size significantly reduced household purchase volume and is positively correlated with food-at-home consumption. This finding suggests that smaller package sizes may help both consumers (reduce

overconsumption) and retailers (increase profits).

• Researchers found, via survey, that the Academy of Nutrition and Dietetics could do more to encourage undergraduate programs to emphasize sustainable agriculture in coursework and offer more continuing education on the topic. This information was shared and could lead to policy changes.

• A flavor and optimal protein study on intermediate wheatgrass identified the optimal bran content for acceptable quality. This finding could assist with marketing intermediate wheatgrass as a substitute for wheat.

• A study on the effect of purified polylactose on rats found the polylactose-fed rats had improved glucose control, decreased epididymal fat and increased large intestine fermentation.

• A diabetes study among Native American tribes in Minnesota did not measure significant changes in health of diabetes knowledge post-intervention. However, study participants did not feel the measurements used to determine success portrayed the positive effects of the intervention. Some mentioned the program helping them maintain sobriety and youth participants shared how they are becoming "health messengers" within their communities.

• A study on the effect of cardiovascular rehabilitation (CR) found social networks within the CR group (i.e. strong ties with CR staff or other patients) was an important factor for patient comfort.

• Researchers at the Wearable Technology Lab tested four approaches to transporting and containing body moisture in microgravity environments. The winner was a novel solution combining wicking textiles and super-absorbent sodium polyacrylate crystals. This discovery will help researchers design materials that reduce exposure to sweat in spacesuit gloves.

• A research project reported on a few years ago involving designing culturally appropriate athletic wear for Muslim girls, has expanded in 2017 to work with the girls' mothers.

2. Brief description of the target audience

Extension. For maximum impact, Extension focuses direct education on:

• parents and other caregivers of low-income children

• situations where more than one organization collaborates to bring SNAP-Ed classes to eligible audiences in the community

• communities that present opportunities for impacting systems, environments, and policies so that SNAP-Ed participants have every opportunity to put into practice what they learn in classes.

In 2017, the team paid greater attention to online accessibility and ADA accommodations. Moreover, culture and language adaptations have been critical to the Health and Nutrition team's strong outreach to Minnesotans of color. Fifty percent of Health and Nutrition participants were participants of color in 2017, and 4.6 percent of SNAP-Ed courses were delivered in other languages; 9.2 percent of EFNEP classes were delivered in other languages. The Expanded Food and Nutrition Education Program (EFNEP) hires professionals from the communities they work with and have a highly diverse staff who connect directly with hard-to-reach communities.

MAES research target audiences also include:

• Food industry.
• Health professionals including dietitians, nurses and physicians.
• Researchers concerned with the diet, nutrition and human health fields.
• The public.

3. How was eXtension used?

The evaluation team participated in qualitative coding trainings with an eXtension Fellow, and participated in facilitation sessions of the "data jam" technique. Health and Nutrition staff joined the Diversity and

Inclusion Issue Corps Design-athon in 2017. These projects address current issues and opportunities in EFNEP education, including changing practices that reinforce the status quo of white-middle-aged-female dominated leadership, increasing program reach by community partners to deliver curricula, and hiring community nutrition educators from multicultural communities.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	10191	305694	11431	0

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

Patent Applications Submitted

Year:	2017
Actual:	9

Patents listed

Freeze Dried Fecal Microbiota for Use in Fecal Microbial Transplantation: 15/837,834 - Dec. 11, 2017
Compositions and Methods for Transplantation of Colon Microbiota: 15/594,087 - May 12, 2017
Compositions and Methods for Transplantation of Colon Microbiota: 15/655,393 - July 20, 2017
Compositions and Methods for Transplantation of Colon Microbiota: 15/626,898 - June 19, 2017
Compositions and Methods for Transplantation of Colon Microbiota: 15/626,880 - June 19, 2017
Compositions and Methods for Transplantation of Colon Microbiota: 15/655,372 - July 20, 2017
Compositions and Methods for Transplantation of Colon Microbiota: 15/594,319 - May 12, 2017
Silica Encapsulated Biomaterial: 9,790,484 - Oct. 17, 2017 - ISSUED
Compositions and Methods for Transplantation of Colon Microbiota: 9,649,343 - May 16, 2017 - ISSUED

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	9	35	44

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops/classes or educational presentations taught.

Year	Actual

2017	1540

Output #2

Output Measure

- Number of organizations represented in community networks.

Year	Actual
2017	617

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of participants who report knowledge change related to human nutrition knowledge.
2	Number of changes made by professionals, organizations and policy makers related to practices, organizational culture and policies that promote food literacy, active living and healthy food access.
3	Percentage of program participants who use research-based information from Extension to improve their intake of healthful foods and engagement in physical activity.
4	Research will support families, children and youth understanding of healthy food choices.
5	Microbiologists partner with medical researchers to help develop innovative medical technology that cures patients.

Outcome #1

1. Outcome Measures

Percentage of participants who report knowledge change related to human nutrition knowledge.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of changes made by professionals, organizations and policy makers related to practices, organizational culture and policies that promote food literacy, active living and healthy food access.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	642

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota ranks among the 10 worst states in the country for access to healthy food. Approximately 30 percent of Minnesotans have limited access to local stores that supply healthy food, and 16 percent live in census-identified food deserts. Groups that are particularly vulnerable include those living in rural areas, residents of color, low-income and senior residents. To increase consumption of fruit and vegetables, communities can change local policies, system designs and environmental factors.

What has been done
In 2017, Extension supported 35 food networks as they implemented food charter strategies. Extension guided the networks as they enhanced local and regional food access. The largest such network, Metro Food Access Network, is currently led and supported by SNAP-Ed educators and Health and Nutrition Extension educators.

Results
642 policy, systems and environment changes were made after Extension sponsored activities. Changes include actions such as adding healthier items to a menu or offering locally grown food. Changes reached approximately 105,718 people. This reach was calculated by gathering

information about the number of people exposed to the change.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Percentage of program participants who use research-based information from Extension to improve their intake of healthful foods and engagement in physical activity.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the Economic Research Service division of the USDA, 9.7 percent of Minnesota households had low or very low food security and 3.6 percent had very low food security in 2016. According to the Minnesota Department of Health, 27.8 percent of adults in Minnesota were obese in 2016, an increase from 26.1 percent in 2015.

What has been done
In Minnesota, EFNEP operates in the Twin Cities metro area. The program targets immigrant families and Native American communities. Nutrition educators work in a diverse array of community sites already trusted by those communities. Nutrition and lifestyle classes are conducted in several languages in community and home visit settings.

Results
In a study of school-age EFNEP participants, 73 percent of students from the 6th-12th grades chose healthier foods, used safe food handling practices, increased physical activity, improved ability to prepare nutritious food, gained skills to be food secure, showed improvement in one or more food resource management practice or engaged in more nutrition practices such as reading

nutrition labels.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Humans need both omega-6 and omega-3 fatty acids in their diet but too much omega-6 and too little omega-3 can raise the risk of obesity, diabetes and cardiovascular disease.

What has been done
In a study over three years, Brad Heins and his team at the Research and Outreach Center in Morris, in collaboration with researchers from around the world, quantified the fatty acid profile in milk from cows fed a 100 percent forage-based diet and compared it to profiles in milk from cows under conventional and organic management.

Results
The 100 percent grass- and legume-based feeding of lactating dairy cows typically yields milk fat with ratios of omega-6/3 close to 1, compared to the 5.8 for milk from cows on conventionally managed farms and 2.3 for typical organic dairy farms.

The differences found in grass-fed milk may help restore a historical balance of fatty acids and

potentially reduce the risk of cardiovascular and other metabolic disease.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Microbiologists partner with medical researchers to help develop innovative medical technology that cures patients.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	89

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Clostridium difficile (C. difficile) is a dangerous and debilitating bacterial infection of the intestine that affects about 500,000 people annually--causing about 29,000 deaths--in the United States.

What has been done
U of MN microbial ecologist and microbiologist Michael Sadowsky (PhD) partnered with U of MN gastroenterologist Alexander Khoruts (MD) to develop a new treatment for C. difficile called fecal microbiota transplantation (FTM). The treatment replaces the gut microbiota in a sick patient with that from a healthy donor.

The team helped to standardize the approach, which has origins in ancient Chinese medicine, and developed an easy-to-use capsule form of the treatment.

Results

A University-based C. difficile study with 49 patients had a cure-rate of 89 percent and private companies, non-profits and gastroenterologists across the country are now adapting the treatment in their own studies.

Researchers believe this could just be the beginning of developing treatments based on microbiota therapeutics, which is also being explored to treat conditions including autism, obesity, diabetes and ulcerative colitis.

4. Associated Knowledge Areas

KA Code	Knowledge Area
704	Nutrition and Hunger in the Population
722	Zoonotic Diseases and Parasites Affecting Humans
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Populations changes (immigration, new cultural groupings, etc.)
- Other (technology)

Brief Explanation

In 2017, the Health and Nutrition team implemented a new online reporting system for educational events. This new data base called FDRED (Family Development Reporting Evaluation Database) allows for easier data entry by educators and participants. Mobile devices on program site are used to collect information. Extension's Information Technology unit designed this tool with educators and specialists so that it would capture data about participants and program outcomes than in previous years.

Also, the team continues to create program adaptations to address Minnesota's increasing diversity.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The evaluation framework for Extension's Heath and Nutrition programs includes data collection, program monitoring and analysis to decide on future program improvements, as well as outcome evaluation for ongoing activities. Pre- and post-program surveys determine the extent to which the program has increased physical activity and healthy food consumption. In 2017, we created better, more user-friendly ways to collect evaluation information using on-site web interactions. These tools collect more accurate information than previous methods.

The Healthy Hunger-Free Kids Act of 2010 transformed SNAP-Ed into a nutrition **and** obesity prevention grant program. Programs now explicitly adopt obesity prevention as a major emphasis and allow comprehensive community and public health approaches for low-income populations. This change in federal guidelines for educators'

work pushed Minnesota's evaluation system to document changes at the Policy, Systems and Environment level (PSE). PSE is documented in six major categories--Eat, Learn, Live, Play, Shop and Work. The work of PSE change is done in partnership with local organizations that can make the healthy choice is the easy choice for low-income communities. From 2015 to 2017, Extension began to actively document the development of these local networks through Network Mapping processes. Network maps track the growth of community PSE networks and the number of networks and coalitions developed to advance PSE initiatives. Network maps show that local action networks are expanding significantly across all six of the categories.

Pre- and post-information found that 72 percent of participants are changing their habits for eating healthy foods and increasing activity. And the examination of policy initiatives demonstrated that local action networks are expanding significantly. In 2015, network mapping found 79 projects and 27 organizational connections among 90 local organizations in Minnesota. In 2017, the network map showed 642 projects and 575 connections among 693 local organizations in Minnesota. Attention to education and support for local organizations is creating local action.

Key Items of Evaluation

Extension. Pre and post-information found that 72 percent of participants are changing their habits in eating healthy foods and increasing activity. And the examination of policy initiatives demonstrated that local action networks are expanding significantly. In 2015, the network mapping found 79 projects and 27 organizational connections among 90 local organizations in Minnesota. In 2017, the network map showed 642 projects and 575 connections among 693 local organizations in Minnesota.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: National Institute of Health, Midwest Dairy and Foods Research Center and Mayo Clinic.

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	50%		60%	
503	Quality Maintenance in Storing and Marketing Food Products	25%		20%	
504	Home and Commercial Food Service	25%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	7.0	0.0	11.1	0.0
Actual Paid	14.0	0.0	11.9	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**
744125	0	193013	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1942974	0	1115816	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
609676	0	942160	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. University researchers are dedicated to ensuring a safe food system by providing tools and information to protect consumers and developing easier methods for the food industry to catch contamination and avoid recalls. 2017 highlights include:

- A study on the prevalence of bovine tuberculosis (bTB) in one-year-old dairy calves randomly tested 137 calves from 28 small-holder dairy farms in Chiang Mai province, Thailand. The results showed more single intradermal tuberculin reactors among calves from farms with a history of bTB.
- Researchers developed a five-to-six log cycle kill phage against Listeria monocytoenes that works as fast as two hours on the surface of thinly sliced roast beef and pastrami.
- The Nuclear Magnetic Resonance spectroscopy was used to obtain spectra used in the elucidation of the chemical structure of biological molecules. Spectra are able to provide scientists with information on the composition of organic chemical compounds.
- Researchers have developed two new methods to analyze food samples for allergens that work within their goal of 25-40 minutes.
- Researchers identified two allelic mutants exhibiting an absence of erucic acid in pennycress seed oil. Erucic acid is not allowed in oils used for human consumption, so its removal makes the mutant oil edible for humans--a huge breakthrough in developing a domesticated pennycress that creates edible oil.
- Results from a pilot study evaluating the impact of using a culture-guided selective dry cow program on udder health and antibiotic use showed selective dry cow therapy can be successfully adopted (maintaining udder health) while significantly reducing antibiotic use on farms. This represents a new approach for farmers and veterinarians to consider.
- Researchers developed a quantitative risk assessment to estimate the number of Campylobacter illnesses that potentially could affect chicken consumers in Northern Thailand.

Extension. After providing ServSafe food service certification for many years, the Food Safety team recognized that these certification services are available elsewhere. In 2017, resources have shifted to address current issues and opportunities in Minnesota.
A primary program focus in 2017 was on the Cottage Food Producer Food Safety Education Program. To expand the reach and offer choice for the learner, the team developed online course options for cottage food producers. To assure the course was appropriate, eight registered cottage food producers were recruited to review the course. The online course that was ultimately designed was reviewed and approved by the Minnesota Department of Agriculture for cottage food training. The course took eight months to develop, pilot and revise. It was released on October 6, 2017.

A 2017 merger between the University of Minnesota Extension Food Safety Team and the Good Agricultural Practices team (which had previously been housed in another area of the University of Minnesota) expanded the capacity of the food safety program to include on-farm processing.

2. Brief description of the target audience

MAES. Research supports the food development industry and food processing industry, while the direct audiences of the outreach efforts are food handlers in community locations, entrepreneurs who market foods through farmers markets and other local channels, and high-risk audiences through the organizations they trust.

Extension. In 2017, outreach to the Cottage Food Producer industry increased Extension's response to Minnesota's population of color, as 22 percent of Cottage Food Producer training participants were persons of color. Moreover, a merger with the Good Agricultural Practices (GAPS) program increases Extension's response to Hmong farmers. The GAPS program works closely with the Hmong American Partnership and the Hmong American Farmers Association. They hosted two field days and two workshops specifically for Hmong farmers relating to farm safety in 2017, reaching over 90 Hmong

farmers.

Through a program agreement with the Indian Health Services, a food safety educator provided a training session for 20 environmental health specialists from Minnesota, Wisconsin and Michigan about cottage foods and best practices for home food processing in Native communities.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	14723	1172702	18	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	13	13

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops or other educational events conducted.

Year	Actual
2017	41

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	Percentage of participants that significantly changed one or more food safety practice as a result of attending classes intended to improve food safety practices.
4	Percentage of pass rates among those who participate in food safety education programs to become certified food managers. (The Minnesota Department of Health reports a decrease in critical inspection violations in establishments that employ a Certified Food Manager.)

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The number of foodborne disease outbreaks in dry and powdered food has been increasing in the U.S. and led to major food recalls.

What has been done
Roger Ruan and his team are developing intense pulsed light (IPL) technology to reduce harmful bacteria and other microorganisms in dry or powdered foods, including non-fat powered milk, wheat flour, black pepper and egg white and whole egg powders. They have designed and fabricated a small lab scale system for testing the IPL process in terms of microbial inactivation and physical, chemical and sensory changes under different conditions.

Results
The initial experiments show the IPL process is able to reduce bacteria by 99.9-to-99.99999 percent in 20-to-30 seconds depending on the dry or powered food tested.

Successful development of IPL technology would enable the food industry to use a non-thermal process to disinfect food products while maintaining its nutritional and sensory quality.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Despite control efforts, Salmonella remains a major cause of foodborne outbreaks in the U.S. resulting in an annual estimated loss of around $4 billion. Effective methods to control multidrug resistant Salmonella, especially as antibiotic resistance becomes a larger problem, are needed to improve the safety of poultry products.

What has been done
Anup Kollanoor Johny and his team determined the effect of different levels of multidrug resistant S. Heidelberg (SH) inoculation in young and adult turkeys on pathogen populations in the cecum, liver, spleen, thigh, breast and drumstick muscles.

They then used this information to analyze the effectiveness of multiple non-antibiotic (alternatives to antibiotics; A2A) interventions that when used individually, or in combination, would reduce SH in the most susceptible areas of the turkeys.

Results
Results showed that, in turkey poults, the recovery of SH was highest in the cecum followed by the spleen, liver, thigh, drumstick and breast. Eight A2A interventions (probiotics, prebiotics, vaccination and their combinations) were then tested and showed that certain A2A treatments, used individually or in combination, can cause a significant reduction of SH in the cecum, liver and spleen of turkeys.

These results showcase the importance of controlling multidrug-resistant SH in turkeys at the farm level and the feasibility of using A2A interventions to reduce SH colonization in turkeys.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Percentage of participants that significantly changed one or more food safety practice as a result of attending classes intended to improve food safety practices.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers in the cottage food industry enrich and diversify local economies by finding niche markets for homemade foods. Minnesota's 2015 Cottage Food Exemption supports these entrepreneurs by allowing Minnesota residents to manufacture and store foods in an unlicensed kitchen. Foods can be sold from home, farmers markets, farm stands or at community events without formal licensing. Registration with the Minnesota Department of Agriculture is required after completing food safety training provided by Extension.

What has been done
In 2016, Extension educators developed curriculum for a three-hour advanced course to satisfy Tier 2 cottage food training requirements. Extension is the only program authorized by the Minnesota Department of Agriculture to offer this training. To expand the reach and offer choice for the learner, Extension developed an online course option in 2017. The course was released on October 6, 2017, and 25 participants completed the online course. Another 254 participated in one of 12 in-person courses.

Results
Follow up with participants showed that 100 percent had knowledge and resources to safely prepare and sell cottage foods; 98 percent planned to continue as cottage food producers in 2018. Forty-three people reported sales of $187,767 or an average of $4,204 per person. For those who had previously registered, the greatest changes in behavior reported after the course

were use of gloves, utensils or other barriers to bare hand contact (increased from 75 to 96 percent), labeling products with name, address, date prepared, ingredients and allergens (from 54 to 96 percent), and displaying required signage at point of sale (from 68 to 96 percent). Among those who hadn't previously registered, 100 percent reported inspecting hands for cuts and hand washing prior to preparing food.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Percentage of pass rates among those who participate in food safety education programs to become certified food managers. (The Minnesota Department of Health reports a decrease in critical inspection violations in establishments that employ a Certified Food Manager.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the latest Centers for Disease Control statistics, one out of six Americans will get sick from a foodborne illness every year. Almost all of these illnesses can be prevented by practicing safe food handling practices from farm to fork. Extension also trained and certified school food service staff to increase knowledge of food allergens.

What has been done
In 2017, 359 participants took the Serve It Up Safely Online course to renew their Minnesota certified food manager certificate, and 47 took one of nine other individual modules.

Results
A follow up survey was sent, and 40 percent of respondents provided examples of changes made in food handling practices after taking the course, including: cooling food faster, increased glove use, increased observation by managers, more hand washing, more sanitizing of food counters, logging employee illness, and more sanitizing of tables and coffee serving areas. As a result of

school food service programs, participants said they would read food labels for hidden food allergens and change oven mitts to prevent cross-contact of allergens and other foods.

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

- Other (Allocation of program resources)

Brief Explanation

We no longer offer the ServSafe Initial Certification Course as of June of 2017. It was discontinued because the program is offered widely by others. However, we did offer certification renewal online for previously certified managers. Outcomes of that effort are described. Extension efforts have moved to other programmatic priorities, namely the support of the new cottage food industry in Minnesota.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension's Food Safety team evaluates educational programming by testing knowledge, supporting industry certification, and following up to assure that behavior change has followed knowledge gains. In 2017, cottage food producers improved the quality standards of their industry by putting safety standards in place, including processing changes, labeling and signage changes. Online education resulted in changes significant to reducing foodborne illness risk factors, and more school food service settings became more cognizant of how to act to reduce food allergen reactions among Minnesota's youth.

Key Items of Evaluation

Extension. In 2017, cottage food producers improved the quality standards of their industry by putting safety standards in place, including processing changes, labeling and signage changes. Online education resulted in changes significant to reducing foodborne illness risk factors, and more school food service settings became more cognizant of how to act to reduce food allergen reactions among Minnesota's youth.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: National Pork Board, Rapid Agricultural Response Fund, National Science Foundation, USDA-AFRI and USDA-CAP.

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	9.3	0.0	22.9	0.0
Actual Paid	14.8	0.0	27.6	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**
764703	0	598709	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1975991	0	1975784	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
595610	0	2797272	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Research related to water resources focuses on protecting this valuable commodity in Minnesota. Researchers are examining water quality issues related to erosion, runoff and aquatic invasive species. 2017 highlights include:

- A three-year study on common carp in the Six Mile Creek subwatershed revealed that the total biomass of carp in the subwatershed is five times greater than the threshold value identified to cause severe ecological impacts in Midwestern lakes. The study also revealed locations where carp have been able to reproduce, showing the population is growing. This information will help develop a multi-year strategic management plan for controlling the carp population in Six Mile Creek.
- Preliminary results of curlyleaf treatments in Lake Susan and Staring show the treatments were effective at reducing curlyleaf lake-wide with minimal effect on native plants but native plants continue to be suppressed by poor water clarity.
- In a whole lake experiment, researchers released and tracked a prostaglandin-implanted (i.e. pheromone releasing) carp into a group of sexually active common carp. They found the pheromone led to the formation of a social network that could be tracked.
- Taxonomic research resulted in the descriptions and revisions of 100s of new species of caddisflies and led to a greater understanding of their phylogenetic relationships and their utilization as biological indicators of water quality.
- The Minnesota Aquatic Invasive Species Research Center has funded a new high-tech study headed by the Department of Natural Resources to look at food webs in nine of Minnesota's largest walleye lakes. Notably, a Blue Ribbon Panel, including U of MN researchers, looking at reasons for walleye declines in Mille Lacs Lake, recommended such a study in their 2014 report.
- Mae Davenport co-authored a book, Inspiring Action for Nonpoint Source Pollution Control, that describes a new approach for water resources protection informed by systems thinking and a model of community capacity.

Extension. To protect Minnesota's waterways, the water resource team increased its capacity by attracting and retaining volunteers. In 2017, 121 Aquatic Invasive Species Detectors were certified after undertaking online and in-person education. Volunteers indicated that the online and in-person training they received prepared them to perform volunteer service related to invasive species. They were deployed almost immediately to search and identify species, as described in program outcomes.

Also in 2017, the team completed a pilot program that helps municipal officials to tackle barriers to green infrastructure through codes and ordinance audits.

2. Brief description of the target audience

Water Resource Programs are available to community jurisdictions across the entire state. The team reaches communities through local government, elected and appointed officials and their staff. Local government engineers and planners, consulting engineers, planners, and architects are also targeted as they help communities make decisions that impact Minnesota's waters. In 2017, the Aquatic Invasive Species Detector program conducted outreach to tribal representatives in hopes of connecting with an underrepresented audience for programs. Initial talks have been successful, and through the collaboration, the water resources team hopes to hold volunteer events and trainings for tribal stakeholders.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5572	70750	40	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	9	34	43

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Output #2

Output Measure

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

Year	Actual
2017	118

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of water resource professionals who are applying skills and resources learned while participating in programs that address specific water management responsibilities and to achieve water management goals.
2	Number of Aquatic Invasive Species detected by volunteer detectors using information about early detection taught by Extension.
3	Research on aquatic invasive species and/or water quality will improve the overall health of Minnesota Lakes and Rivers.

Outcome #1

1. Outcome Measures

Percentage of water resource professionals who are applying skills and resources learned while participating in programs that address specific water management responsibilities and to achieve water management goals.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	67

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Green infrastructure uses plants, trees and soils to manage precipitation and stormwater runoff. Green infrastructure approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater in order to maintain or restore natural hydrology and protect and clean our community's water resources. At the same time, green infrastructure has many benefits for residents, neighborhoods and the city.

What has been done
A new code audit tool developed by the Wisconsin Sea Grant team was used in pilot communities in Wisconsin and Minnesota, prompting communities to adopt Minnesota Minimal Impact Design Standards. A 2017 workshop reached community leaders in the cities of Duluth, Cloquet, Hermantown, Proctor and Superior. These communities are stewards of Lake Superior and the Mississippi River as they flow downstream. The workshop allowed leaders to discuss the role green infrastructure can play in creating green space and preserving clean water resources.

Results
67 percent of participants projected they would make a move to change their community's stormwater ordinance in the coming twelve months. Possible changes include: sizing requirements for stormwater practices that vary by soil type; use of permeable materials to reduce the quantity of stormwater required to be managed; reduced stormwater management requirements for redevelopment and infill sites; providing incentives to developers who reduce impervious surface cover; preserving natural areas or implementing stormwater runoff reduction practices. Those change areas were the result of reviewing (auditing) stormwater management standards across 11 different barriers and grading those barriers on how well they appear in community ordinances now.

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
135	Aquatic and Terrestrial Wildlife
403	Waste Disposal, Recycling, and Reuse

Outcome #2

1. Outcome Measures

Number of Aquatic Invasive Species detected by volunteer detectors using information about early detection taught by Extension.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Starry stonewort is an invasive algae that was first found in Lake Koronis in 2015 and has since spread to nine Minnesota lakes. Starry stonewort can grow tall and dense, forming mats on the surface that interfere with recreation and potentially displacing native plant species.

What has been done
The water resources team conducted "Starry Trek" in partnership with the Minnesota Department of Natural Resources, the Wisconsin Department of Natural Resources, and the University of Wisconsin Extension. On August 5, 2017, 200 volunteers turned out across the state to participate in the inaugural "Starry Trek". After being trained to identify starry stonewort, volunteers fanned out and searched 211 public access sites on 178 lakes statewide.

Results
The Minnesota Department of Natural Resources confirmed one new finding of starry stonewort in Grand Lake in Stearns County. This was the first new confirmation of starry stonewort in a Minnesota lake in 2017. As a result, control efforts were undertaken in the affected lake and 200

volunteers gained skills in detecting the invasive plant.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Research on aquatic invasive species and/or water quality will improve the overall health of Minnesota Lakes and Rivers.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	86

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The sea lamprey, an ancient jawless fish, invaded the Great Lakes early in the 20th century and soon laid waste to stocks of lake trout, whitefish, and other commercially valuable fish species. In the 1955 the Great Lakes Fishery Commission (GLFC), treaty organization between the US and Canada was formed to solve this problem and has spent millions of dollars each year attempting to control sea lamprey and developing new means to do so.

What has been done
In 2005, after sixteen years of research, Peter Sorensen and his team discovered, identified and synthesized petromyzonamine disulfate, the primary constituent of the sea lamprey migratory pheromone along with two other components. This novel compound was the first migratory pheromone ever identified in fish and remains the most potent odorant ever identified in fish (1 gram activates 10 billion liters of water). It was patented and a license granted gratis to the GLFC. This effort triggered a major research and management initiative in the Great Lakes by the GLFC that continues to this day.

Results
The GLFC's "integrated" control project (which includes baiting with pheromones) has led to a documented average decrease of 86 percent of the sea lamprey population across the five lakes as of 2017.

Of the over 180 non-native species in the Great Lakes basin, sea lampreys are the only invader that is controlled basin-wide and are the only example in the world of a successful aquatic vertebrate pest control program at an ecosystem scale.

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
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Other (none)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Citizen and civic action is a key objective for Extension's Water Resources team. Evaluation processes monitor whether education and certification programs provide enough information to guide local actions that are most important to a community, industry or watershed.

Two project evaluations demonstrated impact in 2017, and determined that future replication of programs could create more statewide impact. Volunteer training to support identification of aquatic invasive species resulted in control efforts for the starry stonewart in one important waterway. And a new training to support audits and ordinance changes that integrate Green Infrastructure proved useful in helping city officials make concrete changes to protect the environment.

Key Items of Evaluation

Extension. Two project evaluations demonstrated impact in 2017, and determined that future replication of programs could create more statewide impact. Volunteer training to support identification of aquatic invasive species resulted in control efforts for the starry stonewart in one important waterway. And a new training to support audits and ordinance

changes that integrate Green Infrastructure proved useful in helping city officials make concrete changes to protect the environment.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: Minnesota Environmental and Natural Resources Trust Fund, Minnesota Invasive Terrestrial Plants and Pest Center and Legislative-Citizen Commission on Minnesota Resources.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Community Vitality and Public Finance

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
602	Business Management, Finance, and Taxation	10%		20%	
608	Community Resource Planning and Development	45%		30%	
611	Foreign Policy and Programs	0%		10%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	45%		30%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	29.7	0.0	5.4	0.0
Actual Paid	27.7	0.0	10.4	0.0
Actual Volunteer	2.6	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1030495	0	227886	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2855979	0	1329974	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
973763	0	266906	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. Community Vitality programs at Extension deliver education and applied research that helps communities choose their future. Education informs local decisions, improves the processes leaders use when they make decisions, increases the skills and ability of those who lead and decide, and increases the number of people who step up to lead.

In 2017, Community Vitality educators and specialists managed 35 cohorts that grew leadership or worked together to make decisions. The team delivered 143 applied research reports to communities. The most popular applied research reports examined homeownership rates, leadership demands, or population trends in a community or region. Larger scale economic impact analysis reports were also in high demand.

Reported outcomes in 2017 demonstrate that Community Vitality programs address the leadership gap in rural communities, and discovered tangible ways that applied research is being used to decide on public investments and projects.

MAES. Research related to community vitality and public finance includes projects focused on assisting agricultural communities in Minnesota and around the globe be more prosperous and stable. Significant work is also being done to help support immigrant and minority communities throughout the state. 2017 highlights include:

- Researchers working to motivate youth to learn about money developed Make$ense, a set of 13 activities to strengthen the financial knowledge and skills of youth ages 10-16.
- Researchers working with the Minnesota Department of Health to develop mental health screening protocols for incoming refugees focused on translating materials into five languages in 2017 and gathering key information from providers and a steering committee.
- A new research project exploring substance abuse in rural Minnesota and the possible positive affect of "Positive Peer Journaling" interviewed 33 participants. Overall, they found the practice acceptable and easy as well as useful for recovery but some expressed some initials concerns about possibly being overwhelmed with the need to write well and set daily goals.
- Researchers developed a simple deferred-payment savings product called "Pay Me Later," which is an attractive savings option for workers in developing countries. Pilot studies proved successful in increasing ownership of physical assets and were in high demand.
- The Sustainable Post-Occupancy Evaluation Survey analyzes occupants' satisfaction and helps direct attention for future improvement to both successful areas and areas that need improvement in a building.

To date, nearly 100 spaces have undergone evaluation including the new office space of the Minnesota State Senate.

2. Brief description of the target audience

A broad spectrum of jurisdictions and groups engage the Center for Community Vitality for education and applied research. For example, in 2017, Extension's 35 cohort-based programs in communities were sponsored by:

- Eleven (11) county organizations who want to create stronger ties and a vision for all communities in the county
- Nine (9) groups focused on the protection of a watershed, river or lake
- Five (5) groups bringing people together work together to strengthen the civic or economic vitality of a town or city
- Six (6) groups bringing together emerging or existing leaders from a multi-county region of the state, or participants from across the entire state
- Two (2) regional programs focused on community health
- Two (2) programs -- one national and one state -- focused on the future leadership of Extension

The Center for Community Vitality is also focused on helping communities acknowledge demographic shifts. The team has helped communities recruit and educate emerging and existing leaders from diverse populations--immigrants and tribes, for example. In 2017, 8.1 percent of participants in Community Vitality programming were Minnesotans of color.

3. How was eXtension used?

Extension Center for Community Vitality staff contributed to and benefited from eXtension in 2017. Educators offered a webinar via eXtension titled, "Let's talk about race" on November 28, 2017. They contributed to the Enhancing Rural Communities community of practice, and identified online leadership training programs that could become an online offering of eXtension. They participated in webinars and used links and resources. They also fielded inquiries to eXtension.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9444	155081	37	0

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

Patent Applications Submitted

Year:	2017
Actual:	2

Patents listed
Smart Fabric: 62/463,356 - Feb 24, 2017
Protective Garments and Methods of Making: 9,700,085 - July 11, 2017 - ISSUED

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	12	13	25

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of community cohort groups convened to develop leadership skills, create civic connections, or strengthen the local economy.

Year	Actual
2017	35

Output #2

Output Measure

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

Year	Actual
2017	549

Output #3

Output Measure

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

Year	Actual
2017	143

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants who increased their leadership intensity or involvement in at least one role.
2	Percentage of program alumni who report in follow-up surveys that the program helped make public meetings, planning sessions, or committees more effective.
3	Number of community or economic development decisions that were influenced by applied research or education.
4	Number of positive effects on "capitals" that are essential to the vitality of communities (including human, social, civic, financial, built, health, cultural, and natural) that were stimulated by applied research or education in communities.
5	Researchers will provide insights to local councils and the public related to restorative justice and peacekeeping that will help lead to public action and policy changes. (Expressed as the number of policy changes implemented).

Outcome #1

1. Outcome Measures

Number of participants who increased their leadership intensity or involvement in at least one role.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	155

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Extension research fellow Ben Winchester has sought to understand the demand for leadership. 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 Minnesotan must serve in a leadership position. In comparison, one in every 143 urban residents must serve. According to the Blandin Foundation Rural Pulse survey, 41 percent of rural residents say that they have served in a leadership role. This constitutes a significant 12 percent decline since 2013 study findings.

What has been done
Leadership and civic engagement programs at the University of Minnesota Extension offer organizations, sectors and communities the opportunity to sponsor leadership education programs. Through Extension-led programs, sponsors actively encourage participants to serve or to commit more to leadership in their communities. In 2017, 31 of the 35 cohort programs (described in outputs) focused on growing leadership and civic engagement.

Results
During 2017, leadership role change data were collected with 144 participants in seven leadership cohort programs. Of the participants, 70.1 percent (111 of 144) increased their level of involvement in at least one of their organizational roles (either a new role, an increase from inactive to active or leader roles, or an increase from active to leader roles). In addition, 44 alumni responded on a survey of program alumni that they had expanded or taken on a new role in community or organization since completion of their cohort program.

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 #2

1. Outcome Measures

Percentage of program alumni who report in follow-up surveys that the program helped make public meetings, planning sessions, or committees more effective.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	99

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, community meetings take place. That makes leading productive and civil community meetings and community engagement processes critical to community vitality. It is not practical or affordable for communities to hire professional facilitators for every meeting. That means that knowledge of effective facilitation and civic engagement is an essential skill for local leaders.

What has been done
Extension leadership and civic engagement educators make teaching skilled facilitation a priority as they educate community leaders. The goal is to help emerging and existing leaders understand that good meetings are critical, to pass along practical tools for success and to make skilled facilitation a habit.

Results
99 percent (89 of 90) of leadership alumni reported that participation in a leadership cohort program helped them make meetings, planning sessions, or committees more productive (at least to a slight extent). A strong majority (84.4 percent) reported that the cohort program helped them to a moderate or great extent. Examples include the use of effective agendas to stay on task, use of ice breakers to understand perspectives, preparing strategies that engage everyone at the meeting, asking probing questions, actively valuing different personality types, skilled use of online meeting tools 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

Number of community or economic development decisions that were influenced by applied research or education.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Economic development and public finance decisions, especially in rural areas with fewer resources and few professional staff, may be based on assumptions, fears and antiquated information. Applied economics research explains local economies and their dynamics so that community leaders act on solid information as they invest critical resources in the local economy.

What has been done
The community economics team uses demonstrated research methods to analyze economies and inform local decisions. Examples of applied research offered by Extension include: 1) IMPLAN economic impact analysis; 2) business retention and expansion studies; 3) retail strengths and opportunities (pull factor, location quotient, etc.); 4) tourism development assessments; and, 5) examination of the impact of adopting a local option sales tax to increase revenue.

Results
Community stakeholders in 12 of 14 community and industry groups who received Extension applied research in recent years agreed that the research positively informed community or economic development decisions. For example, a retail trade study was used to attract new businesses to a retail space after a JC Penney's closed. Two communities re-energized economic and chamber groups. One community increased broadband with a fiber expansion project. Businesses redesigned business plans to make them more customer-focused. Three communities adopted local option sales tax. In three cases, studies affected state and local policy

support of local businesses, including a production incentive and support of the aquaculture industry, legislation allowing at-home wagering for horse races, contributions of land, and more dollars to tourism center/resorts to diversify customers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #4

1. Outcome Measures

Number of positive effects on "capitals" that are essential to the vitality of communities (including human, social, civic, financial, built, health, cultural, and natural) that were stimulated by applied research or education in communities.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

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, financial capital, cultural capital, health and natural environment. Community development programs are in a position to create connections and grow community capitals as community groups learn and work together, make decisions about their future and invest in community projects.

What has been done
Community-based applied research helped communities examine critical questions, and mobilized community members to act. Examples include business retention and expansion programs, public finance analysis, retail trade analysis, profiles of visitors to local festivals and events, economic impact analysis of industries and public organizations, and market analysis profiles. Online follow-up surveys and interviews conducted with those who sponsored applied research or their stakeholders.

Results
Follow-up surveys and interviews highlighted 69 positive effects on capitals from 19 offerings. This includes 19 changes in human capital, 14 effects on finance, 13 effects on civic capacity, 12 effects on social capital, four on culture, three built capital assets and one natural capital effect.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #5

1. Outcome Measures

Researchers will provide insights to local councils and the public related to restorative justice and peacekeeping that will help lead to public action and policy changes. (Expressed as the number of policy changes implemented).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
For effective social change to take place, community leaders need to be open to hearing from a combination of stakeholders and community members affected by the current, and potential, policies.

What has been done
The Center for Restorative Justice and Peacekeeping (CRP) at the University of Minnesota conducted an audit in 2015 of the St. Paul Police-Civilian Internal Affairs Review Commission (PCIARC).

The audit included interviews with 23 key stakeholders in the commission's process and reviewing 40 commission memos, which included 310 cases of complaints about police conduct to determine what the commission did once a complaint and the investigation files were given to them. They also looked at the makeup of similar commissions throughout the U.S.

Results
Their audit identified 18 recommended changes to commission operations, the most controversial being that police officers should no longer serve as voting members of the commission. While not seen at the time as politically realistic suggestion, city officials agreed to allow the CRP to facilitate three listening sessions to gather public input.

In December 2016, the St. Paul City Council voted 5 to 2 to remove police officers from the city's PCIARC after a group of 35 took part in a public hearing on the proposed changes. These results highlight how partnerships with academia and the community can lead to effective social change.

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 (none)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

To evaluate the impact of community vitality programming, Extension routinely surveys and interviews individuals and community stakeholders after engaging in programs. For example, at the end of 2017, Extension heard from 90 alumni of leadership programs from past years who responded to a survey of alumni. These surveys help Extension understand the extent to which programs are informing local action, result in the implementation of community plans or grow local leadership.

To further examine the value of the impact community vitality programs have, Extension draws from community capitals research (Flora, et. al, 2008). Information about outcomes is coded to understand what kind of capital these effects bring to communities--human, social, political, civic, natural resource, cultural, financial or built.

In 2017, Extension brought increased leadership to communities, with over 70 percent of program participants saying they accepted a new leadership position after being part of

leadership programs. Communities that received applied research reported they were able to use Extension's applied research to, for example, fill retail space, increase broadband, create business plans, pass public finance options or get investment for local business. Follow up surveys and interviews highlighted 69 positive effects on community capitals, including 19 changes in human capital, 14 effects on finance, 13 effects on civic capacity, 12 effects on social capital, four on culture, three built capital assets and one natural capital impact.

Key Items of Evaluation

Extension. In 2017, Extension brought increased leadership to communities, with over 70 percent of program participants saying they accepted a new leadership position after being part of leadership programs. Communities that received applied research reported they were able to use Extension's applied research to, for example, fill retail space, increase broadband, create business plans, pass public finance options or get investment for local business. Follow up surveys and interviews highlighted 69 positive effects on community capitals, including 19 changes in human capital, 14 effects on finance, 13 effects on civic capacity, 12 effects on social capital, four on culture, three built capital assets and one natural capital impact.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: U of MN Grant-in-Aid and the City of Saint Paul.

V(A). Planned Program (Summary)

Program # 8

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	25%		20%	
802	Human Development and Family Well-Being	25%		30%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	25%		20%	
805	Community Institutions and Social Services	25%		20%	
806	Youth Development	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	26.2	0.0	9.0	0.0
Actual Paid	31.3	0.0	5.7	0.0
Actual Volunteer	1.1	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
967662	0	132764	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2429900	0	630460	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5716158	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. In 2017, Extension's family development and financial literacy teams addressed two strategic goals. The team: 1) found online solutions that increase accessibility for participants and community trainers; and, 2) formed partnerships to reach more populations of Minnesotans who benefit from family life education and financial literacy.

Online accessibility and ADA compliance increased in 2017. In October, they launched Part 1 and Part 2 of the Parenting with a Good Heart Online course. Over 300 participants completed at least one of the courses in the last quarter of 2017. The team took other measures to improve online accessibility. They added captioning to all videos and audio recordings; they chose user-friendly platforms for online offerings. They increased staff awareness about accessibility laws and decreased the amount of non-HTML content that was on the public website.

As described in the brief description of the target audience, new partnerships and program adaptations are making it possible to reach more parents with education that builds healthy, strong families.

MAES. 2017 research related to building strong, healthy families continued to focus on underserved populations and how new technologies are changing family dynamics and parenting. Several researchers are also focused on issues related to eldercare and aging. 2017 highlights included:

- A survey of 233 siblings related to online activity and how it affects sibling relationships revealed a significant positive correlation between social media communication and sibling closeness.
- Family social science researchers published a new textbook on discernment counseling titled, Helping Couples on the Brink of Divorce: Discernment Counseling for Troubled Relationships.
- In collaboration with the University of Wisconsin-Extension, the National Counsel on Family Relations, U of MN researchers created a database featuring information from 725 parent and family educators across the U.S. on their use of technology. This information, will inform models to support innovator practices by non-formal educators who are often overlooked.
- Researchers exploring the role African American grandmothers play in their grandchildren's success identified four themes that have little to no presence in current literature: 1) grandmothers as protectors, 2) grandmothers as direct advisor, 3) grandmothers as passing down ancestral legacy and 4) grandmothers as pushing family bonding.
- Minnesota researchers taking part in a multistate research project focused on elder financial exploitation interviewed and surveyed 28 family members, from 23 different family systems, affected by elder family financial exploitation. The interviews and survey data are being analyzed for patterns.
- Helen Kivnick, in large part due to her long-term NIFA supported research on aging and eldercare,

was named MN Gerontologist of the Year in 2017. She also published a new book titled, The Big Move: Life Between the Turning Points, which focuses on a first person-gerontologist account of the transition to a long-term care facility.

• In a study focused on exploring the prevalence and affect of parental disability in the child welfare system, 31 subject parents' case files were identified and analyzed. Study findings show there is still work to do in the child welfare system to serve parents with disabilities including accurately reporting on disabilities in case files and providing modifications to their services as required by the Americans with Disabilities Act.

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. 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.

To reach more underserved audiences in 2017, the team continued a partnership with the Mexican Consulate to reach rural Latino populations in rural areas. A new partnership with CLEARCorps and other community leaders is focused on safe and healthy homes. Other efforts to reach new populations include increased attention to ADA requirements and requests, increased free online accessibility of resources, and adapted curriculum for the cultures of men, women, transgender people, youth and seniors, Native Americans, Hispanic community members, low-income families, people who are incarcerated, families facing serious mental illness, military families, divorcing and separating parents, parents experiencing stress, and Southeast Asian Hmong families.

MAES. Target audiences for MAES funded research include teachers, social workers, community-focused city workers, young adults and youth and their families.

3. How was eXtension used?

• The Military Family Learning Network is a collaborative offering of eXtension and the Department of Defense. The U of M Extension Center for Family Development provides leadership for the Family Transitions concentration area of that offering.

• A Family Development educator co-taught an eXtension webinar with a colleague in U of M Extension Forestry on the topic of intergenerational land transfer.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	13453	396148	716	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	23	12	35

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of professionals trained to educate and support families.

Year	Actual
2017	7603

Output #2

Output Measure

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

Year	Actual
2017	761

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, or the significance level showing meaningful change in skills, depending on the evaluations methods used.)
2	Parents will improve their parenting practices. (Outcome is the significance level at which parents demonstrated they made meaningful change in behavior.)
3	Divorcing or unmarried parents will improve their co-parenting relationships in ways that are known to be effective in supporting positive child outcomes. (Outcomes expressed as percentage of participants who report improved communication, planning or resource sharing.)
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 is the significance level demonstrating that parents are making meaningful change in financial condition.)
5	Research will provide information and guidance to educators and school administrators that will help lower the achievement gap in the state.
6	Social work researchers will explore uncharted issues related to the effects of exposure to child physical abuse and intimate partner violence (IPV) on various family members and develop tools to provide training and professional development for practitioners (reported as the number of professional tools developed).

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, or the significance level showing meaningful change in skills, depending on the evaluations methods used.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	72

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To be successful renters, low-income heads of households must find housing that is right for their financial and family needs. They also need to know how to care for their unit and maintain good communication with landlords and neighbors to prevent eviction. Renting can be particularly challenging for individuals who have never rented before, have had a challenging rental experience or have barriers stemming from their life situation. Social service providers can deliver critical information about renting in a timely fashion.

What has been done
The RentWise program assures that local organizations with timely access to renters can easily deliver quality education and support. The RentWise Curriculum includes lesson plans, participant resources and more. Workshops train agency staff who use the RentWise curriculum, and culture and language-adapted workshops are delivered to Latino families.

Results
72 percent of professionals trained to deliver Rentwise programming reported they improved their skills in providing renter education, as well as their ability to teach tenant education. Data was based on matched evaluation data from 67 participant surveys. A total of 39 local agencies were trained to conduct the RentWise program, affecting renters in 20 neighborhoods and communities across the state.

4. Associated Knowledge Areas

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

805 Community Institutions and Social Services

Outcome #2

1. Outcome Measures

Parents will improve their parenting practices. (Outcome is the significance level at which parents demonstrated they made meaningful change in behavior.)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Divorcing or unmarried parents will improve their co-parenting relationships in ways that are known to be effective in supporting positive child outcomes. (Outcomes expressed as percentage of participants who report improved communication, planning or resource sharing.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	83

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Though divorce rates are declining, 26 percent of children currently live with a single parent (Pew Research Center, 2015). Divorce and separation contribute, along with other adverse childhood experiences, to the risk of poor health outcomes such as depression and suicide attempts (Dube, et. al., 2003). Co-parenting positively relates to "parenting and child adjustment" (Feinberg, 2009). For low-income families, "supporting co-parenting after relationship dissolution is associated with increased father involvement, which buffers against the negative effects of...dissolution" (Dush et. al., 2001).

What has been done
Parents Forever has been a vital parent education program for Minnesota's parents since 1994. The program reaches parents through referrals from court systems concerned about the effects of contentious divorce situations on children. The program is offered online and in person with trained trainers available in multiple community settings.

Results

The team collected data from 972 participants who completed a Parents Forever evaluation in 2017 (both online and in person). Participants responded to four questions assessing improvements after taking the class, describing their: 1) awareness of strategies to improve co-parenting relationships; 2) understanding of what a parenting plan is and how it can be helpful; 3) strategies to handle conflict with a co-parent; and, 4) strategies to communicate effectively with a co-parent. An average of 83 percent of participants reported improvement in co-parenting relationships as a result of the program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions and Social Services
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 is the significance level demonstrating that parents are making meaningful change in financial condition.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	42

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Those new to Minnesota and the U.S. are often unsure about how to navigate systems such as banking, insurance, and finding a place to live. Still, their dreams are typically American--to support their children, work, get out of debt and even start a business.

What has been done
A new agreement between the Consulate of Mexico in Saint Paul and University of Minnesota Extension includes funding for Protección al Patrimonio y Ventanillas de Asesoría Financiera

(Financial Education and Family Asset Protection Reference Desk). The agreement, the first between the Consulate and the University of Minnesota, was signed on July 21, 2017. The goal is to protect and empower Mexican nationals living abroad. Experienced bilingual educators offer classes or one-on-one sessions depending on the needs of the individual or family.

Results
Based on evaluation data from 177 participants who attended the workshop offered in this education series, participants reported a significant improvement from before the course to afterwards in the level of confidence they bring to their interaction with systems that protect personal and family assets (t=2.283, p=.024) and their confidence in managing and preventing debt (t=2.376, p=.019). An average of 42 percent of participants in the Mexican consulate program reported improvements in their behaviors related to credit scores, reducing debt and identifying scams and frauds.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
805	Community Institutions and Social Services

Outcome #5

1. Outcome Measures

Research will provide information and guidance to educators and school administrators that will help lower the achievement gap in the state.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Social work researchers will explore uncharted issues related to the effects of exposure to child physical abuse and intimate partner violence (IPV) on various family members and develop tools to provide training and professional development for practitioners (reported as the number of professional tools developed).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017 2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2016, approximately 3.5 million children were the subject of at least one report to Child Protective Services (CPS) and researchers estimate that seven million children live in families in which severe IPV occurred at least once in the previous year. However, studies on the effect of child maltreatment have largely focused on one child in the family--the child who is maltreated--and rarely account for how other children in the family experience the abuse.

What has been done
In addition to creating resources for professionals who work with children exposed to IPV, PI Lynette Renner and her team examined the academic outcomes of siblings exposed to child maltreatment.

This was done by looking at individual-level data from the Minnesota Department of Education and the Minnesota Department of Human Services. Specifically, they focused on exploring standardized reading and math scores and school attendance among children who experienced direct and indirect child physical abuse. Children were 8-10 years old at the time of the alleged maltreatment and outcomes were examined over four years.

Results
Overall, the study revealed the attendance and achievement of children involved with CPS decreased at significantly faster rates than those of their peers not involved with CPS. Most significantly, attendance and math and reading patterns were negatively affected. Additionally, they uncovered a lack of references to siblings of children who are maltreated early in the CPS case process. Most often, siblings were mentioned in case files when placement outside the home was deemed necessary but they were not often included in other aspects of the case.

Results have been shared via blogs, two Practice Notes and policy and research briefs on the Center for Advanced Studies in Child Welfare website. In particular, the site's Practice Notes series provides topical information to practitioners; and, this study's investigator encourages including siblings in service provision, as appropriate.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions and Social Services
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Populations changes (immigration, new cultural groupings, etc.)
- Other (new technology)

Brief Explanation

Extension. In 2017, the Center for Family Development implemented a new online reporting system for events called the Family Development Reporting Evaluation Dabatase (FDRED), a database entry system custom built by Extension's Information Technology unit. We believe that this reporting system allowed for easier data entry and is accurately capturing more event data than in previous years. In addition, demographic shifts continue to impact programming.

MAES. A planned research outcome (#5) was not reported on due to research related to lowering the achievement gap being moved to the Youth Development Program in 2016.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of Extension's family development programming spans the program-life cycle, with appropriate methods applied at each stage. After initial development, programs are improved by tapping information from surveys and evaluation scales. In 2017, this process was used to develop curriculum for the Department of Corrections to reach incarcerated fathers. After piloting, data informed further refinement of programming. When the program is more established, surveys informed tweaks to support participant learning, attitude changes and positive experiences with the program. Evaluation also monitors program effectiveness.

Consistent monitoring of program development is informing the development of new and improved courses offered in partnership with the Minnesota Department of Corrections.

Key Items of Evaluation

Participants are learning parenting and relationship skills while incarcerated and upon release. The workshops are based on three different curricula:

- Parents Forever, developed by University of Minnesota Extension
- Overindulgence: How is Too Much, developed by Jean Illsley Clarke
- Together We Can, developed by Michigan State University Extension

During this pilot year of the program, we will be collecting pre- and post-data, as well as session evaluations to capture impact and make adjustments to the curriculum before finalizing it.

V(A). Planned Program (Summary)

Program # 9

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	20%		60%	
806	Youth Development	80%		40%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	42.6	0.0	0.0	0.0
Actual Paid	41.7	0.0	4.7	0.0
Actual Volunteer	524.3	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**
1956111	0	176195	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
3989949	0	556393	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
8763766	0	293748	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

4-H programs at **Extension** are growing and changing to meet the needs and aspirations of today's Minnesota youth. Projects and activities are offered to build skills and tap passions in:

1. Science, Technology, Engineering and Math,
2. Citizen and Leadership,
3. Healthy Living, and
4. Animal Science

As noted in "target audience," 4-H continues to reorganize, reshape and rethink its outreach and programming to consider how to reach first generation 4-H families. Translated materials, new partnerships and changes in programming are all working together to help 4-H reach more of Minnesota's immigrant and minority families, as well as other communities that have not taken advantage of Extension in previous generations.

Adult learning efforts continue to train those working in the youth development field in Minnesota. Research investigates the components of quality youth programming, and evaluates how to best integrate those components into youth development experiences.

MAES supported research related to youth development focused on educating and empowering today's youth. Of the 11 projects mapped to this program, 91 percent concentrated on minorities and other underserved populations in Minnesota and around the world. Key issues like closing the achievement gap and STEM education continue to be priorities. 2017 highlights include:

• A study on education in developing countries found that Peru's education system increases inequality in student performance as students move through the system and Vietnam's does not.
• Researchers studying the effect of social networks on Hmong student achievement recruited a Citizen's Group comprised of five charter schools, five public schools, five small businesses, three parents and two clan leaders to help complete their study design. Based on their feedback, the first phase of the study tracks the students' academic performance. The second phase will involve interviewing the students' social networks. To date, 522 students (231 boys and 291 girls) in 3rd, 4th and 5th grades from five Hmong-focused charter schools have submitted surveys.
• In partnership with Headway Emotional Health Services, U of M researchers built the science infrastructure needed to conduct a study on mindfulness-based intervention for high-risk adolescents. Headway staff received training in the Learning to Breathe intervention and showed fidelity of implementation.
• Researchers working on teaching economics about the five NIFA priority areas to K-12 teachers reached 473 teachers in 108 Minnesota school districts in 2017. These teachers then taught 49,511 students.
• Researchers developed three new curricula related to teaching economics including a program titled, "How to Be Green While Staying in the Black: Teaching Sustainability Through on Economics Lens." Pilot studies of the three new curricula will take place in 2018.

2. Brief description of the target audience

Extension. Minnesota 4-H programs have a rich and long history with Minnesota's families, but since 2015, concentrated efforts have focused on welcoming youth whose families have never before participated in 4-H. Staff and volunteer programs, changed marketing and outreach initiatives, a focus on becoming welcoming, and changes in club activities are all working together to attract and retain first generation youth to the program. In 2017, over 6,500 4-H youth were first-year members. Of those, 45 percent reported this was the first time someone in their family had enrolled in 4-H. Moreover, 19 percent of these youth were youth of color.

MAES. Target audiences for MAES funded research include teachers, social workers, community-focused city workers, young adults and youth and their families.

3. How was eXtension used?

In 2017, 10 youth development educators reported they used eXtension as an informational resource. Two educators contributed blog posts for the site.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	11775	0	62265	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	5	5	10

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
2017	103

Output #2

Output Measure

- Percentage of parents of youth participants who report being satisfied with their first year of

participating in 4-H programming, thus making long-term engagement more feasible.

Year	Actual
2017	81

Output #3

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
2017	4961

Output #4

Output Measure

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

Year	Actual
2017	71

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 who report that they increased their understanding and knowledge of a given youth development topic.
4	Youth in 4-H will build connections with peers, adults and communities.
5	University of Minnesota Extension Specialists and researchers will take part in events that inspire future generations to action around STEM education and solving the world's largest challenges (Reported as the number of students attending event).

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
2017	95

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Youth participation in after-school programs is linked to better school attendance, better grades and test scores, a more positive attitude toward school work, higher aspirations for college, better work habits, better interpersonal skills, and reduced dropout rates. (University of Minnesota, 2006). Structured out-of-school time helps youth develop "21st century skills".

What has been done
4-H programs have established the goal to increase learning by tapping the passions of youth and enhancing leadership skills. In 4-H clubs, youth explore a host of opportunities and engage in hands-on learning opportunities. The Minnesota 4-H Learn and Lead Evaluation measures the extent to which youth are gaining skills through 4-H programs. Two surveys were implemented in 2017 to pilot this new measure. One was conducted with 179 alumni and one was piloted with 102 current 4-H youth. The quantitative outcome above reflects an average of outcomes discovered in this evaluation.

Results
For 4-H alumni, key results show that 99 percent of youth made decisions for themselves in 4-H

and 100 percent mastered a topic; 94 percent held a formal leadership position; 95 percent took part in a service project; 83 percent fixed a community problem. Of current 4-H'ers, 98 percent tried new things; 98 percent made decisions for themselves, 92 percent solved problems together in a group; 89 percent learned about people who were different than them. Finally, 100 percent identified a project that was important to them.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. Outcome Measures

Adult participants in educational offerings who report that they increased their understanding and knowledge of a given youth development topic.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	98

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To engage with youth successfully, adult volunteers benefit from a deep understanding of youth development and the characteristics of quality youth development programming. They need to be orientated to program goals and ways they can intentionally welcome and integrate 4-H members from across many cultures and interests.

What has been done
Local, regional, and statewide training helps youth workers and 4-H volunteers focus on knowledge and skills that make programming more successful. This includes training about youth development, the 4-H mission and programmatic direction, cultural lenses, creating welcoming environments, and resources available to help volunteers succeed over time.

Results
The quantitative outcome above reflects the average response of all 4-H training. Adult volunteers consistently reported learning outcomes: a deeper understanding of youth development topics, an ability to identify components of vibrant youth groups, new ideas for utilizing youth and adults in volunteer roles, an ability to explain the value of a club leadership team, confidence in asking

others to lead, and an intention to share what they learned from others. Participants in risk management programs reported they could confidently use tools and information to plan safe youth activities and agreed that they understood their role when it comes to managing risk when planning 4-H program activities.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Youth in 4-H will build connections with peers, adults and communities.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	96

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
At-risk young adults who have a mentor are 55 percent more likely to enroll in college, 78 percent more likely to volunteer regularly, and 130 percent more likely to hold leadership positions. One study estimates that the human potential lost as a result of the educational achievement gap is the economic equivalent of a permanent national recession. By preparing young people for college and careers, mentoring helps develop the future workplace talent pipeline (mentoring.org).

What has been done
Youth in 4-H investigate careers that are connected to their passions. Minnesota 4-H Science of Agriculture is an example of a program that prepares youth for science and technology-based careers. Participants partner with industry professionals and other supportive adults who mentor youth as they innovate marketable solutions for real and pressing needs in their communities.

Results
96 percent of youth in 4-H built connections with mentors and industry leaders through the 4-H Science of Agriculture Challenge program. These intentional connections become even more

impactful as clubs reach new populations and first generation 4-H families. In 2017, 45 percent of participants reported this was the first time someone in their family had enrolled in 4-H, and 19 percent of those youth were youth of color.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #5

1. Outcome Measures

University of Minnesota Extension Specialists and researchers will take part in events that inspire future generations to action around STEM education and solving the world's largest challenges (Reported as the number of students attending event).

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	150

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
By 2050 the world's population will grow to 9 billion requiring a 70 percent increase in food production. A key component of solving how to feed more people with less land is tied to inspiring future generations to take on the challenge of becoming hunger fighters.

What has been done
The Minnesota Youth Institute (MNYI) is a life-changing experience at the University of Minnesota where high school students are encouraged to think critically about local and global hunger issues. During the one-day event, the students engage with local leaders, experts and industries on critical global challenges, participate in hands-on STEM activities and explore exciting ways to make a difference in Minnesota and around the world.

Results
Seven Extension specialists and MAES supported researchers participated as experts at the MNYI on May 15, 2017. In total, 150 students and their teachers representing 12 schools participated. Of them, nine were chosen to take part in the Global Youth Institute in Des Moines,

Iowa and one won a paid internship to work on rice breeding in India for 8 weeks. Additionally, three MN students are being interviewed for the international paid internships in 2018.

By connecting with high school students, our experts are able to inspire future generations around STEM and encourage them to think critically about how we (and they) can help solve critical challenges and make a difference in the world.

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

- Other (insufficient data)

Brief Explanation

To measure the effects of 4-H on higher education, the program intended to use National Student Clearinghouse data. Unfortunately, problems with data matching provided erroneous data that cannot be used. perhaps because 4-H youth are not enrolling with full names or legal birth dates, or because some colleges do not share data for all students enrolled.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Statewide evaluation of 4-H programs uses surveys of first-year members to get feedback from parents of first-year members, alumni evaluation to collect retrospective feedback on program experiences and state fair evaluation to report feedback on the state fair experience. The Learn and Lead Evaluation measure was developed in Minnesota to assess the state's 4-H program outcomes and indicators. The measure dives into the learning and leadership experiences that we hope young people achieve in their time with 4-H. Items were developed to measure both short- and medium-term outcomes from the logic model.

"21st Century Skills" is a term used to refer to certain core competences such as communication, collaboration, critical thinking and problem solving that youth development advocates believe are essential for youth to be fully prepared to thrive in today's world. Youth development organizations can play a key role in youth's ability to practice 21st Century skills because they are not solely focused on academic success like many K-12 institutions. Out-of-school time programs help youth grow these skills through hands-on experience and leadership roles.

These evaluations show that 81 percent of parents are satisfied with their family's 4-H experiences. This is positive because we know from research that first-year club members have the highest drop-out rates. A majority of 942 youth reported having a supportive, fun

and productive time at state fair. Alumni reported useful and positive experiences retrospectively, and youth reported learning by developing a passion in their area of interest, and opportunities to lead by being innovators and social change agents.

Key Items of Evaluation

Evaluations show that 81 percent of parents are satisfied with their family's 4-H experiences. This is positive because we know from research that the first year has the highest drop-out rate. A majority of 942 youth reported having a supportive, fun and productive time at state fair. Alumni reported useful and positive experiences retrospectively, and youth reported learning by developing a passion in their area of interest, and opportunities to lead by being innovators and social change agents.

V(A). Planned Program (Summary)

Program # 10

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
123	Management and Sustainability of Forest Resources	10%		20%	
124	Urban Forestry	10%		10%	
125	Agroforestry	10%		10%	
133	Pollution Prevention and Mitigation	10%		20%	
134	Outdoor Recreation	10%		10%	
136	Conservation of Biological Diversity	10%		20%	
605	Natural Resource and Environmental Economics	15%		10%	
903	Communication, Education, and Information Delivery	25%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	12.4	0.0	12.9	0.0
Actual Paid	18.1	0.0	35.2	0.0
Actual Volunteer	43.8	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
868437	0	231173	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2270148	0	2605682	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
954865	0	3759017	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. With over 17 million acres of forest along with rivers, lakes and prairies, Minnesota provides a unique location for conducting research related to managing and protecting natural resources. Research in this program area focuses on protecting the diversity of Minnesota's forests, wildlife and native plants as environmental conditions shift in the state. 2017 highlights include:

- Researchers developed an Urban Tree Canopy map for the Twin Cities Metro area. The map will assist with monitoring the extent and health of urban trees which impacts water quality, storm water runoff, phosphorous loading from leaf fall and the urban heat island effect.
- The U.S. Fish and Wildlife Service used information and data from a census coordinated by University of Minnesota researchers to develop new policy recommendations to manage of Double-crested Cormorants.
- A new study published on investigating the effects of white-tailed deer populations on the regeneration of tree species across the northern U.S., will help to refine modeling approaches that integrate forest disturbance scenarios.
- Researchers looking at pollinator conservation strategies in prairies collected nearly 12,000 individual native bee specimens from 16 restoration sites and five prairie remnants. They also collected 7,000 floral plant specimens. Identification of both the bees and plants collected will be completed in 2018.
- A new forest restoration project is assessing a method to keep buckthorn at bay by reseeding recently treated plots with native plants. With careful monitoring, such projects might provide the knowledge needed to not only keep buckthorn at bay but also restore MN forests.
- Researchers have developed new statistical methods for estimating the size and density of wildlife populations. These new methods have resulted in more precise estimates of population size that leads more accurate information for developing management strategies.
- A survey of members of the Minnesota Logger Education Program found that 76 percent of respondents plan to maintain or increase their volume harvest soon but only 20 percent indicated they would encourage a close family member or friend to become a logger. Data from Wisconsin and Michigan will be combined with the Minnesota data in 2018 to create a Lake State composite of the logging business.
- A collaborative study with researchers from Minnesota, Australia, Canada, Spain, China and elsewhere cracked the mystery of leaf size and was published as a cover story in Science. By analyzing over 7,600 species, the researchers found the key-limiting factor for leaf size is night temperature and the risk of frost damage to leaves.
- Researchers discovered the Vegetarian Finch, one of the acclaimed Darwin's finches of the Galapagos Islands, is under threat from a parasitic fly (Philornis downsi). Now ten of the 13 species of Darwin's finches are in decline on the island.

In 2017, **Extension** mobilized 2,006 trained volunteers who contributed 91,174 hours to citizen science projects. These volunteers created impacts as they restore and conserve public lands, and mobilized to find and report infestations of a newly concerning Poison Hemlock plant in Minnesota.

The Natural Resources team also organized two cohorts of Master Woodland Owners in the Laurentian and North Shore regions of Minnesota. Its 82 participants learned sustainable forestry practices that are being applied on 3,722 acres of forestland.

The agroforestry team continues to create institutional change in state and local agencies, facilitating the use of silvopasture as an agroforestry practice that integrates livestock, forage production, and trees into an intensely managed system. A new manual on the subject educates agency staff as they assess the role of silvopasture in ecological restoration projects. Agencies trained this year were the Minnesota Department of Natural Resources, Bureau of Water and Soil Resources, the Great River Greening, and the Anoka Sand Plain Restoration initiative.

2. Brief description of the target audience

MAES research and Extension programs reach: 1) Concerned citizens and volunteers who are willing to be trained and serve in a variety of roles as citizen teachers and scientists; 2) Minnesota professionals from within Extension, the Minnesota Department of Natural Resources, Soil and Water Conservation Districts, US Fish and Wildlife Services, Health and Human Services Departments, and Environmental Sciences; 3) the public schools and others involved in environmental science education programs; and, 4) Youth on the White Earth Reservation in Northwest Minnesota, when funding allows.

In 2017, Extension continued its partnership with the Leech Lake Band of Ojibwe to improve the health and well-being of the Band's members by securing indigenous food supplies, reviving traditional Anishinaabe agricultural practices and protecting the Reservation's natural resources.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12042	636526	465	0

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

Patent Applications Submitted

Year:	2017
Actual:	4

Patents listed
Methods for Microbial Screening and Identification: 62/480,242 - Mar. 31, 2017
Enhanced Filtration Through Compression of Compressible Sorbent: 62/444,520 - Jan. 10, 2017
Methods of Separating Microbes from Samples: 62/480,236 - Mar. 31, 2017
Porous Nanocomposites Sorbents for Multipollutant Capture: 62/476,166 - Mar. 24, 2017

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	16	47	63

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Master Naturalists trained and supported in Minnesota.

Year	Actual
2017	1295

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of hours that volunteers and others involved in programs commit to exploring and conserving the environment, and to teaching others about the environment and environmental stewardship.
2	Number of acres influenced each year by citizens who, through exploration, conservation and education, influence environmental conditions.
3	Infestation of forests by the Poison Hemlock plant was prevented.
4	Researchers will develop new tools to assist with the rapid detection of tree diseases (reported as the number of new tools developed).
5	Researchers will provide new information regarding the susceptibility of pine forest stands in the region to new pests and diseases that will assist forest managers prepare for environmental changes (measured as the percent of forest stands deemed susceptible).

Outcome #1

1. Outcome Measures

Number of hours that volunteers and others involved in programs commit to exploring and conserving the environment, and to teaching others about the environment and environmental stewardship.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	91174

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Citizens who care about the environment can connect valuable information to individuals and groups as they make decisions that affect local ecosystems. Citizen scientists can also educate others about science and science-based solutions.

What has been done
Extension recruits, trains and supports volunteers who find projects that benefit communities. The Minnesota Master Naturalist Volunteer Training Course consists of 40 hours of in-classroom training. The classroom training includes a variety of teaching methods, lectures, PowerPoints, hands-on activities, videos and field trips that provide the participants with information on Minnesota's natural history. The course is designed to be a general overview of Minnesota's three biomes. Each class series focuses on one of the three biomes: Big Woods, Big Rivers; Prairies and Potholes; and North Woods, Great Lakes.

Results
In 2017, 1,295 volunteers reported a total of 85,369 service hours contributed to statewide Minnesota environmental stewardship. Volunteers made an impact on 1,044,809 acres by supporting and informing restoration and conservation management on public lands, collecting data and delivering environmental education. For example, a large group of Minnesota Master Naturalist volunteers gathered on National Public Lands day to contribute a day of service. A group of 227 volunteers contributed 1,037 hours of service to mitigate invasive species and assist with sustainable forest and rangeland management at 12 sites across Minnesota, including federal, state and municipal public lands and one military installation.

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
134	Outdoor Recreation
136	Conservation of Biological Diversity
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Number of acres influenced each year by citizens who, through exploration, conservation and education, influence environmental conditions.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1044809

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Managing local ecosystems requires diligence on the part of landowners and concerned citizens. Citizens who understand how to prevent harm and support healthy landscapes can be on-the-ground resources as private landowners and public managers make decisions that affect ecosystems.

What has been done
Extension recruits, trains and supports volunteers who find projects that benefit communities. In 2017, 1,295 volunteers reported a total of 91,174 service hours to statewide environmental stewardship.

Results
Volunteers had an impact on 1,044,809 acres by supporting and informing restoration and conservation management on public lands, collection of citizen scientific data and public

environmental education. (See description of issue and activity in outcome #1.)

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Infestation of forests by the Poison Hemlock plant was prevented.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2017, there was new concern about the Poison Hemlock plant in Minnesota. This plant is highly poisonous to humans and some animals.

What has been done
Project team members developed and disseminated resources to train volunteers in how to identify Poison Hemlock. They trained and supported a network of volunteer First Detectors to look for and report infestations.

Results
Volunteers identified the presence of poison hemlock in 14 additional counties in southern and central Minnesota. These counties are now working to manage and mitigate spread. There is evidence that this work may have saved at least one life when a gardener used Extension resources to positively identify and confirm poison hemlock growing in a carrot patch where owners assumed it was a large carrot. When the plant was discovered and reported in Rochester, adjacent to the Olmsted County Waste to Energy facility, Extension's follow-up prevented the introduction of poison hemlock seeds into Rochester's municipal compost stream, thus preventing broad infestation in this regional center of 114,000 people.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Researchers will develop new tools to assist with the rapid detection of tree diseases (reported as the number of new tools developed).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Next to Dutch elm disease, oak wilt fungus is the second greatest threat to Minnesota's plants. The USDA forest service has verified oak wilt fungus in 21 eastern states and between 2006 and 2016 it infected over 266,000 oak trees in Minnesota.

What has been done
Abdennour Abbas and his team recognized the need for a faster, more accurate and less expensive tool to detect oak wilt fungus in the field. The technology currently available only allows for visual observation two-to-three weeks after infection or expensive lab tests that can take up to two weeks. If they could create a tool that could provide an accurate positive test field works might have time to apply treatments to save the tree.

Results
The team developed a new tool that combines three technologies: one to extract the fungus from wood chips, one to extract DNA and one to analyze the DNA. Using nanotechnology and gold, a signal appears on a handheld reader if oak wilt fungus is present. Notably, the test takes less than 30 minutes and only costs about five dollars per sample. Currently, the technology can only be performed in this lab, but they are working to make it portable for fieldwork and for detecting other tree diseases.

Quick and inexpensive detection of oak wilt fungus could not only save trees but also save the

state millions of dollars in costs to remove dead trees and replace them.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
124	Urban Forestry
136	Conservation of Biological Diversity
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Researchers will provide new information regarding the susceptibility of pine forest stands in the region to new pests and diseases that will assist forest managers prepare for environmental changes (measured as the percent of forest stands deemed susceptible).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	90

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mountain pine beetle (MPB) is native to western Canada but it recent years has expanded beyond its historical range and has destroyed millions of acres of trees across British Columbia and the Rocky Mountain National Park.

What has been done
Marcella Windmuller-Campione and her team set out to assess the susceptibility of pine forests in the Lake States to MPB. They developed a hazard rating system for the Great Lakes Region that uses common attributes of forest structure and composition and have assessed the current susceptibility using the Forest Inventory and Analysis (FIA) database.

Results
Results show that about 90 percent of FIA plots with at least one living pine tree are moderately to highly susceptible to MPB. Plots with a higher susceptibility had greater total plot density and

pine density, while lower susceptibility was associated with greater tree diversity within the plot. Notably, plots on federally owned lands also were more highly susceptible than private and state-owned plots.

This information will assist forest managers as they develop silvicultural prescriptions and plan for the arrival of mountain pine beetle to the region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None)

Brief Explanation

None

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Natural Resource teams routinely evaluate whether their education of volunteers has resulted in quality engagement with environmental issues. In a 2017 survey of 273 people who attended Minnesota Master Naturalist biome education courses, 40 percent reported they plan to start or increase their volunteer time; 22 percent plan to increase their participation in outdoor recreation activities, and 15 percent plan to change management practices on their land.

Key Items of Evaluation

In a 2017 survey of 273 people who attended Minnesota Master Naturalist biome education courses, 40 percent reported they plan to start or increase their volunteer time; 22 percent plan to increase their participation in outdoor recreation activities, and 15 percent plan to change management practices on their land. Volunteer programs managed by Extension in 2017 created 91,174 hours of time to environmental concerns. Trained Master Naturalists affected 1,044,809 acres of land, and supported the control of a new dangerous infestation of Poison Hemlock in Minnesota.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: National Science Foundation, State Wildlife Grants Program, U of MN Grant-in-Aid and the Minnesota Environmental and Natural Resource Trust Fund.

V(A). Planned Program (Summary)

Program # 11

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	14.4	0.0	37.5	0.0
Actual Paid	18.7	0.0	63.3	0.0
Actual Volunteer	69.8	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
823466	0	469473	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2223717	0	5760388	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1119934	0	5637153	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supports horticultural research for fruit, vegetables and ornamental plants and turfgrasses. Research in these areas includes breeding new crop varieties, exploring new management practices and technologies and studying pests and disease affecting the horticultural industry.

• A study revealed grass seed producers in northern Minnesota can obtain economically viable perennial ryegrass seed yields in second year production fields if the fields are properly managed post-harvest. Specifically, the study found burning or mechanically removing debris after harvest resulted in good seed yields.
• Researchers identified a novel mode of pararetrovirus infection associated with widespread disease of ash.
• The new white wine cultivar 'Itasca', first reported on in the 2016 report, became available for purchase in 2017. To date, about 40,000 vines have been sold across the U.S.
• A field study looking at the effect of imidacloprid on bumblebee colonies found they were negatively affected by 20 ppb imidacloprid. This is less than the 25 ppb identified by the EPA in March 2016.
• Researchers developed a new method to provide discrete plant tissues for indole-3-acetic acid quantification, while preserving the plant tissue in the best possible condition to prevent auxin degradation.
• Turfgrass researchers developed a series of best management practices (BMPs) for salt-tolerant turfgrass on Minnesota roadsides. An earlier mixture developed at the University for MnDOT, MNST-12, led to a series of installation failures and revealed a need for distinction BMPs for salt-tolerant grass installations on roadsides.
• Researchers discovered viable sexual fruiting bodies of hop powdery mildew on hop seeds collected from wild plants. This discovery could lead to increased restrictions on the movement of hop seeds domestically and internationally.
• Surveys of tomato viruses found the major virus affecting Minnesota tomato samples is Tomato mosaic virus. Notable, this virus had not been reported as a major problem in U.S. fresh market tomatoes from Florida and California. These results highlight the importance of surveys to identify prevalent viruses and the need to share findings with farmers.
• A study looking at the best practices related to nitrogen (N) and irrigation in potato fields showed no significant difference in yield between controls and six N-treatments. This study shows best management practices could lead to increased profitability while reducing environmental impacts.
• A consumer preference study related to consumers' willingness to pay more for aquaponically grown lettuces found the 90 participants did not significantly change their bids based on production method. This could negatively affect aquaponic producers planning to sell their product at a premium.
• A new study has successfully revealed the parentage of the Honeycrisp apple. Due to an error in record keeping in the 1970s, Honeycrisp's parents have been a mystery since its release in 1991. But,

thanks to advances in DNA testing, researchers confirmed Honeycrisp is the child of Keepsake and MN1627 (an unreleased U of MN selection).

Extension horticulture programs use horticultural research to increase profitability for fruit and vegetable producers, and to mobilize volunteers to support those who create and maintain green space. The team works through community partnerships to organize initiatives that prevent harm to lawns, gardens and crops. Beyond usual programming, the team undertook two major initiatives in 2017:

1. Clubroot of cabbage was identified as an emerging disease problem in Minnesota in 2016 and 2017. Scouts from the Minnesota Department of Agriculture identified the disease in community gardens in some but not all counties scouted. An educator identified research-based management options for affected gardens that would reduce disease problems and prevent spread of the disease to new sites. This information was shared through the Yard and Garden News blog (1,316 views), as a web publication, and was provided to gardeners at affected sites.
2. The horticulture team developed a survey to help people determine whether their landscape is pollinator friendly. The survey was completed by 655 people, giving Extension educators and Master Gardeners a better sense of what efforts are needed to help people create pollinator-friendly landscapes, including increasing plant diversity, supporting ground nesting bees, eliminating the use of pesticides and increasing the number of months in which they have blooming plants.

2. Brief description of the target audience

Horticulture educators and specialists and volunteers reach:

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.
2. Consumers of horticultural information for yards, gardens and landscapes.
3. Community volunteers who can educate and act to keep yards, gardens and green spaces healthy.

In 2017, educators and specialists served in leadership positions for the Immigrant and Minority Farmers' Conference. This gave Extension new insights and connections, allowing them to better communicate with, partner with and educate immigrant farmers. Due to this and other efforts, 13 percent of Horticulture program participants were persons of color.

3. How was eXtension used?

Educators supported eXtension by responding to appropriate Ask an Expert questions.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	236962	8444467	50584	0

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

Year:	2017
Actual:	1

Patents listed
Grapevine Plant Named "Itasca": 15/530,394 - Jan. 9, 2017

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	34	54	88

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
2017	2400

Output #2

Output Measure

- Number of new fruit, vegetable and ornamental plant varieties sent for additional testing outside the University.

Year	Actual
2017	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of Horticulture program participants that changed one or more horticulture practice as a result of attending Extension events.
2	Research will support new horticultural crops' growth.
3	Number of volunteer hours committed to providing Master Gardener training and expertise in order to create and improve Minnesota's green spaces.
4	Percentage of beekeepers who participate in programs who self-report they've changed their beekeeping practices to better support the bee population.
5	High tunnel owners and managers use new technology to manage diseases.
6	Researchers will uncover key chemical and morphological characteristics of trees responsible for their increased resistance to diseases (reported as the number of characteristics discovered).

Outcome #1

1. Outcome Measures

Percentage of Horticulture program participants that changed one or more horticulture practice as a result of attending Extension events.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Research will support new horticultural crops' growth.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Since its arrival in 2012, the spotted wing drosophila (SWD) has been one of the most damaging invasive species in Minnesota agriculture. SWD has damaged locally grown small fruit crops, shortened pick-your-own seasons, increased pesticide use and reduced incomes for producers.

What has been done
Bill Hutchison and his team are exploring several management practices to help Minnesota small fruit growers deal with this devastating threat. Included in their studies have been fruit preference tests, comparing the effectiveness of various insecticides and exploring how plastic and/or exclusion netting on high tunnels (HT) might assist in keeping these small pests at bay.

Results
2017 research trials documented 98-100 percent reductions in SWD numbers and/or berry infestations using a HT approach in both raspberry and grapes (this included using a traditional plastic cover on top and ventilated exclusion netting on the sides and ends).

Researchers and extension specialists are sharing these results with growers, along with best

practices, and are working on updated cost estimates to help local growers decide if this will be a useful management option for their needs.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Number of volunteer hours committed to providing Master Gardener training and expertise in order to create and improve Minnesota's green spaces.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	145134

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Gardens and green space in communities and homes promote healthy landscapes, healthy foods and healthy lives. While green spaces are gaining popularity in American culture, the skills to create and sustain green spaces are no longer a fundamental skill acquired in homes and schools. Trained volunteers can fill that gap and strengthen skills in landscape management among community members.

What has been done
Master Gardeners teach and act upon University research-based information about horticulture in local communities. They strengthen community bonds, support healthy choices and promote healthier plants for more livable communities. The activities of Master Gardeners benefit schools, community gardens, youth programs, environmental education programs and farmers markets, to name a few.

Results

Master Gardeners installed 14 rain gardens (26,310 square feet) and installed 45 pollinator gardens (17,886 square feet). Groups donated 41,379 pounds of produce to food banks and pantries, worked with 103 school-based gardens and assisted with 40 Habitat for Humanity homes. Several standout outcomes happened in 2017. Work with urban teens in Hennepin County tied gardening, cooking and business skills. The program inspired a group of budding entrepreneurs to develop a recipe for green tomato cakes. The teens ultimately started a Green Garden Bakery, which creates and markets vegetable-based desserts. The entrepreneurs won the youth division of the annual Minnesota Cup entrepreneur competition. Master Gardeners in Goodhue County turned a large rain garden into a living classroom for educational events.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants

Outcome #4

1. Outcome Measures

Percentage of beekeepers who participate in programs who self-report they've changed their beekeeping practices to better support the bee population.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Honey bees play a keystone role in the productivity of agriculture and the beauty of our world by pollinating fruits, vegetables, nuts and flowers. However, in recent years, honey bees populations are not surviving as well as they used to, and beekeepers are seeking new information to help keep their hives healthy.

What has been done
Over the last several years, Marla Spivak and her team have been exploring how honey bees keep themselves healthy through social immunity. Among their focuses has been uncovering information of the value of the antimicrobial properties of propolis (plant resins) within hives.

Results
Research results showed colonies that construct a propolis envelope in the nest cavity have more efficient immune function due to fewer microbes in the nest.

Beekeepers are taking notice of these recent research discoveries and are starting to encourage bees to construct a propolis envelopes within their hives. This represents a major change in perception and behavior as beekeepers have long considered propolis to be a sticky nuisance within colonies.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

High tunnel owners and managers use new technology to manage diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	87

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Minnesota is a national leader in high tunnel use for local food production, with over 1,500 tunnels in production. Tomatoes are the highest value crop grown in high tunnels. Each 2,100 square foot high tunnel planted provides growers an average income of $12,000. Despite protection from environmental hazards, high tunnels often have humid, warm conditions and densely planted crops. These conditions favor development of plant diseases.

What has been done
Over the past two years, researchers and Extension personnel at the University of Minnesota have collected plant disease samples from high tunnels across the state in order to identify plant diseases most prevalent in Minnesota high tunnels. Over 200 disease samples were collected for diagnosis. Common diseases were identified, and a field manual for the identification and management of those diseases was produced and distributed through Extension-led educational opportunities for high tunnel growers across Minnesota.

Results
Research resulted in the dissemination of effective management tools for growers. In pre- and post-session evaluations of Extension education, high tunnel managers reported they came to understand how pathogens were brought into a high tunnel (increased from 17 to 87 percent), understood how environment affects plant disease (increased from 28 to 87 percent), and understood how to use sanitation for disease control (increased from 22 to 87 percent).

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Researchers will uncover key chemical and morphological characteristics of trees responsible for their increased resistance to diseases (reported as the number of characteristics discovered).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dutch elm disease (DED) remains the most devastating invasive tree disease to affect Minnesota. Despite extensive research on DED, it remains unclear what mechanisms allow certain elms to be resistant while others are susceptible.

What has been done
Five cultivars and two populations of American elm (3 and 4 years old) were examined for differences in their abilities to compartmentalize and resist infection. The trees were assessed multiple times for disease severity on a 1-12 scale, based on the percentage of permanent wilt in their crown and microscopic analyses of the host-parasite interaction.

Results
Cultivars differed in their ability to compartmentalize infection. The two cultivars that most consistently limited the spread of infection by walling off the pathogen enabling the tree to continue to grow were 'Prairie Expedition' and 'Valley Forge'. 'Valley Forge,' in particular, used two mechanisms (1) restricting the spread into newly formed xylem and (2) consistently limiting the tangential spread.

Understanding the characteristics that some cultivars have to resist and limit infection is a key component to assist in the evaluation of other cultivars and could, ultimately, lead to this classic American tree relining our streets.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
211	Insects, Mites, and Other Arthropods Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Competing Programmatic Challenges

Brief Explanation

For outcome #4 we reported on an action change however Extension evaluation did not track the percentage of beekeepers adapting this specific practice.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension's horticulture team carefully monitors its ability to attract, train and retain volunteers, and to respond to critical issues in the yard and garden. Volunteers track their contributions, and Master Gardener programs in every county track the benefits of these volunteers to green spaces in communities.

In 2017, Master Gardeners contributed 145,134 hours to community initiatives. That is the equivalent of 70 full-time equivalent staff. Master Gardeners installed 14 rain gardens (26,310 square feet) and installed 45 pollinator gardens (17,886 square feet). Groups donated 41,379 pounds of produce to food banks and pantries, worked with 103 school-based gardens and assisted with 40 Habitat for Humanity homes. Several standout outcomes happened in 2017. Work with urban teens in Hennepin County tried gardening, cooking, and business skills, and inspired a group of budding entrepreneurs to develop a

recipe for green tomato cakes, and then to start a Green Garden Bakery, which creates and markets vegetable-based desserts. The entrepreneurs won the youth division of the annual Minnesota Cup entrepreneur competition. Master Gardeners in Goodhue County turned a large rain garden into a living classroom for educational events.

For outcome #4 we reported on an action change however Extension evaluation did not track the percentage of beekeepers adapting this specific practice.

Key Items of Evaluation

Extension. In 2017, Master Gardeners contributed 145,134 hours to community initiatives. That is the equivalent of 70 full-time equivalent staff. Master Gardeners installed 14 rain gardens (26,310 square feet) and installed 45 pollinator gardens (17,886 square feet). Groups donated 41,379 pounds of produce to food banks and pantries, worked with 103 school-based gardens and assisted with 40 Habitat for Humanity homes. Several standout outcomes happened in 2017. Work with urban teens in Hennepin County tied gardening, cooking, and business skills, and inspired a group of budding entrepreneurs to develop a recipe for green tomato cakes, and then to start a Green Garden Bakery, which creates and markets vegetable-based desserts. The entrepreneurs won the youth division of the annual Minnesota Cup entrepreneur competition. Master Gardeners in Goodhue County turned a large rain garden into a living classroom for educational events.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: Rapid Agricultural Response Fund, MN Invasive Terrestrial Plants and Pests Center, USDA- NRI and Minnesota Department of Agriculture Crop Research Grant Program.

V(A). Planned Program (Summary)

Program # 12

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	20%		25%	
602	Business Management, Finance, and Taxation	20%		20%	
603	Market Economics	20%		20%	
604	Marketing and Distribution Practices	20%		20%	
610	Domestic Policy Analysis	20%		15%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	8.4	0.0	11.5	0.0
Actual Paid	21.3	0.0	23.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
874029	0	319982	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2701256	0	2378554	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1257728	0	3456860	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. With continued low commodity prices in 2017, the Ag Business Management program team focused on helping farmers maximize profitability and protect assets. Ongoing efforts included farmland rental education, marketing clubs, farm transition and estate planning. The newer program on Taking Charge of Your Finances: How to Survive and Thrive continued, along with special programming for women in agriculture. Leadership for Successful Employee Management, a new labor management program, launched its first cohort in 2017.

MAES. Research reported under this program focuses on improving the sustainability and profitability of Minnesota's food system. A particular focus is on assisting small and medium sized farms and discovering new technologies to help optimize agricultural systems. 2017 highlights include:

- A study that found the use of a grazing muzzle reduces horse forage intake by 30 percent has inspired research across the U.S. and Europe looking at behavior of muzzles with horses and ponies.
- The Center for Farm Financial Management worked with educators in partner states to support their educational efforts and provide the training to make the National Farm Business Management Benchmarking Database accessible to producers and educators across the nation. To date, the database houses complete financials for 3,443 farms representing ten partner farm management education programs.
- A new robotic milking system investment decision-support tool assisted dairy farmers to consider the economics of robotic milking compared to conventional milking parlors. Nine hundred sixty-seven users accessed the tool in 2017.
- Researchers used drones and reflectance data to help identify the stressors affecting soybeans in Minnesota fields. Experiments were conducted at the Rosemount and Northwest ROCs and could differentiate between damage by soybean aphid and Brown Stem Rot.

2. Brief description of the target audience

New outreach in 2017 focused on women in agriculture, with programming events throughout the year. Target audiences for Ag Business Management programs include:

- Minnesota's farmers who are facing life or business transitions
- Farm business management associations
- Agricultural leaders
- Other agricultural professionals (e.g., crop consultants)
- Farm business management educators
- State and federal policy makers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	6463	86385	19	0

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

Patent Applications Submitted

Year: 2017

Actual: 1

Patents listed

Integrated Remote Sensing Tools for Timely Predictions of Crop Quality and Yield: 15/663,112- July 28, 2017

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	26	26

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational events.

Year	Actual
2017	140

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of participants that change one or more business management practice as a result of attending an Agricultural and Business Management workshop or conference session.
2	Dollar amount of profitability increased as a result of agricultural business decisions made after receiving Extension information.
3	Family farm assets are protected.

Outcome #1

1. Outcome Measures

Percentage of participants that change one or more business management practice as a result of attending an Agricultural and Business Management workshop or conference session.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Dollar amount of profitability increased as a result of agricultural business decisions made after receiving Extension information.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	6113580

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
About 90,000 land owners and dairy farmers produce food in Minnesota. These producers make difficult management decisions that must respond to market forces, public policy shifts and personal life circumstances. Focused education and research from Extension can inform these decisions. In 2017, these market forces include continued low prices for commodities and fluctuating rental value for farmland.

What has been done
Extension organized southern Minnesota marketing groups of farmers who agree to work together over an extended time period to market the agricultural products they produce.

Results
From 2004 through 2015, farmers in marketing groups averaged 5 cents per corn bushel marketed more than the average price received by their peers and 24 cents per soybean bushels. This would translate into a total benefit on 88,300 bushels of corn sold and 20,200 bushels of soybeans sold each year per farm. This is a total of $9,263 per farm per year more income than their peers.The total per farm over 12 years would be $111,156. For all 55 farms, the increased

revenue above their peers would total $6,113,580.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Family farm assets are protected.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	58600000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The business and personal assets of those who produce the world's food supply are threatened by critical issues such as long-term health care and succession planning, especially as baby boomers age.

What has been done
Extension educators and faculty have designed and routinely deliver educational workshops that help producers and families plan for farm transition and estate planning. A total of 145 farm family members attended workshops about farm transfer, representing 73 farm units and four non-farm businesses from 54 different Minnesota communities.

Results
In a post-program survey, participants reported whether they developed or updated their personal estate plans. A total of 92.9 percent of those returning surveys stated they had begun the process and 50 percent of those (13 families) had completed and implemented their personal estate plan. Participants reported the value of assets protected and available for transition to the next

generation as a result of the business transition and personal estate plan. Participants reported a total of $58.6 million worth of assets now protected for the next generation by having a business transition and personal estate plan in place. Given that the total net cost of program delivery was $4,159.41, there was a financial impact of $14,076.51 per net dollar of program cost.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (none)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension's agriculture business management team routinely conducts follow-up evaluation of participants to monitor how education made a difference in their farm management decisions. By calculating the program's impact on profitability and asset management, program managers are assured that producers are better able to continue to feed the world. In 2017, evaluations related to profitability and asset management demonstrated that investment in Extension programs resulted in more than $64,713,580 of impact.

Key Items of Evaluation

In 2017, evaluations related to profitability and asset management demonstrated that investment in Extension programs resulted in more than $64,713,580 of impact.

MAES. Non-NIFA research funds and grants leveraged by PIs in this program include: MnDRIVE, USDA-SARE, Rapid Agricultural Response Fund and the Minnesota Invasive Terrestrial Plants and Pests Center.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
1659	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 whit 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)	
3	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.