# 2016 University of Minnesota Combined Research and Extension Annual Report of Accomplishments and Results

**Status: Accepted**

**Date Accepted: 06/13/2017**

## I. Report Overview

### 1. Executive Summary

**I. Report Overview**
**1. Executive Summary**
This report highlights the accomplishments of the University of Minnesota's Agricultural Experiment Station (MAES) and Extension in 2016. Fourteen programs provide the organizing structure to report both MAES and Extension outcomes and impacts. Two 2015 programs, Community Economics and Public Finance and Leadership and Civic Engagement, are now merged and are called Community Vitality and Public Finance in 2016. This merger acknowledges that these programs share Knowledge Areas and have similar outcomes related to community development and planning. Other planned programs are unchanged since 2015. We are reporting on 13 of the 14 planned programs in 2016 because there were no housing impacts to describe.

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 48 impacts reported in 2016, 17 describe joint Hatch and Smith-Lever funded impacts.

**MAES. Summary of 2016 activities**

This report summarizes the effort and results of 432 MAES-funded research projects conducted by 299 faculty 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 (COD). While the research efforts have been reported under program areas, the majority of this research is broad-based and interdisciplinary and has impacts on multiple programs areas.

Though Hatch funding accounts for only 7.7 percent of the annual funds for research, we have chosen to report on outcomes from all projects connected to PIs receiving non-discretionary funding. NIFA non-discretionary funds are used to support general-use infrastructure, including our greenhouses and research fields, to ensure researchers have the basic requirements to start their projects and begin to 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 2016, 52 projects (up from 45 in 2015) 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. To date, MnDRIVE funding has submitted disclosures for 184 new inventions and helped launch 13 startup companies, engaged more than 225 external partners, and hired 511 faculty, students, fellows, and staff. Based on this success, the University is exploring ways to expand the MnDRIVE program into new research areas.

Other key opportunities:

- A nearly $5 million state investment in agricultural productivity at the University of Minnesota was used to hire scientists and improve infrastructure. Known as the Agricultural Research, Education, Extension and Technology Transfer Program (AGREETT) new faculty will be hired by CFANS, Extension, and CVM many of whom will be based at research and outreach centers located across the state.
- Researchers from the U of M have joined a national consortium, known as the Rapid Advancement in Process Intensification Deployment (RAPID), seeking to address key challenges in energy-intensive manufacturing process industries. An MAES-supported researcher has been chosen to co-lead the renewable bioproducts team and will help shape research and development priority areas and key industry partnerships over the next five years.
- The University of Minnesota's Healthy Foods, Healthy Lives Institute received $1 million from the Shakopee Mdewakanton Sioux Community in support of the national Seeds of Native Health Campaign. In 2016, they hosted the inaugural Conference on Native American Nutrition in Prior Lake, MN, which attracted 456 attendees from 33 states, two Canadian provinces, and three countries in South/Central America and Africa.

Research highlights for 2016 include:

- Researchers have developed and patented a sponge that is able to remove 99.9 percent of mercury in water. This new technology could improve not only the safety of Minnesota's waters but could also have major implications for human health.
- Economic researchers completed an analysis of 50 years of global food and agricultural research and development (AgR&D) spending. They uncovered key trends and found, for the first time in history, middle-income countries are investing more in AgR&D than high-income countries.
- In August 2016, Governor Dayton kicked off the "Year of Water Action" urging businesses, the agricultural industry, outdoor enthusiasts, communities and families to take action to conserve and improve Minnesota's water quality. University researchers and Extension educators have been and will continue to be key partners at events and meetings throughout the year.
- Itasca, a newly released wine grape, will continue to build on the success of Minnesota's wine industry as the first cold-hardy grape capable of producing dry-white wines.
- Thanks in part to years of research and Extension outreach related to honeybee colony health, Governor Dayton announced a new executive order in fall 2016 which calls for the state to take immediate action to protect pollinators and creates a new taskforce to further study the issues affecting pollinators and recommend long-term solutions.

**Extension. Summary of 2016 Activities**

Though non-discretionary USDA funding provides just 14.6 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 all centralized services, including human resources, accounting, communications, information technology, and bricks-and-mortar offices, are available and meet program staff needs so that they can generate outcomes and impacts.

**Service levels:** In 2016, Extension programs delivered programming to over 1,000,000 Minnesotans. This includes 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 supports stakeholder relationships statewide.
Indirect contacts are defined differently by each program. They often refer to unique visits to educational web sites, social media sites, listserves or educational outreach. **Direct contact counts reported for adults and youth are typically unduplicated, and refer to actual program contacts that are likely to achieve changes in knowledge, action or condition, rather than casual readers or learners.**

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 1,288,872 hours of service in 2016, the equivalent of 619.65 full-time staff. This is a 4.7 percent increase from 2015. According to the Independent Sector, this service can be valued at $32,479,574. Strong volunteer training and support programs are managed by 4-H and youth development programs, the Master Gardener program (Horticulture), the Master Naturalist program (Natural Resource Management), and the Regional Sustainable Development Partnerships.

**Outreach to underserved audiences:** According to Minnesota Compass (www.mncompass.org), Minnesota ranks 38th among the 50 states in persons of color as a share of the population. In 2015, 19 percent of Minnesotans were persons of color. This percentage is expected to increase to 25 percent by 2035. These changing demographics mandate that Extension adapt to meet the needs of underserved audiences. In 2016, five of Minnesota's 14 planned programs have adapted programming and outreach to engage diverse populations and have achieved participation rates near or above 19 percent.

- Urban 4-H: 42 percent, including 17 percent African-American, 11 percent Latino, 11 percent Asian, 3 percent more than one race and .2 percent Native American. Statewide, 10 percent of 4-Hers were youth of color.
- Building Strong Healthy Families: 39 percent of all participants; 37 percent of adults; 68 percent of youth
- Health and Nutrition: 38 percent of all participants; 36 percent of all adults; 39 percent of all youth
- Leadership and Civic Engagement Programs: 16 percent of participants
- Natural Resource Management: 15 percent of participants

**Multi-state engagement:** All programs reported some degree of collaboration with Extension in other states, especially with contiguous states that share land and water issues. Eleven of the 13 reporting programs this year described some participation in eXtension, and Extension's increased use of technology is increasing the amount of shared training that is occurring among states.
Multi-state programming is encouraged by North Central Region partnerships with Ohio State, Michigan State, Purdue University, the University of Illinois, the University of Wisconsin, Iowa State, the University of Missouri, North Dakota State, South Dakota University, the University of Nebraska and Kansas State. Each state Extension has four primary program areas, though there are variations in structure from state to state -- Agriculture and Natural Resources, Youth Development and 4-H, Community Vitality, and Family and Consumer Sciences. Administrators for each of these programs meet on a regular basis to discuss strategies, address common issues, and plan together across state lines to create more effective programs. Mini-grants, joint professional development opportunities, common reporting metrics, and joint positions among contiguous states are just a few outputs from these partnerships.

**Strategic Plan:** Extension's 2012 strategic plan called for greater use of technology to expand reach and enhance outcomes. In 2016, a restructuring of the Information Technology Unit underscored Extension's investment in learning technology and online education. Technology support functions were moved to the greater University of Minnesota tech support unit after assurance that service would be the same or superior to that provided by Extension. A significant portion of savings was invested in positions to improve the online experience of Extension web site visitors and to support staff in developing and delivering more education through technology and online. Examples are described in the planned programs portion of this report.

Extension also mobilized inter-disciplinary teams to respond to the University's directive to address grand challenges, including: 1) ensuring just and equitable societies; 2) fostering human potential and well-being across the course of life in a diverse and changing world; 3) advancing human health; 4) developing sustainable cities and resilient communities; and 5) providing secure food, water and energy today and in the future. Four issue area grants, directly supported by the University provost, were provided to cross-disciplinary teams to address grand challenges in 2016. Outcomes will be reported in future reports.

**Staff expertise:** In 2016, 142 highly specialized Extension educators (138.5 FTE) delivered planned programs described in this report. In county offices, 30 (28.5 FTE) local educators delivered programming and 184 (172.6 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 educators' performance and scholarship. In 2016, three regional educators and two local educators were promoted after rigorous peer review of their scholarship, teaching, and program leadership, as described in "Merit Review Processes."

**Academic and scholarship ties:** Partnerships with six academic affiliates assure Extension funding or partial funding for 84 faculty (31.7 FTE). Efforts over the years to improve the scholarship of Extension's program and staff have been successful. Extension's scholar-practitioners produced 141 peer-reviewed publications in 2016.

**County stakeholder relationships.** Extension offers contracts to each of Minnesota's 87 counties so that local educators can develop, deliver and evaluate county-based programs that align with local priorities. This county system works alongside Extension's regional system, which is funded with federal and state dollars. In 2016, county investment increased by 3.3 percent in 2016. While 15 of Minnesota's 87 counties decreased their overall budget, 48 counties increased Extension investments by more than the 2.25 percent inflationary increase that was written into formal agreements statewide in 2016 (55 percent). The retirement of local Extension staff is affecting local investments and decisions, as counties reconsider their programmatic investments in relationship to current needs and issues.

**Total Actual Amount of professional FTEs/SYs for this State**

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 281.6 | 0.0 | 336.9 | 0.0 |
| Actual | 260.8 | 0.0 | 433.4 | 0.0 |

## II. Merit Review Process

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

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

### 2. Brief Explanation

**MAES.** The merit review of research faculty supported by MAES funding occurs within each of the five partner colleges. The process follows standards established by the University for promotion and tenure, and explicitly includes an evaluation of research quality and impact. In 2016, eight MAES-supported researchers in the College of Food, Agricultural and Natural Resource Sciences were granted promotion. Five were promoted from assistant professor to associate professor with tenure, and three were promoted from associate professor to professor.

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

In the College of Veterinary Medicine, MAES-related research projects are peer-reviewed by members of the CVM research committee, signature program steering committee members and ad hoc reviewers, selected based on their expertise in proposal subject matter. In 2016, 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** continues to manage its academic promotion process for all educators working in local and regional offices and specialists working in the Extension college. In 2016, three regional Extension educators were promoted and two local (e.g., county) educators were promoted. Each was promoted after a rigorous review of their educational outcomes, scholarship and outreach to communities.
In 2016, an internal review of the promotion process was completed by the Senior Associate Dean and a team of educators and specialists. The Dean and Human Resources Director approved a revised promotion process for the 2017-18 promotion cycle. The revised plan provides greater clarity, giving educators examples that align with expectations of significance and distinction. Criteria for promotion were clarified, indicators for success in several areas were added and an appeal process was described. Language between the Promotion Guidelines for Educators with Rank and the Promotion Guidelines for Educators Without Rank were standardized where possible. It is expected that these changes will provide educators with greater clarity for seeking successful promotion.

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 criteria 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 in 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

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

**Brief explanation.**

**MAES** supported research is defined by the five colleges that receive MAES funding. Those decisions are guided by stakeholders' input gathered through each college's research advisory committees. Feedback is also gathered from stakeholder groups on specific research areas. Besides the formal processes in place to identify stakeholders and gather input, other strategies are in place to elicit input for research decisions, such as the requirements for stakeholder input to be included in each proposal for Rapid Agricultural Response research project funding, and for Small Grains Initiative research project funds. 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 across the state, supported by MAES funding, has an advisory committee, which reflects the composition and interests of the local area. Also, at the Research and Outreach Centers, there are other specific stakeholder groups advising on particular programs. For example, the Southwest Research and Outreach Center has a program that is guided by an Advisory Committee of conventional and organic farmers, researchers and educators. Research advisory boards also exist in several academic departments in CFANS.

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

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

1,000 **Extension** volunteers serve on Extension's county, regional and state advisory boards and committees. This includes over 425 local stakeholders who serve on county Extension Committees, as mandated by state law, and 22 Minnesota citizens convened by Extension's Dean and Director to serve on the Statewide Citizen's Advisory Committee. It also includes Minnesotans who serve on Regional Sustainable Development Partnership boards. In addition, program areas frequently convene short or long-term advisory committees to inform and support program and research that comes from Extension.

**Local and State Advisory Committees** review, promote and support county-based programs, and determine 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, who reflect the diversity of Minnesota's communities, are willing to advise Extension administration at the big picture level, and are willing to build grassroots support. Members serve a three-year term, and are selected to represent the geographic diversity of the state. Members are encouraged to give 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 community boards, work groups, issue convenings, social media sites, webinars and formal surveys. In 2016, information gleaned from this outreach informed the activities of 11 of the 14 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 2016 in each region of the state. Work groups set regional priorities and present ideas. Newsletters, webinars and research fact sheets from RSDP deliver updates to opinion leaders, policy makers, students, farmers, business people, media, local government and community members.

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

**1. Method to identify individuals and groups**

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys

**Brief explanation.**

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

**Extension County Extension Committees and Citizens' Advisory Committees:** Committee members are drawn from groups of local leaders, volunteers and program participants. They are identified as candidates for local or statewide advisory committee membership because they have knowledge or or experience with Extension, have 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 puts out calls for nominations and memberships and recruits viable participants.

**Regional Sustainable Development Partnerships (RSDP)** intentionally engage board members and staff who can reach out to various communities, constituents and organizations to develop priorities for each region of the state. One venue for soliciting community and University ideas is through RSDP's Idea Form, which is available on its public website. Once priorities are identified, RSDP brings together stakeholders with key involvement in the prioritized issues. In 2016, the Deep Winter Greenhouse research convening is an example of such key stakeholder involvement. RSDP also hosts listening and comment sessions and surveys stakeholders to inform projects. The boards and work group members serve as ambassadors across the state, sharing opportunities and learning about community needs.

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

**1. Methods for collecting Stakeholder Input**

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

**Brief explanation.**

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

**County Extension Committees and Citizens' Advisory Committees:** Meetings are held at regular intervals throughout the year and include programmatic as well as administrative updates. Committees are actively engaged in discussions that result 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.

**Regional Sustainable Development Partnership** work groups and boards connect local ideas to program expertise available at the University of Minnesota, especially Extension. Web-based seminars about particular issues of interest bring together community and University stakeholders with like interests for learning and feedback. RSDP regional directors convene local boards, work groups and partners to help plan and implement research, education and outreach projects that meet the priorities identified by these groups. Each project includes involvement from University faculty, staff, students and other resources. As a result, RSDP convenes stakeholders yearly on critical issues. In 2016, these convenings focused on local foods and supply chain issues.

**3. A statement of how the input will be considered**

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

**Brief explanation.**

**MAES** supported research has been redirected to high priority areas and on the development of breakthrough technologies based on information gained from stakeholders. Key examples of this in 2016 include the development of rapid bacterial diagnostic tests for the food industry and the collaborative work to put together the inaugural Conference on Native American Nutrition. An advisory committee also worked with the Deans of CFANS, CVM and Extension on AGREETT. The committee helped build priorities for faculty hires in CFANS and CVM and Extension educators in Extension.

**County Extension Committees and Citizens' Advisory Committees:** Input from these committees primarily inform the process by which Memorandums of Understanding are constructed between Extension and counties. They also support advocacy and support for Extension to state sources of funding and offer Extension critical feedback from local, regional and state stakeholders.

**Regional Sustainable Development Partnerships** set programmatic priorities within regions in the areas of food, tourism and resilient communities, natural resources and clean energy. An annual action-planning process brings together stakeholders across each region to set project priorities for the next year. These priorities drive where staff time is spent and where seed funding is allocated. Priorities are brought to Extension and other University entities for response. One 2016 example relates to concerns about rural grocery stores. A survey of over 200 rural grocery stores resulted in the development of toolkits for small groceries, as well as consultation on energy-efficiency upgrades. Findings also informed a proposal to AFRI to pilot a visionary model that can connect small and medium-sized farms to wholesale markets through backhauling from rural grocery stores. Another response to local opportunity brought five Deep Winter Greenhouses and the first deep winter greenhouse research convening at the University of Minnesota.

**Brief Explanation of what you learned from your Stakeholders**

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

**Extension's** stakeholder assessment processes revealed strong community interest in strengthening local food systems, including through training materials and resources 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.

Community groups are thinking about the future and want to partner with the University to create it. These community efforts resulted in the development or adaptation of programming within these planned programs: Global Food Security and Hunger, Sustainable Energy, Climate Change, Health and Nutrition, Water Resources, Community Vitality and Public Finance, Youth Development, Natural Resource Management, Forestry and Forest Products, Horticulture, and Agricultural Business Management.

## IV. Expenditure Summary

| 1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS) | | | |
|---|---|---|---|
| Extension | | Research | |
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 9083932 | 0 | 6344440 | 0 |

| 2. Totaled Actual dollars from Planned Programs Inputs | | | | |
|---|---|---|---|---|
| | Extension | | Research | |
| | Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| Actual Formula | 10314718 | 0 | 5535005 | 0 |
| Actual Matching | 27311730 | 0 | 35967658 | 0 |
| Actual All Other | 27539027 | 0 | 41039290 | 0 |
| Total Actual Expended | 65165475 | 0 | 82541953 | 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 | 0% | | 10% | |
| 204 | Plant Product Quality and Utility (Preharvest) | 10% | | 5% | |
| 205 | Plant Management Systems | 10% | | 5% | |
| 206 | Basic Plant Biology | 0% | | 2% | |
| 211 | Insects, Mites, and Other Arthropods Affecting Plants | 5% | | 10% | |
| 212 | Pathogens and Nematodes Affecting Plants | 5% | | 5% | |
| 213 | Weeds Affecting Plants | 10% | | 5% | |
| 216 | Integrated Pest Management Systems | 10% | | 5% | |
| 301 | Reproductive Performance of Animals | 5% | | 5% | |
| 302 | Nutrient Utilization in Animals | 5% | | 5% | |
| 304 | Animal Genome | 0% | | 2% | |
| 305 | Animal Physiological Processes | 5% | | 5% | |
| 306 | Environmental Stress in Animals | 5% | | 5% | |
| 307 | Animal Management Systems | 10% | | 5% | |
| 311 | Animal Diseases | 10% | | 10% | |
| 315 | Animal Welfare/Well-Being and Protection | 10% | | 10% | |
| 601 | Economics of Agricultural Production and Farm Management | 0% | | 2% | |
| 606 | International Trade and Development Economics | 0% | | 2% | |
| 611 | Foreign Policy and Programs | 0% | | 2% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 38.4 | 0.0 | 89.1 | 0.0 |
| **Actual Paid** | 24.6 | 0.0 | 164.8 | 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** |
| 1065095 | 0 | 2666079 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 2533585 | 0 | 14312672 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 818089 | 0 | 17192702 | 0 |

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

### 1. Brief description of the Activity

**MAES.** Research in 2016 provided new information and strategies to improve crop and animal production systems in Minnesota. Diseases and pests affecting our crop and animals remain a primary concern for researchers along with exploring new opportunities presented by new agricultural technologies and genotyping.
Research highlights for 2016 include:

• Surveys of the presence of soybean aphid parasitoid Aphelinus certus throughout the state have found its abundance has increased annually since it was first discovered in Rosemount, MN in 2011. Significantly, while rates in the field remain relatively low (five percent), cage field studies have shown A. certus is capable of suppressing soybean aphid below the economic threshold level of 250 aphids per plant making it one of the most important natural enemies of soybean aphid.
• A workshop organized by the University's Stakman-Borlaug Center for Sustainable Plant Health took place in Washington DC in February 2016. It brought together regulatory authorities from nine countries that have experience with risk assessment and compared their experiences to the Cartagena Protocol. Nine consensus points were agreed to that capture the departure of guidance from their experiences with actual cases.
• A three-year, nine state, evaluation of inputs on soybean crops found that none of the products included in the study that claimed to be "yield enhancers" provided any increase in yield. Furthermore, while pesticides were the most likely to provide yield enhancement, they did not do so universally.
• Researchers expanded field trials on microbial inoculants to organic production fields at six locations in Minnesota and continued two large-scale studies on potato diseases and yield at ROCs. The potato studies had outstanding disease suppression results and data showed that microbial combinations are more effective than individual isolates at suppressing disease.
• Research on the spread of PRRSV found that currently circulating viruses are evolving rapidly, and showing a higher level of relative genetic diversity over time. This highlights the importance of phylodynamic models for informing decision-making processes and controlling the spread of animal

diseases.

- Corn is a major source of energy for turkey feed in the Midwest. Traditionally, the maturity of the corn kernel at harvest is used as an indication of corn nutritional value. A new University study has revealed that lower test weight corn reduced energy by seven percent compared to higher test weight corn.
- Research on PRRSV revealed that the virus grows better in young animals than older ones. It was also found that there is a strong anti-viral response in infected pigs, which is contrary to numerous publications. This information will assist in future vaccine development and helps explain why there is variation of vaccine efficacy in the field.

**Extension** addressed current trends in 2016 while maintaining its educational outreach activities to support the agriculture industry and food growers. Soybean, corn for grain, and sugar beet production were the highest on record in Minnesota in 2016, but commodity prices remain low. In response, Extension put additional effort into education that improves profitability. In anticipation of the next Avian flu outbreak, educational efforts emphasized biosecurity, and Extension's dean allocated funding for a new educator position focused on preventing the spread of avian influenza. Several program areas worked together to develop new resources for soil health and cover crops, including launching a new web section on Soil Health and Maintenance. Several educators also combined efforts to focus more on farm safety, and their program designs will be piloted in 2017. EPA and USDA nutrient reduction goals are also being addressed through programs with state agencies.

Outcomes reported for 2016 describe Extension training that helps the pork industry maintain the confidence of its consumers, its ongoing success in helping producers manage nitrogen use, and outcomes related to control of a new weed that is a threat to production of corn and soybeans.

**2. Brief description of the target audience**

**Extension's** 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.

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

**3. How was eXtension used?**

Many educators and specialists in the Global Foods planned program area contributed resources to eXtension in 2016. A specialist authored an educational resource related to feeding horses. The Dairy team contributed to DAIReXNET Partnerships. Dairy educators authored materials about Robotic Milking Systems. An educator posted a presentation delivered at an Extension event related to nitrogen fertilizer management. Extension staff is leading a group of state Extension pesticide safety education program educators. Private sector funding is supporting this effort for state Extension Pesticide Safey Education Coordinators from all states to have a more effective way to share educational materials and courses across state lines.

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 103750 | 2683706 | 1565 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 3 |

**Patents listed**

"Bolles" Wheat Variety: 201600163 - 3/11/2016
Transgenic Plants with Enhanced Agronomic Traits: 14/999,032 - 3/21/2016
Seneca Valley Virus Antigens and Methods of Use: 62/378,324 - 8/23/2016

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 62 | 130 | 192 |

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

**Output Target**

**Output #1**

**Output Measure**

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

**Output #2**

**Output Measure**

- Number of Extension learning opportunities.

| Year | Actual |
|---|---|
| 2016 | 558 |

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

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Participants of Extension livestock and crop program workshops/classes and conferences will achieve significant learning gains regarding research-based knowledge and skills. (Target expressed as the percentage of participants who achieved significant learning gains as a result of attending Extension program workshops/classes and conferences.) |
| 2 | Participants of workshops/classes and conference sessions related to livestock and crop production will significantly improve their production practices as a result of attending the program. (Target expressed as a percentage of participants that significantly changed one or more of their practices as a result of attending workshops/classes and conference sessions intended to improve participant practices.) |
| 3 | Interventions will result in changes in conditions related to profitability, crop and livestock health or environmental conditions. (Target expressed as number of changes in condition reported each year.) |
| 4 | Research will support a more sustainable, diverse and resilient food system (Measure: number of new or improved innovations developed for food enterprises. Measure: number of new diagnostic systems analyzing plant and animal pests and diseases) |
| 5 | Development of new crop varieties will help Minnesota growers improve profitability |
| 6 | Research will provide information to support strategies to control animal diseases. |
| 7 | Economic research will reveal national and global trends on investments in R&D spending in food and agriculture. |

## Outcome #1

### 1. Outcome Measures

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

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Public opinion favors that livestock be treated well by producers. In order to maintain consumer confidence, the pork industry acts to assure the public that the best practices in treating pigs are being used and create a good pork product.

**What has been done**
Pork producers and transporters now take part in Pork Quality Assurance Plus® (PQA Plus®) trainings. Certification is required as a condition of sale by all major packers. PQA Plus® trainings teach best practices for managing pigs, proper use of health products, and techniques to assure pig well-being. Hatch-funded research on animal well-being is incorporated into best practice recommendations. PQA Plus® program offers a process for third party, on-farm evaluation of pig health, barn conditions and record keeping. In 2016, Extension trained 176 certified PQA+ Advisors, affecting 10.52 million pigs.

**Results**
According to the aggregate MN PQA+ Site Assessment report from the National Pork Board, Minnesota pig farms have acceptable scores for much of the needed records, and documentation that is very close to national averages. They exceed in the area of medication and treatment records needed, according to FDA guidelines. Minnesota pig farms also exceed the national average in the percentage of animals with acceptable body condition scores.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|

| | |
|---|---|
| 306 | Environmental Stress in Animals |
| 307 | Animal Management Systems |
| 315 | Animal Welfare/Well-Being and Protection |

**Outcome #2**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 40 |

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

**Issue (Who cares and Why)**
Nitrogen (N) is absorbed in large amounts by Minnesota crops. It is the major nutrient supplied in a fertilizer program. Nitrogen in soil exists in several forms and conversion from one form to another can be complex. There is general agreement that voluntary best management practices are an economically sound choice and that, if used, they can minimize nitrogen loss to the environment and maximize utilization by the crop.

**What has been done**
Nitrogen Smart training programs for producers presented fundamentals for maximizing economic return on nitrogen investments while minimizing nitrogen losses. Eight workshops were delivered across the state in December of 2016. Updated research from Hatch funding regarding appropriate nitrogen levels has influenced established best practices.

**Results**
There were 274 people who attended Nitrogen Smart trainings. Farmers were 73 percent of survey respondents with a total of 183,177 acres. In a follow up survey, 39.5 percent reduced their N rate by an average of 33 lb/acre, which would translate into a savings of $7,181 per attendee; 14.5 percent changed from an all-fall application to all-spring, which resulted in an estimated increase of 121,856 bu. of corn or $13,056 per farmer who made the change. Almost

12 percent stopped using fall Urea, which converted an estimated 12,512 acres of land and extrapolates to a reduction of 150,240 ob. of N lost to the environment.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 204 | Plant Product Quality and Utility (Preharvest) |

**Outcome #3**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 2 |

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

**Issue (Who cares and Why)**
Palmer amaranth is a very fast growing and competitive weed that has proven to be very adaptable to corn and soybean herbicides commonly used in Minnesota. In some states, yield losses in corn and soybeans have been as high as 90 percent and 80 percent, respectively. In some fields, harvest equipment cannot cut through the weed infestation and the field must be mowed down.

**What has been done**
After encouragement from Extension, the Minnesota Department of Agriculture (MDA) included Palmar amaranth on the Prohibited Noxious Weed-Eradicate list. Press releases, web pages and Crop News blog notices were quickly rolled out to warn people of potential threat. Before the program, 22 percent knew much or very much about the weed. After the program, 72% understood how to identify the weed. Previous MAES research about the effect of palmer amaranth in other states was applied to this outreach.

**Results**
In September of 2016, Palmer amaranth was identified for the first time in Minnesota in 30 planting sites across 200 acres. It was first identified by a landowner who contacted his crop

consultant after having been informed by Extension as to how to properly identify the weed. Coordinated management plans are now being prepared by MDA and Extension faculty for the 30 affected sites, and the plan will be implemented during the 2017 growing season. U of M Extension Faculty will continue to educate crop consultants and other interested parties about the identification and biological weaknesses of Palmer amaranth, and will help the MDA develop effective eradication measures at the affected areas.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 204 | Plant Product Quality and Utility (Preharvest) |

**Outcome #4**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 0 |

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

**Issue (Who cares and Why)**
Ug99 is a lineage of wheat stem rust present in wheat fields in several countries in Africa and the Middle East. Due to its virulence to several stem rust resistance genes, it is predicted to spread rapidly through these regions and possibly further afield.

**What has been done**
In an effort to identify genes with resistance to Ug99, University researchers carried out a genome-wide association study on a panel of 250 spring wheat breeding lines from the International Maize and Wheat Improvement Center, six wheat breeding programs in the US, and three breeding programs in Canada.

**Results**
Only nine of the 250 lines displayed seedling resistance to all three races. Twenty-seven SNP markers associated with APR against Ug99 were detected and 23, 86, and 111 SNP markers associated with seedling resistance against races TTKSK, TRTTF, and TKTTF respectively.

This study demonstrates that North American wheat breeding lines have several loci that provide APR and seedling resistance to highly virulent Pgt races. Using the resistance lines and the SNP markers identified in this study, marker-assisted resistance breeding can assist in the development of varieties with elevated levels of resistance to virulent stem rust races including TTKSK.

**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 |
| 212 | Pathogens and Nematodes Affecting Plants |

**Outcome #5**

**1. Outcome Measures**

Development of new crop varieties will help Minnesota growers improve profitability

Not Reporting on this Outcome Measure

**Outcome #6**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 0 |

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

**Issue (Who cares and Why)**

Influenza A virus is endemic in pigs and ongoing concern to producers. It has proven extremely difficult to control in part due to the multiple strains that may be co-circulating on a farm and the limited cross-protection current vaccines provide against various strains. Additionally, more information is needed about various transmission routes including aerosols.

**What has been done**
Faculty at the College of Veterinary Medicine have extensively studied influenza aerosols in lab experiments and in the field.

In 2015, due to the HPAI outbreak, researchers were able to get extensive samples from infected turkey farms all over the state, including samples from exhaust fans. Significantly, they uncovered virus particles, in a wide-range of sizes, on surfaces outside the farm implying that given the right conditions aerosols may play a role in the spread of influenza viruses between farms.

**Results**
The information derived from these studies is important to design effective airborne disease control programs, including mitigation of occupational exposure to people in contact with infected swine and poultry.

Significantly, the findings of this study indicate that recommendations provided so far by the CDC to prevent exposure, in people in particular, may not be enough to avoid infection. Results have been shared with Extension educators, poultry producers, government officials, and filtration companies working on improving biosecurity on farms.

**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**

Economic research will reveal national and global trends on investments in R&D spending in food and agriculture.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|

| | |
|---|---|
| 2016 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
The amount, orientation, and effectiveness of investments in research and development (R&D) shape our technological futures, but the processes play out over long-periods of time and require long-run perspective that takes into account all-dimensions of food and agriculture productivity.

**What has been done**
Applied economic researchers at the University were interested in how the geographical distribution of food and agricultural R&D is changing. To track shifts on where R&D spending occurs worldwide, they revised and updated datasets maintained by the University of Minnesota's International Science and Technology Practice and Policy Center. They also pooled data from government and international agencies and private firms. In all, the update took six years, and involved more than 60 collaborators at national and international statistical and scientific agencies.

**Results**
Their analysis of 50 years of data from across the globe revealed that we are in the midst of a historic transition--the governments of middle-income nations are investing more than those of high-income ones for the first time in modern history. Additionally, the study revealed the majority of food and agricultural R&D is now being done by private firms rather than government institutions and public universities.

Today's R&D investment decisions will cast shadows forward to 2050 and beyond, making the trends being uncovered now significant for the future of food production. As population numbers continue to sore, it will be especially important to ensure that R&D advances are shared with low-income countries.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 204 | Plant Product Quality and Utility (Preharvest) |
| 601 | Economics of Agricultural Production and Farm Management |
| 606 | International Trade and Development Economics |
| 611 | Foreign Policy and Programs |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**
- Economy

**Brief Explanation**

Low prices for commodities shaped programmatic priorities in 2016.

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

### Evaluation Results

Global foods educational presentations are routinely evaluated to understand the degree to which educational efforts are providing new knowledge and guiding people to act. Follow up evaluations determine whether actions were taken and affected a significant portion of Minnesota's agricultural economy. In 2016, the evaluations discovered outcomes such as the following:

- A poultry education program was relaunched in collaboration with the Minnesota Turkey Growers Association and the Chicken and Egg Association of Minnesota. More than 14.3 million birds were represented by owners, managers and industry professionals through this workshop. Thirty days later, 53 percent of attendees had made a change to benefit their operations.
- Cattle Feeder Days reached a combined feeding capacity of 22,000 head of cattle. Over 95 percent of producers indicated they would implement information covered at the meeting on their own operation. An additional Dairy Expo had 288 attendees from 16 counties, representing 17,635 cattle, and 67 percent reported they had made a change in their operations as a result of last year's expo.

### Key Items of Evaluation

Evaluation showed that Extension education has influenced producer activity for more than 14.3 million birds, almost 40,000 heads of cattle, and 10.52 million pigs.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- USDA-AFRI
- Rapid Agricultural Response Fund
- Small Grains Initiative
- National Science Foundation
- United Soybean Board
- United Nations Environmental Program
- Minnesota Department of Agriculture
- Biotechnology Risk Assessment Grant
- USDA Foreign Ag Service Program
- Bill and Linda Gates Foundation
- MnDRIVE

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

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 8.5 | 0.0 | 16.8 | 0.0 |
| **Actual Paid** | 18.4 | 0.0 | 42.6 | 0.0 |
| **Actual Volunteer** | 0.4 | 0.0 | 0.0 | 0.0 |

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

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 511622 | 0 | 122163 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 2192806 | 0 | 2704353 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 1340920 | 0 | 3691458 | 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 utilize renewable energy sources and technologies in economically and environmentally feasible ways.

- Researchers at the Research and Outreach Center at Morris are working to increase energy efficiencies in agriculture-including dairy and swine operations. One innovation captures the heat from the milk and uses it to heat the water they need to clean the dairy.
- An interdisciplinary MnDRIVE funded project called WasteNot focuses on re-engineering our system of handling organic waste including exploring how we can turn food into fuel. One new technology called microwave-assisted pyrolysis turns food waste into three marketable products: char residue, synthetic gas, and bio oil. They've built and tested a small mobile unit but more investors are needed to refine and upscale it for commercial use.
- A study exploring efficient management of energy production and use looked at three geographic areas, Minnesota, Illinois and Michigan, to estimate how the shifts in electricity use associated with changes in electricity pricing policy would influence total emissions. The results suggest that real time pricing would cause lower electricity costs while having little or no impact on emissions.
- Researchers developed heat-curable fully biobased adhesives. The new adhesives are competitive in bond strength with commercial adhesives used for wood bonding.
- A study on the use of P. Electrocoagulation (EC) to remove phosphorus and recover it from dairy manure found low carbon steel achieved the most efficient P removal (96.7 percent) and the average particle size of manure solids was increased from 32.2 to 126.9 micrometers. Overall, researchers found EC by low carbon steel is an effective method for P separation from liquid phase of dairy manure to solid phase.
- Researchers developed approaches to knockout multiple genes in Azotobacter vinelandii using counter-selection. This is an early step in their aim to produce urea biosynthetically through nitrogen fixing soil bacterium.
- A study on anaerobic digestion showed co-digestion, if controlled in an optimized ratio, can maximize the biogas production and potentially increase the profitability of the digester.
- A study has begun on the assessment of waste nitrogen, from dairy wastewater, and its potential for growing algal biomass. Thus far, researchers have identified the dilution factor needed to optimize algal biomass growth.

**Extension.** Sustainable Energy programming at Extension is primarily carried out through the Clean Energy Resource Team project (CERTs). CERTs is a statewide partnership with a shared mission to connect individuals and their communities to the resources they need to carry out community-based clean energy projects. CERTs activities in Extension include the following partners: University of Minnesota

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

In 2016, CERTs demonstrated the significance of its work by publishing 172 new stories to its Minnesota Energy Stories blog. These stories included case studies about CERTs seed grant projects, highlights of successful projects, interviews with business owners who made changes to energy consumption with CERTs intervention, and summaries of tours and events that focused on clean energy options. Continuing its work in public education, CERTs hosted 31 events to highlight energy-saving opportunities through workshops, tours and forums. Additionally, CERTs connected with Minnesotans directly through 267 other outreach activities, including convening meetings with community-based organizations. CERTs oversaw the use of $100,000 awarded as seed grants for 39 local clean energy projects. CERTs piloted new campaigns and tested new models for scaled-up sustainable energy impact.

Reported outcomes describe how CERTs programming is saving or offsetting 204.9 billion BTUs annually. This is equivalent to heating 2,568 Minnesota homes for an entire winter, or powering the electricity for 5,306 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 entire state of Minnesota. CERTs empowers communities and their members to adopt energy conservation, energy efficiency and renewable energy technologies for their homes, businesses and local institutions. Types of communities that CERTs works with include, but are not limited to, businesses, civic organizations, economic developers, faith groups, farmers, local governments, residents and neighborhoods, schools, and utilities.

**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 uses eXtension extensively to research farm energy resources that should be included in educational content for public and state-funded research and implementation projects, to increase the team's knowledge about specific energy efficient farm technologies, and to gain an understanding of which state Extension programs are the "authority" on given subjects. eXtension also helps substantiate best practices and verify vendor claims.

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 18111 | 468800 | 734 | 11808 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 6 |

**Patents listed**

Compositions Including Ligninsulfonate, Compositions Including Unalkylated Lignin, and Methods of Forming: PCT/US2016/050372 - 9/6/2016
Compositions Including Lignin: National Stage No.15/125 - 9/12/2016
Genetically Modified Diazotrophs and Methods of Using Same: 15/067,802 - 3/11/2016
Production of Biodiesel from Scum: 15/019,707 - 2/9/2016
Methods of Extracting Phosphorous from Distillates: 15/148,454 - 5/6/2016
Bioactive Composition Including Stabilized Protein and Process for Producing the Same: 2016-207089 - 10/21/2016
Lipase-containing Polymeric Coatings for the Facilitated Removal of Fingerprints: 9,428,740 - 8/30/2016 (ISSUED)
Pressure-sensitive Adhesives Having High Bio-based Content and Macromonomers for Preparing Same: 9,469,797 - 10/18/2016 (ISSUED)

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 0 | 51 | 51 |

**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 |
|---|---|
| 2016 | 72861 |

**Output #2**

**Output Measure**

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

| Year | Actual |
|---|---|
| 2016 | 31 |

## 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 |
|---|---|
| 2016 | 12265 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

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

## Outcome #1

### 1. Outcome Measures

Research will investigate and help develop novel sources of bioenergy.

### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
In the US, the total amount of municipal solid waste is rising each year. Millions of tons of solid waste and scum are produced annually that require safe and environmentally sound disposal. More research is needed to help turn municipal waste scum into economically feasible renewable bioenergy technologies.

**What has been done**
Researchers developed an economic screening method that compares the potential energy and economic value of three waste-to-energy technologies: incineration, anaerobic digestion, and biodiesel.

A St. Paul, MN wastewater treatment facility producing 3175 "wet" kilograms of scum per day was used for comparison. Variables that control environmental performance were identified and evaluated including fossil fuel use, greenhouse gas emissions, eutrophication, and acidification.

**Results**
After applying all available subsidies, scum-to-biodiesel was shown to have the greatest economic potential, valued between $491,949 and $610,624 per year. And the incineration of scum yielded the greatest reclaimed energy potential at 29 billion kilojoules/year.

The results also showed scum-to-biodiesel technology has negative impacts in all impact categories and that the benefits assigned by replacing diesel production contribute to reducing life cycle impacts significantly.

### 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**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 58 |

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

**Issue (Who cares and Why)**
Specific target audiences have different means available for saving energy and using clean energy resources. Introducing new technology and its viability for everyday use can help people adopt new clean energy technology. Communities, especially, have the opportunity to make energy efficiency possible among residents. When business owners, local units of government and community members share stories and examine options, technology adoption results.

**What has been done**
CERTs hosted 31 events in 2016, reaching audiences such as farmers, small business owners, residents, local units of government and utilities. Each event includes educational content on specific topics ranging from efficient lighting to biomass energy, and major mechanical upgrades to solar energy, as well as suggested actions Minnesotans can take to advance clean energy.

**Results**
Out of the 31 events, 12 were assessed regarding attendees' subsequent actions. As an average, weighted to attendance at the 12 events, 58 percent of respondents reported they are likely to take action. The events advanced actions such as the following: 1) Local governments subscribed

to community solar gardens, 2) Community solar gardens were offered to communities, 3) Individuals subscribed to a community solar garden, 4) Buildings of many kinds were upgraded to LED lighting and other energy efficient equipment, 6) Individuals adopted use of electric vehicles. If all respondents implement actions, approximately 47 billion BTUs will be saved through energy efficiency or renewable energy.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 131 | Alternative Uses of Land |
| 401 | Structures, Facilities, and General Purpose Farm Supplies |
| 402 | Engineering Systems and Equipment |
| 501 | New and Improved Food Processing Technologies |
| 511 | New and Improved Non-Food Products and Processes |
| 605 | Natural Resource and Environmental Economics |

**Outcome #3**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 204909 |

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

**Issue (Who cares and Why)**
Minnesota's energy supply is not as clean, efficient, reliable and affordable as it could be. Minnesotans spent $24 billion and consumed a total of 1,860 trillion BTUs of energy (electricity, natural gas, petroleum products, coal and biomass) in 2013 to supply energy needs. Energy use spreads across four main sectors: Transportation (24 percent total use), residential (23 percent total use), commercial (19 percent total use) and industrial (34 percent total use).

**What has been done**

CERTs works with Minnesota communities to connect them to resources, research-based information and networks that advance clean energy projects. The goal is to help Minnesota meet energy efficiency and renewable energy goals, many of which were signed into law in 2007 at Minnesota's NEXT Generation Energy Act. The law requires Minnesota utilities to produce 25 percent of energy using renewable resources by 2025 and established a statewide energy conservation goal of 1.5 percent of annual retail electric sales and 1.0 percent of annual gas sales each year.

**Results**

The 2016 calculated total BTUs saved is 204.9 billion. The ways this was accomplished include the following outcomes: 1) 22 local governments subscribed to community solar gardens to offset energy use in publicly-owned buildings (122 billion BTUs) 2) Property Assessed Clean Energy financing was arranged with local jurisdictions, allowing 21 businesses to complete efficiency and solar projects (54 billion BTUs) 3) a $2 billion, multi-year Guaranteed Energy Savings Program with deep energy retrofits for one city's buildings and streetlights was completed (14 billion BTUs) 4) 30 independent gas stations upgraded to LED canopy lighting and 19 non-canopy lightings projects, and more (4.6 billion BTUs).

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 131 | Alternative Uses of Land |
| 401 | Structures, Facilities, and General Purpose Farm Supplies |
| 402 | Engineering Systems and Equipment |
| 501 | New and Improved Food Processing Technologies |
| 511 | New and Improved Non-Food Products and Processes |
| 605 | Natural Resource and Environmental Economics |

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Other (No factors affected outcomes.)

**Brief Explanation**

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

**Evaluation Results**

The CERTs evaluation plan tracks intentions and follow through of those who are educated, receive seed grants, or take advantage of technical assistance for projects. CERTs quantifies total BTUs of energy saved annually through campaigns, technical assistance, utility support and seed grants. The 2016 total is 204.9 billion BTUs in annual energy savings or renewable energy offset.

**Key Items of Evaluation**

Sustainable energy programs at the University of Minnesota have generated 204.9 billion BTUs in annual energy savings or renewable energy offset. This energy conservation is enough to heat 2,568 Minnesota homes or power electricity for 5,306 homes annually.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- Renewable Development Fund
- Minnesota Department of Agriculture
- UMN Grant-in-Aid
- Environmental Defense Fund
- UMN 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 | 20% | | 20% | |
| 123 | Management and Sustainability of Forest Resources | 10% | | 20% | |
| 132 | Weather and Climate | 50% | | 20% | |
| 605 | Natural Resource and Environmental Economics | 10% | | 20% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 0.0 | 0.0 | 46.4 | 0.0 |
| **Actual Paid** | 0.0 | 0.0 | 28.5 | 0.0 |
| **Actual Volunteer** | 0.0 | 0.0 | 0.0 | 0.0 |

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

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 0 | 0 | 249646 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 0 | 0 | 1605571 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 0 | 0 | 2638533 | 0 |

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

### 1. Brief description of the Activity

**MAES.** Climate change is the greatest challenge facing resource managers and policy experts today. Research conducted at University of Minnesota related to climate change takes on this challenge from several lenses. Breeders are working to discover trees and crops with climate adaptive traits and researchers are exploring how changes to our climate will affect Minnesota and the world.
Research highlights for 2016 include:

- Research on the restoration of Great Plains ecosystems led to a new decision support model for assessing management options for grasslands that support water-dependent rare plant populations that are likely vulnerable to climate change and invasive species. The model has been published and communicated to stakeholder groups.
- Using a Bayesian inverse modeling approach, U of M researchers demonstrated that nitrous oxide emissions are much larger from the direct source categories compared to IPCC (Inter-governmental Panel of Climate Change) inventory estimates. These results suggest a high sensitivity of emissions to climate and that in a warmer and wetter world, it will be more difficult to mitigate nitrous oxide emissions.
- Researchers exploring the potential effect of climate change on corn yields in Iowa developed a model that predicts that for every 1 degree Celsius increase in average temperature, maize yields will decline by 4.6 percent. Significantly, the model suggests that even if maize received all the water it needed, yields will decline by at least 10 percent by the end of the 21$^{st}$ century.
- A climate change adaption manual developed specifically for the management of World Heritage Sites has been tested with audiences in India and Kenya. It is now available worldwide to guide managers in predicting climate changes, understanding how protected areas might be affected by those changes, and developing adaptation strategies in anticipation of such strategies.
- Two new tree germplasms with superior traits were grafted and established in the arboretum. Both the trembling aspen (Populus tremuloides) and European aspen (Populus tremula) were identified as superior during evaluation of progeny trials.
- Researchers searching for potential tree species to improve reforestation efforts post-harvesting added Ponderosa pine to their study as a potential substitute for red pine which may not be able to adapt to a warmer, drier climate in northern Minnesota.
- A project exploring whether deforestation is a viable option for mitigating climate change have developed an Agro-IBIS model that they have validated over 30 carbon and energy flux sites in the US and Canada. Further simulations will be done in 2017 that will help address where and how much afforestation can be effectively maintained to reduce carbon emissions.
- Examinations of the contributions of black ash to the total water budget in the lowland black ash forests indicate that ash transpiration accounts for 42-80 percent of the total potential evapotranspiration in these forests. These results show that large-scale loss of black ash due to Emerald Ash Borer outbreaks or harvesting may prolong periods of flooding in the system.

**Extension.** The Climate Change Initiative is a multi-disciplinary program mobilizing available and relevant Extension expertise from program 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. Some outcomes and outputs of education related to climate change are likely described in other program areas.

Minnesota is one of the areas of the United States most impacted by climate change. In 2016, Minnesotans experienced the third warmest year in history and the second wettest year. For the first time, Minnesota experienced two mega-rain events (1,000 square miles covered by at least six inches of rain), resulting in widespread flash flooding. The average September to November Minnesota temperature finished in a tie for the warmest autumn on record. These weather conditions contributed to more weed

and pest outbreaks because they thrive in warm and wet conditions. To some extent, research attributes avian influenza to climate change.

Direct education regarding climate change is done by Extension's climatologist, who provides statewide leadership and expertise on climate change and its impact on agriculture and the environment. He is a highly-sought speaker and has a standing weekly spot on Minnesota Public Radio's Morning Show. Extension provides leadership for the Minnesota Climatology Work Group in partnership with the State Climatology Office and the Department of Natural Resources Division of Ecological and Water Resources. Its goal is to coordinate efforts that help local and state governments and practitioners know how to deal with climate change. Extension also co-hosts the Minnesota Climate Adaptation conference, as reported herein.

**2. Brief description of the target audience**

Targeted audiences are community leaders and professionals who can make a difference, and who can benefit from research-based information. Many will be audiences targeted by other program areas, as described in those plans of work. Primarily, audiences are 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**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 240 | 19548 | 0 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 0 | 31 | 31 |

## 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 |
|---|---|
| 2016 | 3 |

**Output #2**

**Output Measure**

- Research will lead to new plant germplasms with superior or climate adaptive traits.

| Year | Actual |
|---|---|
| 2016 | 2 |

**Output #3**

**Output Measure**

- Researchers will develop new and improved models to measure climate change and its affect on crop yield, plants and forests, greenhouse gases, and/or water quality.

| Year | Actual |
|---|---|
| 2016 | 6 |

### 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 | Educational events that guide public and private interests to make adaptations for climate change will result in changes in decisions and behavior. |
| 3 | Research will support the development of intermediate wheatgrass and ensure new future varieties meet the needs of Minnesota farmers, the food industry, and the environment (Expressed as the number of intermediate wheat grass varieties currently in advanced testing). |

## Outcome #1

### 1. Outcome Measures

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

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Action Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 1 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Evidence for organismal response to climate change is growing but we lack basic information about how plants adapt to changing climates. Phenology, or the study of plant and animal life cycle events and how these are influenced by seasonal changes, is one tool scientists can use to understand how plants are changing and adapting to our changing climate.

**What has been done**
Over 13,000 individual records representing more than 650 species of amphibians, reptiles, birds, butterflies, dragonflies, and plants have been digitized and made available on the Minnesota Phenology Network (MnPN). The oldest observations date back to 1941 providing an excellent source for comparison.

Numerous trainings have been done to recruit new phenology observers in collaboration with Extension's Master Naturalists program. In addition, new information on phenology is being distributed via the Backyard Phenology Project which deploys a silver camper called the Climate Chaser to record stories of changes in Minnesota's climate.

**Results**
Since 2013, observers have made 95,460 individual observations. 44,157 were added during the 2016-reporting period alone, which represents a 44 percent increase over the previous reporting period. These observations have been added to a database managed by the USA-National Phenology Network.

### 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

Educational events that guide public and private interests to make adaptations for climate change will result in changes in decisions and behavior.

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Action Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 60 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Minnesota is one of the areas in the United States most impacted by climate change. Adaptation to climate change is necessary for those in the agriculture industry, communities, water resource managers, human health professionals, emergency management service managers and more.

**What has been done**
The Minnesota Climate Adaptation conference was held January 28, 2016. The conference was called "Climate Adaptation: Transforming Awareness into Action," and it highlighted outstanding climate adaptation work. Attendees and presenters included Hatch-funded researchers.

**Results**
Participants identified 60 changes that they would make as a result of information, contacts and ideas gleaned from the conference. Most significantly, state officials who attended the conference used information to revise the goals and information included in the "climate change" section of the State Hazard Mitigation Plan. Other examples included applying adaptation strategies to disaster epidemiology work, installing rain gardens to re-use water from a local draining ditch,

looking into FEMA grants for Flooding/Natural Resource Protection, and exploring work done in nearby communities in order to facilitate new collaboration.

**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 #3**

**1. Outcome Measures**

Research will support the development of intermediate wheatgrass and ensure new future varieties meet the needs of Minnesota farmers, the food industry, and the environment (Expressed as the number of intermediate wheat grass varieties currently in advanced testing).

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 5 |

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

**Issue (Who cares and Why)**
As the first widely available perennial grain crop, intermediate wheatgrass will change agriculture landscapes by providing multiple ecosystem services including making them more sustainable, especially in the face of climate change. But more work is needed to breed new varieties of intermediate wheatgrass that will be profitable for farmers and fulfill industry needs.

**What has been done**
Several Forever Green Initiative projects are focused on breeding superior varieties of intermediate wheatgrass for profitable production in the Midwest. Domestication traits such as seed shattering, threshability, and seed size are all being targeted by these efforts. Early results have been made with seed size increasing at a rate of about 5 percent per year. Researchers are also optimizing the breeding process by using DNA fingerprinting and other genomic tools to shorten this process.

**Results**
The first five variety candidates of intermediate wheatgrass entered statewide yield tests in 2016. General Mills has also teamed up with the Land Institute and the University of Minnesota to help commercialize Kernza and provide funding for the Forever Initiative to support further developments and research.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 104 | Protect Soil from Harmful Effects of Natural Elements |
| 605 | Natural Resource and Environmental Economics |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**
- Other (No factors affected outcomes.)

**Brief Explanation**

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

**Evaluation Results**

Extension educators and specialists evaluated the Minnesota Climate Adaptation Conference to determine whether, and how, information from the conference would be used by participants in their work and life settings. In total, participants reported 60 outcomes resulting from information and stories identified at the conference. Several outcomes resulted in system changes at the jurisdictional level, including pursuing new grants, changing local policy decisions, and changing sections of the State's Hazard Mitigation Plan.

**Key Items of Evaluation**

Several outcomes from the Minnesota Climate Adaptation Conference affected system changes at the jurisdictional level, including pursuing new grants, changing local policy decisions, and making changes in sections of the State Hazard Mitigation Plan.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- Minnesota Legislative and Citizens Commission on Natural Resource (LCCMR)
- National Science Foundation

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

**Program # 4**

**1. Name of the Planned Program**

Health and Nutrition

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 501 | New and Improved Food Processing Technologies | 0% | | 25% | |
| 701 | Nutrient Composition of Food | 0% | | 10% | |
| 703 | Nutrition Education and Behavior | 70% | | 10% | |
| 704 | Nutrition and Hunger in the Population | 0% | | 10% | |
| 721 | Insects and Other Pests Affecting Humans | 5% | | 10% | |
| 722 | Zoonotic Diseases and Parasites Affecting Humans | 0% | | 10% | |
| 724 | Healthy Lifestyle | 25% | | 25% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 12.2 | 0.0 | 50.4 | 0.0 |
| **Actual Paid** | 18.3 | 0.0 | 20.8 | 0.0 |
| **Actual Volunteer** | 3.0 | 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** |
| 533723 | 0 | 672876 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 1456880 | 0 | 2446733 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 5527174 | 0 | 1247021 | 0 |

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

### 1. Brief description of the Activity

**Extension.** In 2016, Health and Nutrition educators and faculty at Extension continued to find innovative and collaborative ways to reach low-income Minnesotans, with a continued emphasis on education that leads communities to make changes in policies and systems that make it easier for residents to choose healthy nutrition and exercise.

Major initiatives in 2016 used technology to enhance programming and evaluation. For example, GIS maps are being utilized to better craft and target programming. In several communities, GIS maps reveal where there are healthy food access gaps so that educators can target action to sites in neighborhoods where programming was most needed. And a new EFNEP "app" is being developed to allow educators and coordinators to more easily collect 24-hour recall data required by funders. This will make data collection easier because it leads participants through the assessment in the classroom setting, capturing high quality information about dietary intake in participants' preferred language. This technology will incorporate a database of culturally-specific foods and beverages as well as audio and visual formats. The app is being developed in English first, with future adaptations planned in Spanish, Somali, Hmong and Karen. The team will implement use of this technology in 2017.

Increased partnerships with communities and trusted community-based organization continues to result in prolific use of health and nutrition programs, with reported outcomes relating to healthier eating, improved physical activity, and structural and policy changes in communities that make it easier for residents to eat healthier and stay active.

**MAES.** Research reported under this program is focused on improving the health and dietary practices of Minnesotans and the general public. Several projects are focused on uncovering issues affecting health and nutrition among various specific populations as well as understanding the existing barriers to improving health and nutrition.
Research highlights from 2016 include:

- Researchers have made significant progress developing treatment protocols for bacterial films. They have shown that Cold-Atmospheric Pressure Plasma (CAP) jet can dramatically reduce biofilms and is more effective against biofilms than hydrogen peroxide and numerous antibiotics. In testing, CAP jet not only affects bactericidal activity but also physically disrupts the biofilm. This is significant since current antibiotic therapies cannot penetrate biofilms.
- Researchers at the University of Minnesota's Wearable Technology Lab are developing cloths that can shrink on demand (aka compression garments) that could help people with circulatory problems and could help treat simple sports injuries.

• Forty patient interviews were conducted to understand similarities and differences in cardiac rehabilitation (CR) experiences among rural and urban Minnesotans. No differences were found in regards to depression, anxiety, perceived autonomy, or cardiac self-efficacy. However, urban residents showed significantly higher heart rate disease knowledge. Rural patients also indicated distance to CR clinics and mental health professionals can be a barrier to utilization.

• A study looking at vegetable liking and availability in low-income homes found that home availability of vegetables and vegetable liking may be less of a constraint on vegetable consumption than previously thought.

• Based on a multi-year study of healthfulness of food distributed by food shelves, researchers developed the Food Assortment Scoring Tool (FAST). This new model shows great promise for use at all levels of the hunger relief system.

• Researchers compared survey data collected from 626 dieticians in 49 states to data collected from Minnesota dieticians in 2002. They found more dieticians are incorporating environmental issues (including sustainable agriculture) into practice but similar barriers remain including lack of knowledge, ability, time, and employer support.

• Researchers at the flavor institute are now working with a new methodology called position annihilation lifetime spectroscopy (PALS) for new insights into capsule structure. They hope PALS will assist with creating new encapsulation formations to improve flavor and shelf life in the food and beverage industry.

• A study on how acculturation and environmental factors affect the eating habits of Chinese students living in the US found they are undergoing the process of dietary acculturation. Breakfast and lunch were the first meals to become more American along with snacks. Additionally, weight gain was common among the students (69 percent male, 85 percent female), which could lead higher risks of developing chronic diseases. The study shows the importance of providing more information regarding health and diet to incoming foreign students at orientation.

**2. Brief description of the target audience**

**Extension.** For maximum impact, Extension's health and nutrition team reaches:

• 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 SNAP-Ed participants have every opportunity to put into practice what they learn in classes.

**MAES** research target audiences also include:

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

**3. How was eXtension used?**

In 2016, Health and Nutrition's Program Director was an eXtension I-Three Issue Corps Member for the Minnesota Food Charter Network. This Network was launched in November of 2015. Also, eXtension links to UMN's website: bedbugs.umn.edu.

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 15505 | 1335974 | 7936 | 0 |

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

**Patent Applications Submitted**

Year: 2016

Actual: 4

**Patents listed**

Therapeutic Compounds: PCT/US2016/019374 - 2/24/2016
Composition for Detection and Treatment of Bed Bugs: International Filing - 12/23/15
Stitched Stretch Sensor: 15/137,736 - 4/25/16
An Umami-Enhanced Food Product and Method of Enhancing the Umami Taste of Food Product: 15/088,560 - 4/1/2016
Bio-renewable Plasticizers Derived from Vegetable Oil: 9,315,650 - 4/19/2016 (ISSUED)
Stitched Stretch Sensor: 9,322,121 - 4/26/16 (ISSUED)

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 12 | 51 | 63 |

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

**Output Target**

**Output #1**

**Output Measure**

- Number of workshops/classes or educational presentations taught.

| Year | Actual |
|---|---|
| 2016 | 1458 |

**Output #2**

**Output Measure**

- Number of organizations represented in community networks.

| Year | Actual |
|---|---|
| 2016 | 1149 |

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

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Program participants will increase human nutrition knowledge. (Target expressed as percentage of participants who report knowledge change.) |
| 2 | Professionals, organizations and policymakers will adopt practices, organizational culture and policies that promote food literacy, active living and healthy food access. (Target expressed as number of changes made.) |
| 3 | An increased number of program participants will use research-based information from Extension to improve their intake of healthful foods and engagement in physical activity. (Target expressed as a percentage of participants who self-report change.) |
| 4 | Research will support families, children and youth understanding of healthy food choices. |
| 5 | Nutrition researchers and Extension educators will work closely with Native American populations to share academic knowledge and help establish best practices to improve Native American nutrition (expressed as the number of conferences or other opportunities presented to share). |

**Outcome #1**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 58 |

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

**Issue (Who cares and Why)**
In 2014, 10.4 percent (588,770 Minnesotans) were food insecure, and of these, 59 percent were eligible for SNAP. In that same year, there were 3.34 million visits to 300 food shelves in the state. Approximately 15.2 percent of children live in food-insecure households in Minnesota. Almost 4 in 10 students in Minnesota public schools are eligible for free and reduced lunch, an increase from 2015. Information about how to prepare and enjoy healthy foods on a budget addresses the ultimate health outcomes of low-income families.

**What has been done**
In Minnesota, Extension's Expanded Food and Nutrition Education Program operates only in the metro area. They target immigrant families and Native American communities. Nutrition educators work in a diverse array of community sites already trusted by these communities. Nutrition and lifestyle classes are conducted in several languages in group and home visit settings.

**Results**
EFNEP coordinators administer behavior checklists and 24-hour dietary recalls at program exit to measure improvement. In 2016, this data showed that 79 percent of children and youth improved their ability to choose foods, 49 percent use safe food handling practices more often, 39 percent improved their physical activity, and 52 percent improved their ability to prepare simple, nutritious affordable food. Among adults, 77 percent showed improvement in one or more practice related to food management (planning meals, using grocery lists), and 83 percent showed improvement in a nutrition practice (reading nutrition labels, healthy food choices, making breakfast for their child).

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|

| | |
|---|---|
| 703 | Nutrition Education and Behavior |
| 704 | Nutrition and Hunger in the Population |
| 724 | Healthy Lifestyle |

**Outcome #2**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 484 |

**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 retail options for 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. Improving residents' consumption of fruits and vegetables requires approaches that influence multiple levels of policy, system, and environmental factors.

**What has been done**
Extension supports 60+ food networks as they implement food charter strategies, helping them enhance local and regional food access and address health issues in food systems. By current estimation, SNAP-Ed staff are involved in, facilitating or leading more than 45 such networks across the state. The largest such network, Metro Food Access Network, is currently led and supported by SNAP-Ed educators and Health and Nutrition Extension educators.

**Results**
In all, 484 such changes were made in communities in 2016. Examples of outcomes included: healthier menus at restaurants, residential settings, non-profits, and summer feeding programs; the development of community gardens in neighborhoods, public schools, and non-profit settings; improved access to physical activity in schools and neighborhoods; backpack programs that send food home with at-risk kids for weekends; healthier foods in schools; guides to healthy choices at food shelves and grocery stores, EBT access at the farmers markets, healthy vending machines,

referral systems for nutrition classes, and supportive environments for breastfeeding moms.

**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**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 59 |

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

**Issue (Who cares and Why)**
SNAP recipients are low-income (165 percent of poverty guidelines) or particularly vulnerable, such as limited income residents who are senior or disabled. SNAP-Ed is a federal program established in the Healthy, Hunger-Free Kids Act of 2010. In Minnesota, the Department of Human Services is the state agency that receives the grant, and the sub-grantees are the Minnesota Chippewa Tribe and the University of Minnesota Extension. In 2014, 232,828 adults and 162,724 children were eligible for SNAP in Minnesota.

**What has been done**
SNAP-Ed classes serve a diverse array of participants and address critical needs. An assortment of 18 programs address various populations through targeted experiential and learning activities focused on eating healthy, being active, changing household routines and preventing heart disease and diabetes.

**Results**
Carefully designed evaluation approaches have collected information about change in 8,866

participants, with demonstrated outcomes in increased fruit and vegetable consumption and increased physical activity. Adults were found to increase their fruit consumption by .38 servings a day and increase their vegetable intake by .44 servings a day. Adults increased their scores on the Godin Leisure-Time Exercise Questionnaire by 26 percent. Teens increased their fruit consumption by .37 servings a day and increased their vegetable consumption by .22 servings a day. Youth increased their fruit intake by .20 servings a day and vegetable servings by .12 servings a day. Youth also played sports .28 times more a day and played outside .25 times more a day.

**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.

Not Reporting on this Outcome Measure

**Outcome #5**

**1. Outcome Measures**

Nutrition researchers and Extension educators will work closely with Native American populations to share academic knowledge and help establish best practices to improve Native American nutrition (expressed as the number of conferences or other opportunities presented to share).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 1 |

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

**Issue (Who cares and Why)**
Extreme poverty and the loss of traditional foods have caused many Native Americans to suffer from poor or inadequate diets. This has led to increased obesity, diabetes, and other profound health problems on a large scale.

**What has been done**
Important work to solve the problems of Indian nutrition is already being done by many tribes, nonprofits, public health experts, researchers, and advocates on a localized basis. But much more work remains to be done to raise awareness, spread knowledge, create capacity for change, and develop additional solutions.

Seeds of Native Health is a multifaceted national campaign to improve Native American nutrition and is supported by the Shakopee Mdewakanton Sioux Community. The University is a strategic partner in the campaign and received a one million dollar gift to convene annual conferences on Native American nutrition and food access; create a public, comprehensive repository of best practices and national experts in the field; and analyze the obstacles between Western academic research and Native American traditional knowledge relating to food and nutrition.

**Results**
In September 2016, 456 participants attended the first Annual Conference of Native American Nutrition in Prior Lake, MN. Attendees were about half native and half-non-native and represented 33 states, two Canadian provinces, and three other countries. The conference provided an opportunity to share academic and indigenous wisdom in one location and help establish best practices to utilize in the future.

Feedback from participants will inform future conferences and influence the ongoing efforts within the Seeds of Native Health Campaign.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 701 | Nutrient Composition of Food |
| 703 | Nutrition Education and Behavior |
| 704 | Nutrition and Hunger in the Population |
| 724 | Healthy Lifestyle |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**
- Other (No external factors affected outcomes.)

**Brief Explanation**

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

## Evaluation Results

**Extension.** Because health outcomes are related to healthy food consumption and increased physical activity, the health and nutrition team conducts rigorous evaluation to examine changes in habits that are sustained over time. Community-based efforts to create local environments that support those choices are also assessed.

In 2016, evaluations found that adults increased their fruit consumption by .38 servings a day and increase their vegetable intake by .44 servings a day. Adults increased their scores on the Godin Leisure-Time Exercise Questionnaire by 26 percent. Teens increased their fruit consumption by .37 servings a day and increased their vegetable consumption by .22 servings a day. Youth increased their fruit intake by .20 servings a day and vegetable servings by .12 servings a day. Youth also played sports .28 times more a day and played outside .25 times more a day.

Extension efforts also resulted in 484 local changes in policy or resources that made healthier menus available, developed community gardens and increased access to physical activity and access to healthy local foods in public places.

## Key Items of Evaluation

**Extension** participants were found to increase their fruit consumption by .38 servings a day and increase their vegetable intake by .44 servings a day. Adults increased their scores on the Godin Leisure-Time Exercise Questionnaire by 26 percent. Teens increased their fruit consumption by .37 servings a day and increased their vegetable consumption by .22 servings a day. Youth increased their fruit intake by .20 servings a day and vegetable servings by .12 servings a day. Youth also played sports .28 times more a day and played outside .25 times more a day.
Extension efforts also resulted in 484 local changes that made healthier menus available, developed community gardens and increased access to physical activity and access to healthy local foods in public places.

**MAES**. Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- National Institute of Health
- Midwest Dairy Foods Research Center
- Mayo Clinic
- Shakopee Mdewakanton Sioux Community

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

**Program # 5**

**1. Name of the Planned Program**

Food Safety

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 501 | New and Improved Food Processing Technologies | 0% | | 50% | |
| 503 | Quality Maintenance in Storing and Marketing Food Products | 0% | | 20% | |
| 504 | Home and Commercial Food Service | 100% | | 30% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 8.3 | 0.0 | 9.6 | 0.0 |
| **Actual Paid** | 14.1 | 0.0 | 13.9 | 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** |
| 717299 | 0 | 206349 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 1859482 | 0 | 1535497 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 635055 | 0 | 714102 | 0 |

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

### 1. Brief description of the Activity

**MAES.** University researchers are working to create a safe food system for consumers by developing novel technologies to detect foodborne pathogens while partnering with the food industry to prevent food spoilage and recalls.

- Researchers exploring effects of desiccation on survival of Escherichia coli K-12 found that only 0.00l percent of the original culture sample could form colonies on solid growth medium in the first 12 hours after rehydration. However, after 36 hours this increased to 15 percent. They determined this increase is due to the cells ability to divide and form colonies as the number of cells and the density of the culture samples did not increase.
- A study on how multidrug resistant Salmonella Heidelberg invades cecum, organs, and skeletal muscles of turkey poults indicated: (1) the ceca showed high colonization potential; (2) the spleen was more infected than the liver; and (3) some muscle samples tested positive for S Heidelberg.
- A lab scale intense pulsed light (IPL) system has been developed and constructed by U of M researchers. The IPL system consists of three components including a powder feeding mechanism, powder transport/fluidization, and light sources. It will be used to increase the safety of powered foods by disinfecting key pathogens. Early results are promising and work will continue in 2017.
- Research on ST398 LA-MRSA, a multidrug resistant infection that affects food animals and retail meat worldwide, revealed the ST398 isolate is resistant to Amoxicillin, Ampicillin, Oxacillin, Bacitracin, Phospomycin, Kanamymin, and Chlorampenicol. But is sensitive to Novobiocin, Rifampicin, and Vancomycin.
- A study comparing the Automated Milk Leukocyte Differential (MLD) Test and the California Mastitis Test (CMT) for detecting intramammary infection in early lactation and late lactation quarters and cows found that both tests might have greater utility in late lactation. However, large randomized field studies are needed to determine impacts on udder health, antibiotic use, and economics.
- Researchers successfully developed a mouse model of soy allergy-induced GI inflammation. After three generations of breeding mice on a soy-free diet, mice in the study were challenged with a soy protein isolate. The isolate appeared to cause an elevation in soluble epoxide hydrolase, which is known to have a pro-inflammatory role in inflammation models.

**Extension** Food Safety programs continue to partner with the Minnesota Department of Health and Minnesota Department of Agriculture to create and deliver education that assures compliance with state regulations, certifying food managers and cottage food producers so that food handling keeps the public safe. Extension's food safety program managed two program priorities in 2016. The first was to create curricula that addresses new and emerging issues. In 2016, these efforts resulted in expanding the delivery of training that responds to Minnesota's Cottage Food Legislation passed in 2015. (See impacts.) The second is to increase access to educational resources by moving all certified food manager renewal courses online. Moving more content to its website has resulted in an 89 percent increase in web-unique page views since 2014.

### 2. Brief description of the target audience

Research supports the food development industry and food processing industry. Extension's direct audiences are food service workers, the National Restaurant Association, food handlers in community locations, fishermen and farmers. Underserved audiences are reached through the organizations they trust.

### 3. How was eXtension used?

eXtension was not used in this program

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

### 1. Standard output measures

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 5932 | 1049884 | 0 | 0 |

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

**Patent Applications Submitted**

Year: 2016

Actual: 1

**Patents listed**

Detection Assays and Methods: 15/055,217; PCT/US2016/019772 - 2/26/2016

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 0 | 9 | 9 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- Number of workshops or other educational events conducted.

| Year | Actual |
|---|---|
| 2016 | 52 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Research will increase number of viable technologies to improve food safety. |
| 2 | Research will increase understanding of threats to food safety from microbial and chemical sources. |
| 3 | Participants of Food Safety program classes will achieve significant learning gains regarding research-based food safety knowledge and skills. (Measure is the percentage of participants who achieved significant learning gains.) |
| 4 | Participants of Food Safety program classes will significantly improve their food safety practices as a result of attending the program. (Measure is the percentage of participants that significantly changed one or more of their food safety practices as a result of attending classes intended to improve food safety practices.) |
| 5 | Cottage food producers are registered with the State of Minnesota after Extension training. (Outcome is the number of producers registered.) |

## Outcome #1

### 1. Outcome Measures

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

### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Condition Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 1 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
According to the Centers for Disease Control and Prevention (CDC), each year roughly 1 in 6 Americans get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. Simple and rapid microbial food spoilage diagnostic tools are needed to not only protect public health but also assist the food industry.

**What has been done**
U of M researchers scrutinized conventional diagnostic tools and concluded new tools needed to be not only rapid, but also sensitive, specific, and cost-effective for the industry to adopt them.

Colorimetric tests met these requirements: they are very sensitive, eliciting accurate results in a short period, and they don't require the purchasing of expensive equipment. Researchers then developed naked-eye bioassays for rapid detection of foodborne pathogens that are fairly simple to perform and indicate the presence of bacteria, fungi, and/or molds.

**Results**
One new technology is able to detect for bacteria and fungi in yogurt in less than an hour, other foods take as little as five minutes. In the food safety and food quality arena, these systems not only solve problems but also change the game, eliminating the lag between administering a test and obtaining results.

Industry partners are already taken notice with both General Mills and Schwan providing industry insights and funding for research. A start up company is in development to commercialize the new technologies and assist in getting them out to industry partners.

### 4. Associated Knowledge Areas

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

**Outcome #2**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 0 |

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

**Issue (Who cares and Why)**
The desire for locally grown and sustainable food sources continues in Minnesota. But more work is needed to integrate risk-based research and outreach to improve the safety of food from farm to fork.

**What has been done**
U of M food safety researchers partnered with Extension's Regional Sustainable Development Partnerships and a local sustainable food and agricultural non-profit to research and validate an innovative permaculture chicken production system that is accessible to low-income and beginning farmers.

Specifically, they were studying the food safety risks of using chicken manure for field fertilizer in an alternative poultry production system.

**Results**
Microbial testing was conducted on spinach and cantaloupe grown in fields fertilized the prior year with organic chicken manure. The tests revealed coliforms, Salmonella, and Listeria spp. were present on both produce items.

From these results researchers have recommended chemical or heat treatment of organic

manure when using in such practices.

**4. Associated Knowledge Areas**

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

**Outcome #3**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 94 |

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

**Issue (Who cares and Why)**
Thousands of Minnesotans eat at events where food is prepared and served by volunteers from facilities that are not inspected by the Minnesota Department of Health or the Minnesota Department of Agriculture. These meals might be served at churches, school fund raisers, community halls, and food stands at community festivals and fairs.

**What has been done**
Cooking Safely for a Crowd is food safety training for anyone who volunteers to plan, prepare, serve or handle food at large group events.

**Results**
In the Cooking Safely for a Crowd course, over 94 percent of participants who responded made positive gains from the pre-program to post-program in terms of knowledge and behavior. They indicated that they would change actions related to personal hygiene, safe food handling, cleaning and sanitizing, and educating others.

**4. Associated Knowledge Areas**

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

**Outcome #4**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #5**

**1. Outcome Measures**

Cottage food producers are registered with the State of Minnesota after Extension training. (Outcome is the number of producers registered.)

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 1800 |

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

**Issue (Who cares and Why)**
Small producers in the cottage food industry enrich and diversify local economies by finding niche markets for homemade foods. The Minnesota 2015 Cottage Food Exemption supports these entrepreneurs by allowing Minnesota residents to manufacture and store particular foods in an unlicensed kitchen. Foods can be sold from home, farmer's markets, farm stands or at community events without formal licensing by the State of Minnesota.

**What has been done**
In 2016, Extension developed curriculum and activities for a three-hour advanced course. Registration with the Minnesota Department of Agriculture is required after completing cottage food safety training. Extension consulted on the Department of Agriculture's basic training and exclusively provides advanced training. Extension is the only program authorized by the

Department of Agriculture to offer training. Ten sessions in seven locations educated 98 cottage food producers. Producers with sales under $5,000 took advantage of an online course.

**Results**
Before the educational efforts, the Department of Agriculture had less than 100 registered cottage food producers. Now there are over 1,800 Minnesota cottage food producers registered with the state. Some of the ways that producers indicated they would improve the safety of their cottage food products was better sanitizing practices, implementing pH testing, and ensuring they are producing items that follow guidelines.

**4. Associated Knowledge Areas**

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

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**

- Government Regulations
- Other (learning technology adoption)

**Brief Explanation**

Collaboration with the State of Minnesota changes the audience and programming offered by Extension when educational programming can support state legislation. In 2016, state legislation changed program outcomes by supporting the training and registration of the cottage food industry. Indirect outreach and contacts were enhanced in 2016 due to delivery of content online.

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

**Evaluation Results**

Extension routinely evaluates its face-to-face and online educational delivery by monitoring test scores that support certification of food service professionals. In 2016, 248 ServSafe exams were given by University of Minnesota Extension to first time class members, retest participants, TAP online certification course participants and individuals who took the course from another provider but needed to find their own exam site and proctor. Seventy percent (173) of these exams had a passing score.

**Key Items of Evaluation**

**Extension** is a key partner to the State of Minnesota in training and certifying food service professionals. In 2016, this included an expanded effort to support the cottage food industry. Before the educational efforts, the Department of Agriculture had less than 100 registered cottage food producers, and now there are over 1,800 Minnesota cottage food producers registered with the state.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- MnDRIVE
- USDA-AFRI
- General Mills
- Schwan Food Company
- National Science Foundation
- Midwest Dairy Association

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

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 7.5 | 0.0 | 18.2 | 0.0 |
| **Actual Paid** | 15.3 | 0.0 | 36.7 | 0.0 |
| **Actual Volunteer** | 0.0 | 0.0 | 0.0 | 0.0 |

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

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 747195 | 0 | 391261 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 1935345 | 0 | 1999688 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 600161 | 0 | 3110051 | 0 |

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

### 1. Brief description of the Activity

**MAES and Extension**. Minnesota has a total water surface area of around 13 million acres, and has more wetland acres than any state except Alaska. Minnesota's history is closely tied to its bodies of water and their clearness but today more than 40 percent of Minnesota's lakes, rivers and other water bodies are considered polluted or impaired. Additionally, our waters are facing new threats in the form of aquatic invasive species, changes in land-use, and climate change.

Managing these resources presents a host of concerns that require a cross-disciplinary focus, and bringing education to the spectrum of situations in Minnesota communities. The University's Water Resources Center, a partnership between Extension and the College of Food, Agricultural and Natural Resource Sciences, deploys educators and specialists across Extension's centers to focus on a number of opportunities to keep water healthy, safe, clean and abundant in Minnesota. These efforts:

- provide education to local elected and appointed decision makers who have a role in addressing the relationship between land use and natural resource protection (See outcome.)
- partner with turf grass experts and Golf Course Managers to effectively manage turf for parks, recreation and sports (See outcome.)
- research and educate residents who can reduce water use in home landscapes, which accounts for nearly one-third of residential water use.
- monitor and prevent the spread of aquatic invasive species.
- work with agricultural producers to maximize return on fertilizer investments while minimizing the spread of nitrogen into water supplies (See Global Foods outcome).
- responding to climate changes (See Climate Change).
- trains conservation professionals and volunteers in civic engagement processes that engage communities in protection of water supplies (See Community Vitality).

**MAES.** In August 2016, Governor Dayton kicked off a "Year of Water Action" in Minnesota, urging businesses, the agricultural industry, outdoor enthusiasts, communities and families to take action to conserve and improve water quality. The importance of protecting Minnesota's water for future generations is the driving force behind research efforts related to water resources.

Research highlights for 2016 include:

- Researchers designed and tested a new, portable soil nutrient sampling device that will provide farmers and ag. engineers with accurate, realtime nitrate-nitrogen information.
- Researchers exploring how tree harvesting affects nearby stream quality have set up measurements in a Northern MN stream for stream water level, electrical conductivity, temperature, and turbidity. Measurements will be recorded every five minutes in addition to seasonal analysis of water quality. Data will be collected for the next 1.5 years, which will encompass before, during, and just after a nearby timber harvest.
- An additional 8,744 specimens and 26 species were added to the collection of Trichoptera at the University of Minnesota Insect Collection. In all the collection houses 631,943 specimens representing 2,691 species, making it one of the most important collections of Trichoptera in the world.
- The Sand Plain Research Station did a study on the effectiveness of two blends of struvite product (Crystal Green, Ostara) with MAP as a source of phosphorous in potato fields. Results showed the use of blends of MAP and Crystal Green provides neither advantages nor disadvantages compared to 100 percent MAP. They concluded that because the cost of Crystal Green as a P source is higher than MAP alone, it is unlikely if a market for Crystal Green for potato production will develop without a subsidy being provided.

• A research project exploring the fate of mercury following forest fires found no noticeable increase in mercury in lake waters or in perch following forest fires of moderate severity.
• Researchers working on control and management techniques for common carp in Minnesota's lakes successfully attracted the fish to areas of the lake using both sex pheromones and food. This allowed them to quantify abundance and could assist with carp removal in the future.
• A new factsheet was released summarizing research, applications to management, and the new Minnesota buffer rule.
• Strategies for reducing excess imports and/or increasing exports of phosphorous were developed into nine case studies that were published on the Extension Manure Management and Air Quality website.
• U of M designed computer software that helps determine the length of filter strip required to control stormwater runoff from a parking lot or paved roadway is being used by municipalities and highway departments as they assess, design, and plan systems that use the infiltration capacity of the soil to reduce and control stormwater.
• Two economic studies on the importance of water as a constraining resource for agricultural production in Morocco and Kazakhstan were provided to the United Nations Environmental Program (UNEP) and presented at workshops organized by UNEP. An independent review said they were one of the most successful undertakings funded by UNEP.

**2. Brief description of the target audience**

Water Resource Programs are available to communities and industries across the entire state. Local government engineers and planners, consulting engineers and architects are targeted as they help communities make decisions that impact Minnesota's waters. Natural resource and horticulture professionals are engaged as partners, learners and agents of change. Homeowners and community members are another key audience because their use of water and management of waste can positively and negatively affect water supply.

**3. How was eXtension used?**

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

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 10115 | 90187 | 380 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 5 |

**Patents listed**
Selenium Nanomaterials and Methods of Making and Using Same: PCT/US2016/056850 - 10/13/2016
Soil Sampling and Testing Apparatus and Method: 62/335,286 - 5/12/2016
Methods of Coating Microorganisms with Nanoparticles and Methods of Use Thereof and Compositions: 62/287,894 - 1/27/2016
Lateral Flow Assay Device and Methods of Using: 62/287,892 - 1/27/2016
Hydrothermal Carbonization of Sewage Wastes: 9,475,698 - 10/25/2016

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| Actual | 7 | 31 | 38 |

**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 |
|---|---|
| 2016 | 129 |

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

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Community decision-makers, leaders and professionals will increase their knowledge related to approaches to water planning, water conservation and water quality improvement. (Outcome expressed as a percentage of participants.) |
| 2 | Using knowledge gained from research and water resources education programming, community groups will create and/or implement existing local plans to protect and improve water quality and/or conserve water resources. (Outcome is the number of plans developed or revised in part due to programming.) |
| 3 | Water resource professionals will apply skills and resources learned while participating in programs to address specific water management responsibilities and to achieve water management goals. (The outcome is a percentage of professionals who said they are applying skills.) |
| 4 | A collaboration between research, Extension and the Minnesota Golf Course Superintendents Association has resulted in reduced water use. (Outcome is the percentage of reduced water use reported by golf course superintendents.) |
| 5 | Research on the best ways to restore Minnesota's waters will inform agency engagement plans and training materials (expressed as the number of workshops or training materials incorporating research findings). |
| 6 | Researchers will develop state-of-the-art tools to lower mercury levels in water safely and effectively (expressed as the number of new tools developed). |
| 7 | Research will uncover new information to assist with controlling aquatic invasive species that are negatively affecting Minnesota's lakes, rivers and streams. |

## Outcome #1

### 1. Outcome Measures

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

### 2. Associated Institution Types

- 1862 Extension

### 3a. Outcome Type:

Change in Action Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 83 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Nonpoint source pollution, or polluted runoff, is the number one water quality problem in the United States. Because water quality is a reflection of land use in a watershed, and because land use is determined and managed at the local level, local land use officials need information to determine the appropriate steps they can take to protect the water supply in their watersheds.

**What has been done**
Nonpoint Education for Municipal Officials is a nationally recognized educational program for elected and appointed officials who have a role in addressing the relationship between land use and natural resource protection. In 2016, three "workshops on the water" were held for 145 elected and appointed officials and community leaders, including city council members and watershed board and advisory committee members. The interactive, hands-on shipboard workshops took place on the lakes, rivers and streams they manage.

**Results**
Of the leaders participating, 83 percent said they were preparing to take action. Some of the top actions identified included: intent to work toward adoption of Minimal Impact Design Standards in communities; preparing to educate the community on the benefits of redirecting downspouts, sump pumps and other potential runoff away from slopes and ravines; and work to identify high risk erosion areas in the community and enforce policies to protect them.

### 4. Associated Knowledge Areas

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

| | |
|---|---|
| 133 | Pollution Prevention and Mitigation |
| 403 | Waste Disposal, Recycling, and Reuse |

**Outcome #2**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #3**

**1. Outcome Measures**

Water resource professionals will apply skills and resources learned while participating in programs to address specific water management responsibilities and to achieve water management goals. (The outcome is a percentage of professionals who said they are applying skills.)

Not Reporting on this Outcome Measure

**Outcome #4**

**1. Outcome Measures**

A collaboration between research, Extension and the Minnesota Golf Course Superintendents Association has resulted in reduced water use. (Outcome is the percentage of reduced water use reported by golf course superintendents.)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 22 |

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

**Issue (Who cares and Why)**

Golf is a $2.3 billion industry in Minnesota. Providing a good experience for golfers requires a playable and appealing landscape, but enhanced stewardship of water resources is important to the public's perception of the sport and the golfing industry. Industry leaders are voluntarily seeking help from the University of Minnesota to become good environmental stewards.

**What has been done**
In a collaboration between Extension, Hatch-funded Agricultural Experiment Station, and Minnesota's Golf Course Superintendents Association, superintendents are receiving environmental education on the basics of assessing site water use, auditing irrigation, technology options, drought-tolerant turf, and more. The collaboration also played a role in supporting the Hazeltine Golf Course in preparation for the Ryder Cup in 2016.

**Results**
Research-informed changes in turf management have resulted in a 22 percent reduction in water use by Minnesota golf courses in recent years. The executive director of the Association reflects the attitude shift of the industry: "We think of a local golf course as a community's largest rain garden."

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 111 | Conservation and Efficient Use of Water |

**Outcome #5**

**1. Outcome Measures**

Research on the best ways to restore Minnesota's waters will inform agency engagement plans and training materials (expressed as the number of workshops or training materials incorporating research findings).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 4 |

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

**Issue (Who cares and Why)**
Science makes it clear that the greatest factor affecting water resources is what people do on the land. In order to mobilize Minnesotans to take voluntary actions to protect and restore

Minnesota's waters, we need to better understand and address the drivers of positive actions as well as the barriers and constraints that exist.

**What has been done**
In 2008, the Minnesota Legislature committed to supporting improvements in Minnesota's water quality through the Clean Water Fund. University researchers and Extension educators have been key partners in this effort including tracking how well education, outreach, and civic engagement strategies are working.

Researchers developed a new social monitoring system that has been piloted and adopted by several state agencies in Minnesota and Wisconsin. The Social Measures Monitoring System (SMMS) is a scientific approach that provides a common set of social outcome statements that can be used by each state agency thus creating a common starting point for consistency.

**Results**
End users have applied SMMS findings to redesign community engagement strategies in natural resource plans, better implement community engagement in natural resource programming, and design new training materials and programs for natural resource agency staff and other professionals.

In one example, in a statewide survey staff at Minnesota's Soil and Water Conservation Districts (SWCD) identified the need to "grow" more local ability to address ground water issues and spend more money and time on local outreach efforts. The survey results were used to tailor the content of four groundwater workshops for SWCD in greater Minnesota.

**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 |
| 605 | Natural Resource and Environmental Economics |

**Outcome #6**

**1. Outcome Measures**

Researchers will develop state-of-the-art tools to lower mercury levels in water safely and effectively (expressed 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 |
|---|---|
| 2016 | 1 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Despite decades of effort to reduce mercury contamination in water sources low levels of mercury are still being released into the environment causing a threat to public health and harming aquatic life. In northern Minnesota alone, 10 percent of newborns tested positive for mercury concentration above EPA recommendations highlighting the need to reduce mercury exposures of some pregnant women in the state.

**What has been done**
Building on the work of previous research with nanoparticles, U of M researchers used a store-bought, memory foam sponge and coated it with a nano-layer of selenium. The resulting sponge can remove over 99.9 percent of mercury from lakes, rivers, storm water ponds, wetlands, and wastewater within seconds.

**Results**
The efficiency of the sponge was demonstrated by removing mercury to undetectable levels from tap, lake, and industrial water, regardless of pH conditions. Additionally, it meets all EPA standards for nonhazardous waste disposal by permanently binding the mercury into biologically inert, non-toxic complexes.

The demonstrated removal capacity will open up new opportunities to clean rain, surface and groundwater, and reduce mercury cycling at multiple stages. Both a US and international patent are currently pending.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 112 | Watershed Protection and Management |
| 133 | Pollution Prevention and Mitigation |

## Outcome #7

### 1. Outcome Measures

Research will uncover new information to assist with controlling aquatic invasive species that are negatively affecting Minnesota's lakes, rivers and streams.

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 0 |

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

**Issue (Who cares and Why)**
Invasive aquatic plants are difficult to control and restoring native habitats after controlling an invasive pest is even more difficult. More information is needed to develop effective control and, ultimately, restoration efforts.

**What has been done**
Researchers at the University's Aquatic Invasive Species Center setout to discover the status of hybrid watermilfoil--a cross between the invasive Eurasian watermilfoil and Minnesota's native northern watermilfoil--in Lake Minnetonka and how it is or is not affected by herbicide applications being used to control Eurasian watermilfoil.

**Results**
Using cutting edge genetic screening techniques, researchers discovered that hydrid watermilfoil is actually denser in areas treated with herbicides. This finding highlights the need to customize management techniques for invasive species to the plants' specific genetic makeup. And in the case of watermilfoil, the study also revealed the species is more genetically diverse than previously thought.

This pilot study has already led to plans for a larger study and will inform Extension outreach regarding management techniques for controlling watermilfoil in Minnesota's waters.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 112 | Watershed Protection and Management |
| 135 | Aquatic and Terrestrial Wildlife |

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**
- Other (No external factors affected outcomes.)

### Brief Explanation

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

### Evaluation Results

Citizen action is a key objective for **Extension's** Water Resources team. Evaluation processes monitor whether the education and certification programs (e.g., for golf course superintendence or municipal officials) have provided enough information to guide local actions that are most important to their specific community, industry, or watershed.

Post-program evaluations and assessments have determined that leaders are ready to act after engaging with Extension in education about water conservation. Municipal officers are ready to coordinate with local partners, to identify dangers to water quality, or to adopt community-wide standards. In the case of an in-depth partnership with the Minnesota Golf Superintendents Association, selected actions resulted in a 22 percent decrease in water use on Minnesota's golf courses.

### Key Items of Evaluation

Post-program evaluations and assessments have determined that leaders are ready to act after engaging with **Extension** in education about water conservation. Municipal officers are ready to coordinate with local partners, to identify dangers to water quality, or to adopt community-wide standards. In the case of an in-depth partnership with the Minnesota Golf Superintendents' Association, selected actions resulted in a 22 percent decrease in water use on Minnesota's golf courses.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- Minnesota Environmental and Natural Resources Trust Fund (MAISRC)
- USGA - State Water Resources Research Institute
- EPA 319 Program - MN Pollution Control Agency
- McKnight Foundation
- Minnesota Legacy Funds - Clean Water Fund
- UMN Water Resources Center
- Minnesota Invasive Terrestrial Plants and Pest Center (State Funded)
- Legislative-Citizen Commission on Minnesota Resources (LCCMR)

## 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 |
|---|---|---|---|---|---|
| 608 | Community Resource Planning and Development | 50% | | 40% | |
| 611 | Foreign Policy and Programs | 0% | | 20% | |
| 803 | Sociological and Technological Change Affecting Individuals, Families, and Communities | 50% | | 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: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 31.5 | 0.0 | 4.4 | 0.0 |
| **Actual Paid** | 27.7 | 0.0 | 10.0 | 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** |
| 919089 | 0 | 158660 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 2948097 | 0 | 1280879 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 762515 | 0 | 504659 | 0 |

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

### 1. Brief description of the Activity

**Extension.** Community Vitality programs at Extension deliver educational opportunities and applied research that help communities choose their future. Education informs local decisions, improves the processes civic leaders use when they make decisions, enhance the skills, ability and confidence of the people who lead and decide and increase the number of people who step up to lead and decide.

In 2016, Community Vitality educators and specialists managed 34 community cohorts that grew leadership or conducted community-driven research. The team delivered 165 applied research reports that informed local decisions, including examinations of retail trade strengths and opportunities, tourism development options, and business retention and expansion options. The most popular applied research reports examined local demographic trends, with attention to which age cohorts are moving in and out of rural counties throughout the United States. This "brain gain" research is helping communities consider ways to attract and retain their future workforce.

Reported outcomes in 2016 demonstrate that Community Vitality programs are addressing the leadership gap in rural communities by encouraging and educating leaders in long-term educational programming. Outcomes indicate that these leaders are more confidently and competently leading citizens to make decisions. Research is being applied directly to choices made in community planning, and once plans are implemented, communities see a direct impact on community capitals that can be leveraged to support community vitality.

**MAES.** There are only a few research projects tracked to this planned program. Predominantly, these include projects related to the effect of SNAP, providing new training and guidance to social workers and mental health professionals and developing new wearable technologies for first responders.
Research highlights for 2016 include:

- For a project looking at how mental health professionals in MN screen refugees, researchers provided training and evaluation for key staff at four refugee health screening clinics. In addition, a laminated pocket guide reference tool was distributed to all screening clinics in the state.
- In 2016, over 50 mental health professionals in Minnesota received training in Narrative Exposure Therapy, an evidence-based treatment for posttraumatic stress disorder. Annual training opportunities will continue.
- In fall 2016, an evidence-based parenting intervention was adapted and piloted with Karen refugee caretakers in St. Paul, MN. Results from this pilot study are forthcoming.
- University of Minnesota textile design researchers developed a technique to measure the contact

between a garment and the body during movement. This method can evaluate garments that require skin contact like body sensors and liquid cooling garments.

**2. Brief description of the target audience**

Community Vitality and Public Finance programs reach out to local government agencies, employees, community leaders, nonprofit organizations through their collaborative associations, foundations and their grantees, the natural resources sector, the agricultural and tourism sectors, public health organizations, Chambers of Commerce, Economic Development Associations and thousands of alumni of leadership cohort programs from previous years.

In 2016, community vitality programs were delivered in the following types of communities:

- City and county leaders and emerging leaders (18 of 34 cohorts)
- Regional waterways and soil and water conservation districts (8)
- State industry leaders and civic leaders (e.g., economic development, agriculture) (4)
- Extension state and national volunteers and staff (2)
- Regional leaders and emerging leaders (2)

**3. How was eXtension used?**

Community Vitality educators and specialists participated in learning exchanges with other Extension professionals via eXtension, served on Communities of Practice, posted on the eXtension blog, followed discussion groups, and joined forward-looking networks of Extension professionals.

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 14810 | 130198 | 0 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 5 | 14 | 19 |

**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 |
|---|---|
| 2016 | 34 |

**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 |
|---|---|
| 2016 | 381 |

**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 |
|---|---|
| 2016 | 165 |

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

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Community leadership education cohort members will increase the intensity of their leadership. (Target expressed as percentage of evaluated participants who increase their involvement in at least one of their organizational roles.) |
| 2 | Structured community gatherings led by program alumni are more productive. (Target expressed as percentage of program alumni who report in follow-up surveys that the program helped make public meetings, planning sessions, or committees more effective.) |
| 3 | Participants in programs will apply research and education to projects that strengthen the social, civic, economic, or technological capacity of their communities. (Target expressed as percentage of participants who report in follow up surveys that they implemented action steps they committed to at the end of the program.) |
| 4 | Communities engaged in programming will implement plans, policies, or strategies using research and education provided by Extension. (Target expressed as number of plans attributed, at least in part, to programming in end of year survey.) |
| 5 | Communities engaged in community programming will report positive effects on the capitals that are essential to the vitality of communities, including human, social, civic, financial, built, health, cultural, and natural. (Target expressed as the average number of effects identified by communities during evaluation sessions.) |

## Outcome #1

### 1. Outcome Measures

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

### 2. Associated Institution Types

- 1862 Extension

### 3a. Outcome Type:

Change in Condition Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 74 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Extension Research fellow Ben Winchester has sought to understand the demand for leadership in each Greater Minnesota county. He considered the number of board and elected positions needed by government, civic and nonprofit entities in Greater Minnesota and estimates that one in every 34 rural Minnesotans must serve in a leadership position. In comparison, one in every 143 urban resident must serve. According to the Blandin Foundation's Rural Pulse Survey, 26 percent of rural Minnesotans who hadn't served in a leadership role hadn't been asked to serve.

**What has been done**
Leadership and civic engagement programs at the University of Minnesota Extension offer organizations, sectors and local groups the opportunity to sponsor leadership education programs. Through these Extension-led programs, sponsors actively encourage new people to serve or to commit more to leadership in their communities and organizations. In 2016, 23 of the Center's 34 cohort programs focused on growing leadership and civic engagement.

**Results**
During 2016, leadership role change data were collected from 178 participants in eight leadership cohort programs. Of the participants, 73.6 percent (131 of 178) 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). Of interest to NIFA may be that the strongest outcome was achieved in the North Central Extension Leadership Development program (NELD), which engaged 33 Extension professionals in the North Central region. Of these, 88 percent stepped up their leadership in at least one role.

### 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**

Structured community gatherings led by program alumni are more productive. (Target expressed as 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 Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 87 |

**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 critical to community vitality. It is not practical or affordable for communities to hire professional facilitators for every meeting, which means that knowledge of effective meeting facilitation and civic engagement processes is critical to making communities work.

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

**Results**
Alumni of leadership programs (n = 130 responses) reported that as a result of their participation in a leadership cohort program, they had made meetings, planning sessions or committees more productive. A full 100 percent said at least "to a slight extent." The majority (86.9 percent) reported that the cohort program helped them to a moderate or great extent.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 608 | Community Resource Planning and Development |

**Outcome #3**

**1. Outcome Measures**

Participants in programs will apply research and education to projects that strengthen the social, civic, economic, or technological capacity of their communities. (Target expressed as percentage of participants who report in follow up surveys that they implemented action steps they committed to at the end of the program.)

Not Reporting on this Outcome Measure

**Outcome #4**

**1. Outcome Measures**

Communities engaged in programming will implement plans, policies, or strategies using research and education provided by Extension. (Target expressed as number of plans attributed, at least in part, to programming in end of year survey.)

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 12 |

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

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

**What has been done**
The community economics team uses demonstrated research methods to analyze local economies and inform local decisions. Examples of applied research offered include: 1) demographic analysis of resident recruitment and retention 2) IMPLAN economic impact analysis 3) business retention and expansion strategy community studies 4) studies of retail strengths and opportunities (pull factor, location quotient, etc.) and 5) tourism development assessments. In

2016, Extension delivered 165 applied research to community groups to guide decisions.

**Results**
Evaluators conducted end-of-year interviews with key informants in communities that participated in Community Economics programming during 2016. Among communities contacted, 12 community plans, policies, or strategies were implemented as a result of contributions from Extension's applied research reports. Examples include: matching job applicants to local jobs, completed comprehensive plans, implemented tourism development opportunities, implemented community marketing plans, a restructured Chamber and an Economic Development Corporation, and an issued new tax abatement policy.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 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**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 69 |

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

**Issue (Who cares and Why)**
Community capitals can be leveraged to increase the vitality of communities. As described by Flora and Flora, community capitals include social capital, human capital, civic and political capital, built capital, financial capital, cultural capital, health and natural environment. Community development programs are in a position to create connections and grow community capitals as

community groups learn and work together, make decisions about their future and invest in community projects.

**What has been done**
Extension educators and specialists engaged cohorts in business retention and expansion and leadership education program in order to help individuals and groups identify assets and make contributions that grow the amount of community capital available in communities.

**Results**
Ripple Effect Mapping sessions were conducted for four program offerings during 2016. A total of 275 effects were reported for these four program offerings. This is an average of 69 per program. The type of capital most consistently reported for leadership programs were human capital (knowledge and behavior), social capital and civic effects. The most frequently reported affects for community economics programs were human capital, financial effects, built capital, social and civic capital.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 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 |

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**
- Other (No external factors affected outcomes. )

**Brief Explanation**

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

**Evaluation Results**

To evaluate the impacts of community vitality programming, Extension routinely surveys and interviews individuals and community stakeholders after engagement in the program. For example, Extension surveyed 223 leadership program alumni at the end of 2016 and received responses from 58.3 percent of former participants, indicating enthusiastic support for Extension and engagement in programs. These surveys help Extension understand the extent to which program deliverables are informing local action, result in the implementation of community plans or grow local leadership.

To categorize the types of effects community vitality programs create, Extension draws from community capitals research (Flora, et. al., 2008). Ripple Effect Mapping sessions are conducted with cohorts after program participation, where they reflect on the chain of effects that occurred as a result of Extension programs. Though Extension programs may

not be the sole cause of reported outcomes, participants in these sessions were challenged to only name outcomes that would not have happened but for the involvement of Extension.

In 2016, evaluations demonstrated that 74 percent of participants in leadership and civic engagement cohort groups stepped up their leadership in at least one role, 87 percent reported that leadership and civic engagement programs had helped them make community meetings more productive, and 12 community initiatives were implemented particularly to address applied research findings. In ripple effect mapping sessions, a total of 275 effects were reported for just four completed cohort programs, an average of 69 per community. Extension conducted 34 such cohort programs in 2016.

## Key Items of Evaluation

**Extension**. In 2016, Extension's evaluations demonstrated that 74 percent of participants in leadership and civic engagement cohort groups stepped up their leadership in at least one role: 87 percent reported that leadership and civic engagement programs had helped them make community meetings more productive, and 12 community initiatives were implemented particularly to address applied research findings. In ripple effect mapping sessions, a total of 275 effects were reported for just four completed cohort programs. Extension conducted 34 such cohort programs in 2016.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:
• Minnesota Extension Block Grant

## 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 | 40% | | 40% | |
| 802 | Human Development and Family Well-Being | 40% | | 50% | |
| 806 | Youth Development | 20% | | 10% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 22.5 | 0.0 | 8.5 | 0.0 |
| **Actual Paid** | 31.5 | 0.0 | 5.6 | 0.0 |
| **Actual Volunteer** | 0.2 | 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** |
| 902329 | 0 | 106566 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 2154304 | 0 | 702052 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 5659233 | 0 | 0 | 0 |

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

**1. Brief description of the Activity**

**MAES**. 2016 research on building strong, healthy families continued to concentrate on several minorities and under-served populations in our state including the elderly and military families. Several research projects are exploring how new technologies affect parenting and youth development. Research highlights for 2016 include:

- A project exploring parents and their use of social networks found the Parentopia platform needs to be redesigned to be more flexible, mobile and familiar to other forms of online social interaction. Researchers are consulting with parents and staff on the redesign, which should be ready to pilot in spring 2017.
- Researchers captured the views of twenty-five African American grandmothers on their cognitive health and their self-defined social activities with their grandchildren. All participants reported excellent cognitive health and six categories of activities were identified that they felt enhanced their grandchildren's educations success and deterred suspensions (having meals in restaurants, going fishing and hiking, teaching to cook, playing games to enhance thinking skills, having discussions to assist in problem solving, and financing evaluations to determine their grandchildren's education levels).
- In collaboration with the Minnesota Elder Justice Center, U of M researchers are conducting a survey with twenty family members who have experienced elder family financial exploitation (EFFE) but were not the perpetrator or elder victim. Through these individual interviews, researchers hope to identify ways to prevent and intervene earlier in the exploitation process.
- Research on how much parents use online parenting resources led 670 parents and 159 youths from across the US and India to take part in an online survey. Data is still being analyzed but early findings reveal that fathers are more likely to use online activity in general than for parenting and that overall they did not have a positive attitude toward online parenting resources.
- A research project on the concept of fairness when dealing with family inheritance informed a new factsheet for family members on "estate planning matters." This factsheet is available on the UMN Extension personal finance website.
- Researchers exploring how the ADAPT curriculum, and, in particular, whether military parents' use of online mindfulness exercises (OME), affects their emotional regulation and mindfulness found nearly half the parents engaged in OME and mothers engaged in OME more than fathers. Furthermore, mothers who used OME showed significantly higher mindfulness at their 6-month follow-up than those that did not. The results illustrate the feasibility and effectiveness of online mindfulness training in parenting programs for post-deployed military families.

**Extension.** The Building Healthy, Strong Families program continues to invest heavily in partnerships with local organizations and institutions trusted by the spectrum of underserved populations in Minnesota. As a result, in 2016, 39 percent of all participants, including 37 percent of adults and 68 percent of youth, were Minnesotans of color. This is a 10 percent increase from 2015. Current evaluation efforts are tracking the effectiveness of these programs and train-the-trainer efforts.

Reported outcomes describe success in helping low-income families use Earned Income Tax Credits and changed behaviors during parent separation and divorce.

**2. Brief description of the target audience**

Building Strong, Healthy Families programs serve professionals in collaborating agencies such as mental health agencies, parent education programs, 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.

Cultural adaptations of programs and outreach have attracted a significant percentage of Minnesotans of

color. While 19 percent of Minnesotans are non-white, 37 percent of adult participants of Family Development program are persons of color, and 68 percent of youth participants are youth of color. A total 38 percent of reported participants were non-white in 2016.

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

**3. How was eXtension used?**

Extension educators and specialists were highly engaged in eXtension this year. A program leader serves on the eXtension Health Insurance Action Team. She participated in the eXtension Financial Security for All COP America Saves Social Media Campaign, and used eXtension WordPress Learn Event pages and webinars to fulfill a cooperative agreement with the Department of Defense to role out the Military Financial Learning Network.

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 11021 | 915664 | 856 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 20 | 20 | 40 |

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

**Output Target**

**Output #1**

**Output Measure**

- Number of professionals trained to educate and support families.

| Year | Actual |
|---|---|
| 2016 | 4213 |

**Output #2**

**Output Measure**

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

| Year | Actual |
|---|---|
| 2016 | 845 |

**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 | Promoting the concept of Vital Involvement (VI) to Senior Service Coordinators will led to increased levels of using VI with residents. |

## 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 Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 94 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
The shift away from fixed benefit programs, and the complexity of available financial services, requires individuals to take greater responsibility for their long-term financial well-being. In 2015, the average poverty level in Minnesota was 10.2 percent. An example of the need for financial literacy education involves the Earned Income Tax Credit. This tax credit can account for 30 percent or more of a household's entire annual income. The IRS highlights that many rural audiences, in particular, are eligible for the EITC and are not aware of it. Educating service providers who are already connected to Minnesotans in poverty can assure that eligible persons know about the credit they are entitled to.

**What has been done**
Taxes 101, a tax primer series, was held in 2016 for social service providers who support individuals in completing their taxes. With this training, professionals then offer the most accurate and up-to-date financial education to low income tax filers. Taxes 101 was offered both in person and online.

**Results**
In post-workshop evaluations, respondents described most significant learning, which was analyzed for most prevalent words. The top learning was about available resources, tax credits, and free tax services. While it is difficult to assess how many Minnesotans were impacted by these trainings, one group -- MN Community Action -- reported they provided tax preparation and financial education to 117,575 people in 2016 and 46,678 families. This represents just one of the groups that took the Taxes 101 workshop.

### 4. Associated Knowledge Areas

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

**Outcome #2**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 98 |

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

**Issue (Who cares and Why)**
Paternal aggravation and stress in parenting is associated with lower levels of father engagement and less supportive co-parenting relationships. Parenting is a key path by which children maintain resilience in the face of stress and transition. Therefore, educating parents about high-quality parenting, particularly during a time of stress, such as divorce or separation, can improve outcomes for children.

**What has been done**
In 2016, 586 parents attended Parenting Forever classes throughout the state and 1,632 parents attended the online course. Parents Forever has a 20-year history in Minnesota, reaching close to 30,000 parents. Rigorous evaluation consistently demonstrates the program creates healthier co-parenting behavior. The Minnesota Supreme Court has approved the program because it meets and exceeds all 25 standards for parent education, as described by the court's policy.

**Results**
Participants answered questions about knowledge and skills gained from class, stating what they knew before and what they know now in a retrospective pre-post evaluation design. Scores on seven different parenting behaviors were all statistically significant. Parents reported they would act to balance their own needs with the needs of their children, their understanding of how parents and children shape each other in reciprocal ways, examining how their parenting style influences their parenting, child development knowledge, the effects of divorce and separation on

children at different ages and stages and strategies to strengthen the parent-child relationship and improve a child's support network.

**4. Associated Knowledge Areas**

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

**Outcome #3**

**1. Outcome Measures**

Divorcing or unmarried parents will 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 |
|---|---|
| 2016 | 50 |

**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, "supportive 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**
In 2016, the Parents Forever program conducted a rigorous impact study of one if its flagship programs where upwards of 30 parents a month take an in-person class. In the IRB approved study, parents were asked to complete a pre-survey in the two weeks before class, a post-survey in the three weeks after class and a follow up survey three months later. Follow up surveys will be conducted until March of 2017. Currently, there are 123 completed post-surveys and 87 follow up surveys.

**Results**

The Co-Parenting Alliance Scale (PAYS) assesses how co-parents work together as a parenting team, including solving problems, communicating, addressing co-parenting issues, trusting the other co-parent and being a united team in front of children. Among those who completed the impact study all three times, 50 percent of parents who were part of Parents Forever improved their co-parenting from before the class to after.

**4. Associated Knowledge Areas**

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

**Outcome #4**

**1. Outcome Measures**

Individuals, families and employees who participate in Resource Management programming will report they have used the knowledge and materials provided by the program to change behaviors related to targeted financial management goals. (Outcome 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 |
|---|---|
| 2016 | 40 |

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

**Issue (Who cares and Why)**
Many researchers have pointed out that the lack of personal financial knowledge is a major barrier to an individual's sound financial practices (Financial Literacy & Education Commission, 2006). Thus, greater attention has been paid to increase people's financial literacy. Financial literacy education is more important especially with the current economic hard times since research has reported a positive association between financial knowledge and the financial well-being of families (Kim, 2001).

**What has been done**
Dollar Works 2 is an updated and revised version of the Dollar Works curriculum originally developed in 1997. One of the updates was cultural adaptation. The Dollar Works 2 curriculum was culturally adapted for Spanish-speaking audiences while still allowing it to be applicable to other cultural groups and learners. It contains 12 independent units with teaching goals, learning

targets, list of terms, action pages and evaluation tools. It helps instructors teach financial management skills based on the needs of the learners.

**Results**
To measure the effectiveness of the Dollar Works 2 curriculum, a pre and post test was done. The entire money behavior scale and some of the sub-categories showed effectiveness. Financial satisfaction was significantly different between pre-test and post-test after the education session. People who are satisfied with their financial situation are more in control of their finances.

**4. Associated Knowledge Areas**

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

**Outcome #5**

**1. Outcome Measures**

Promoting the concept of Vital Involvement (VI) to Senior Service Coordinators will led to increased levels of using VI with residents.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 0 |

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

**Issue (Who cares and Why)**
By 2030, twenty-four percent of Minnesota's population will be sixty-five years or older. These elders are requiring more and different care, services, and support, for longer periods of time, than ever before.

University of Minnesota social scientists have developed the Vital Involvement (VI) construct, which allows us to address the challenges presented by an aging population in ways that are both humane for elders and productive for society, but more work is needed to involve individuals that work with seniors in this process.

**What has been done**
To work effectively with Service Coordinators at senior housing centers, researchers developed the Vital Involvement-based Service Coordination model, which allows Service Coordinators to

access outside services and training and an outlet to promote VI among their residents.

Researchers receive and analyze 70 VI stories per month from various Service Coordinators and pick 2-4 exemplary stories to highlight in the bi-monthly AHEPA newsletter.

**Results**
Since, initiating these bi-monthly teaching tools, researchers have noticed an increased complexity and depth in the quality of overall VI stories submitted each month. These increases indicate a fuller Service Coordinator understanding of VI, more effective promotion, and increased levels of resident VI in the properties where these service coordinators work.

This process is helping to build a foundation for measuring elder well-being that looks at more than the simple dollar amount saved on health-care and mental-health-care costs. It has great potential for influencing programming for older adults and healthy psychosocial development at each stage of life.

**4. Associated Knowledge Areas**

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

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**
- Other (No external factors affected outcomes. )

**Brief Explanation**

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

**Evaluation Results**

Extension's Family Development team's goal is to equip those persons in communities who have the trust of low-income families and parents with the tools, knowledge and curriculum they need to provide information in critical periods of transition. Current evaluation studies are implementing a quasi-experimental design to examine the consistent effectiveness of the Parents Forever curriculum so that it can meet the high standards of the National Registry of Evidence-based Programs and Practices monitored by the Substance Abuse Mental Health Services Administration. The findings of the quasi-experimental design study are described in this year's report. In 2017, the team will be comparing these results to a comparison sample of divorced and single parents that was recently collected. If this study is successful in quantifying program success with a comparison group, it will be one of just three divorce education programs on the National Registry, and the first program with an eight-hour intervention to be on the registry. Other states are already adopting this curricula to meet a mandate to deliver parenting education and interest in the program is increasing among Extension in other states.

Ongoing studies of curriculum demonstrate that Extension's curriculum and train-the-trainer methods are creating consistent results. Among those reported this year were the use of Earned Income Tax Credits to improve household resources, and the use of Parenting Education programs to change parenting behaviors so that they focus on child development and health in single parent households.

## Key Items of Evaluation

**Extension.** Ongoing studies of curriculum demonstrate that Extension's curriculum and train-the-trainer methods are creating consistent results. Among those reported this year were the use of Earned Income Tax Credits to improve household resources, and the use of Parenting Education programs to change parenting behaviors so that they focus on child development and health in single parent households.

A quasi-experimental evaluation study of the Parents Forever curriculum as found evidence of program success in changing behaviors. These study findings will be measured against a comparison group study in 2017 in order to put the Parents Forever on the National Registry of Evidence-based Programs and Practices.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- U of M Internal Research Grants

## 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: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 48.8 | 0.0 | 0.0 | 0.0 |
| **Actual Paid** | 45.4 | 0.0 | 2.7 | 0.0 |
| **Actual Volunteer** | 497.0 | 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** |
| 1867583 | 0 | 98056 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 3845578 | 0 | 262985 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 8750410 | 0 | 224233 | 0 |

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

**1. Brief description of the Activity**

**Extension's** Center for Youth Development manages statewide 4-H programs and trains quality youth workers and volunteers in critical issues related to youth development and best practices in youth programming. Three national mission mandates provide a programmatic focus allowing the Center to leverage funds from NIFA, the state of Minnesota, and other grants and gifts. They are:

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

A significant change in 2015 was the transfer of the Quality Matters program, a certification process that instills best practices among youth-serving organizations, to the University of Minnesota's School of Social Work. In 2016, the Center continued to conduct adult education for professionals and volunteers responsible for youth programs, including 4-H.

In 2016, two educational outcome goals were identified as part of new logic model changes:

1. Youth will learn by developing a passion for their areas of interest.
2. Youth will lead by being innovators and social change agents.

Evaluation studies are tracking educational outcomes related to this, and are monitoring post-secondary education choices made by alumni of 4-H programs. Efforts to better welcome new members and first generation 4-H participants have resulted in an additional 7,000 4-H members. Moreover, re-enrollment rates are quite high. Seventy percent of youth who enrolled in the 2014-2015 year came back for the 2015-2016 year. Longevity matters in youth development because when youth have the ability to form strong relationships with other youth and caring adults, they also have the opportunity to deepen their learning.

**MAES** has not typically extended funding to the Youth Development Program but increasingly MAES funded research projects are fitting in with the objectives of this planned program. In particular, MAES funded research focused on uncovering ways to close the achievement gap in Minnesota schools, encouraging minority youth interest in STEM, and providing guidance to youth counselors as they deal with at-risk youth fit in well with this program. We plan to continue to report on the success of these projects here.

Research highlights for 2016 include:

- A research project exploring the influence of social networks on Hmong elementary students academic achievement recruited 75 students and their families to take part the their initial survey. From this group ten will be chosen to take part in the qualitative study.
- A project focused on retraining workers at community recreation centers worked with ten supervisors who plan programs for centers in their area. To date, the project has led to some intellectual and philosophical changes but limited behavior change.
- A pilot studying exploring how to improve the emotional health of high-risk adolescents found evidence to support a linkage between extreme emotional response and substance abuse. This finding is consistent with existing literature.
- Researchers working on teaching economics regarding the five NIFA priority areas to K-12 teachers held 24 professional development programs that reached 635 teachers who taught 57,427 students.
- A research project exploring how young adults learn to manage their finances focused on college students' perspectives on being overindulged in childhood and how that relates to their current financial skills. Findings suggest that overindulgence is correlated with impulsive spending but not with credit card use and that overindulged young adults may have not learned good money management skills in their youth.
- Fourteen workshops on increasing financial literacy among adolescents and emerging adults were held and reached 138 youth and 87 adults. Surveys showed both adults and youths showed significant

knowledge gains in four of six concepts taught (22 percent increase for adults and 20 percent increase for youth).

**2. Brief description of the target audience**

There is a concerted effort in Minnesota (and in the North Central region) to target first generation 4-H members. These are young people who have never had a family member in the 4-H program. This Minnesota 4-H initiative is working to ensure the program represents all demographics of youth in Minnesota. A strategic benchmark deployed by the Center is that 4-H will reflect the population in the communities it serves. Efforts are underway to reach new populations around the state. This outreach has been successful -- 7,000 new members enrolled in 2016. This is a 22 percent increase over the previous year.

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?**

Eight 4-H staff reported they use eXtension to get or give information.

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 11164 | 1020680 | 68595 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 3 | 2 | 5 |

**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 |
|---|---|
| 2016 | 105 |

**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 |
|---|---|
| 2016 | 74 |

**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 |
|---|---|
| 2016 | 2093 |

**Output #4**

**Output Measure**

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

| Year | Actual |
|---|---|
| 2016 | 87 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Youth participating in 4-H Youth Development who go on to higher education. |
| 2 | Youth participating in 4-H Youth Development who are prepared with 21st century learning skills; e.g., communicating effectively, building connections, making positive choices, and making contributions to their community.) |
| 3 | Adult participants in educational offerings will report that they increased their understanding and knowledge of a given youth development topic. (Outcome expressed as a percentage of participants in agreement.) |
| 4 | Youth in 4-H programs will develop 21st century leadership skills. (Outcome is percentage of youth reporting change.) |

**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 |
|---|---|
| 2016 | 97 |

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

**Issue (Who cares and Why)**
Participation in after school programs has been 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 can help youth develop 21st century skills.

**What has been done**
4-H programs have established goals to increase learning by tapping the individual passions of youth and enhancing their leadership skills.(Learning goals are reported here. Leadership is reported in Outcome #4.) In 4-H clubs, youth have the opportunity to explore a host of opportunities and engage in projects that create hands-on learning opportunities.

**Results**
In the past, we have implemented the 4-H common measures to assess 21st century skills. These are currently undergoing national review. Minnesota youth took part in field testing the common measures in August of 2016. In spring 2016, an outcome survey was sent to 206 seniors in high school who are nearing alumni status. Results show that alumni had learning benefits from their

involvement in the program: 98 percent had learned something new; 97 percent helped another 4-Her get better at something; and 97 percent reflected on what they learned, explored their own views and mastered a particular skill.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 806 | Youth Development |

**Outcome #3**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 97 |

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

**Issue (Who cares and Why)**
Successful engagement with youth requires that adult volunteers to have a deep understanding of youth development orientation to program goals, and an intentional method to welcome and integrate all 4-H members across cultures and interests.

**What has been done**
Local, regional and statewide trainings help youth workers and 4-H volunteers focus on knowledge and skills that can 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 reflects the average response among all 4-H trainings. Adults reported that they have a deeper understanding of youth development topics (88percent), better understand the mission and organizational intentions of 4-H, and where to access support resources (98.9 percent), better understand their cultural lens and can apply it in the 4-H setting (99 percent) and that they are more ready to welcome new 4-Hers (99 percent).

**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 programs will develop 21st century leadership skills. (Outcome is percentage of youth reporting change.)

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 94 |

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

**Issue (Who cares and Why)**
According to a recent survey by the National 4-H council, most youth (81 percent) think leaders are more concerned with their own agendas than achieving goals; 76 percent say leaders are focused on different priorities than what matters to them; half of youth rate government and political leaders as having weak leadership, not accomplishing what is promised, not collaborating and not offering solutions. Most (96 percent) think leadership is important to addressing issues, but only one in three say they have skills they need to lead.

**What has been done**
4-H programs support youth in gaining skills in the tasks of leadership while providing an opportunity to experience what it is like to make a difference in their community. In that way, youth move from passive observation of leadership to engaged citizenship.

**Results**
The study of 4-H alumni in Central Minnesota found that 97 percent had helped in their community; 96 percent had presented in front of others; 94 percent saw that youth are an important part of the community; 93 percent had tackled a challenge; 93 percent felt they were part of their community; and 92 percent said they had made a difference in their community.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 806 | Youth Development |

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Competing Programmatic Challenges

**Brief Explanation**

**We are not reporting on post-secondary enrollment.** Data collection among 4-H youth shows that the post-secondary enrollment among 4-H youth is actually 7 percent lower than Minnesota's enrollment writ large. Distinct regional differences in post-secondary enrollment across the state make those comparisons more complicated to discern.

Nevertheless, the youth development team is deliberately conducting planning and programming to enhance post-secondary enrollment rates. Specific program efforts have engaged middle school aged youth into programs that connect them to college. Assessment of these efforts will be conducted over time.

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

**Evaluation Results**

**Extension's** youth development and 4-H programs establish logic models, program priorities, and evaluation strategies that are often informed by national priorities. Evaluation strategies are measuring youth learning in topics that nurture areas of passion and interest, as well as nurturing youth leadership. In the past, the Center implemented 4-H Common Measures to assess 21st century skills. The Common Measures are currently undergoing review for improvement. Minnesota youth took part in field-testing the Common Measures in August of 2016 and gave feedback to the measures through focused conversations with researchers from the University of Nebraska.

To assess 21st Century skills in 2016, Extension implemented multiple measures to assess youth learning and youth leadership in Minnesota. The Central Region of Minnesota was tapped to conduct the evaluation.

Youth members who recently completed their senior year in 4-H were asked to report on their learning and leadership. Because of their near completion of the program, they are entering program "alumni" status. Over 200 youth responded to the survey. Results show that alumni are learning and leading through the program.

**Learning benefits:**

- 98 percent of alumni learned something new
- 97 percent helped another 4-Her get better at something
- 97 percent reflected on what they had learned
- 97 percent explored their own views
- 97 percent got really good at something

**Leadership benefits:**

- 97 percent helped in the community
- 96 percent presented in front of others
- 94 percent saw that  youth are an important part of the community
- 93 percent tackled a challenge
- 93 percent felt like they were part of their community
- 92 percent said they had made a difference in their community

**Key Items of Evaluation**

Youth members who recently completed their senior year in 4-H were asked to report on their learning and leadership. Because of their near completion of the program, these 4-Hers are entering program "alumni" status. Over 200 youth responded to the survey.  Results demonstrate that alumni are learning nad leading through the program.

**Learning benefits:**

- 98 percent of alumni learned something new
- 97 percent helped another 4-Her get better at something
- 97 percent reflected on what they had learned
- 97 percent explored their own views
- 97 percent got really good at something

**Leadership benefits:**

- 97 percent helped in the community.
- 96 percent presented in front of others.
- 94 percent saw that  youth are an important part of the community.
- 93 percent tackled a challenge.
- 93 percent felt like they were part of their community.
- 92 percent said they had made a difference in their community.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- National Institute on Drug Abuse
- National Institute of Mental Health
- University of Minnesota "Grand Challenges Grant"

## 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 |
|---|---|---|---|---|---|
| 136 | Conservation of Biological Diversity | 25% | | 50% | |
| 605 | Natural Resource and Environmental Economics | 25% | | 40% | |
| 903 | Communication, Education, and Information Delivery | 50% | | 10% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 7.0 | 0.0 | 13.4 | 0.0 |
| **Actual Paid** | 13.4 | 0.0 | 22.5 | 0.0 |
| **Actual Volunteer** | 39.8 | 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** |
| 661434 | 0 | 215201 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 1930667 | 0 | 1449202 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 641757 | 0 | 3254933 | 0 |

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

### 1. Brief description of the Activity

**MAES.** Research focused on natural resource management involves several academic departments at the University. Key issues addressed through research are environmental stewardship, conservation and protection of endangered animals, protecting and improving wildlife habitats in Minnesota and beyond, and protecting Minnesota's abundant natural resources.
Research highlights for 2016 include:

- The University of Minnesota Insect Collection received 69,015 new accessions in 2016. This brings the collection's total to 3,945,744 species, representing 52,066 species. This makes it the 7th largest University affiliated insect collection in North America.
- Genomic analysis of a new rickettsia tick cell line from California revealed that rickettsia is closely related to R. buchneri ticks found in north central and the eastern US and the Rickettsia monacensis found in Ixodex species in Europe.
- U of M researchers participated in a statewide assessment on the abundance and distribution of the American White Pelican. Their results were shared with the Minnesota Department of Natural Resources (DNR) and should be made public in 2017. In its last survey, the DNR estimated there are 22,000 pairs of pelicans whom nest at 16 sites on seven lakes across the state.
- An interdisciplinary team of researchers working to assess moose health in Minnesota's declining moose population has determined the gut microbial community structure among fecal samples of wild moose. Their next steps involve identifying correlations between the fecal microbiome and the moose's health and determining if the feal microbiome is predictive of landscape patterns.
- In an effort to uncover the role whitetailed deer play in forest regeneration and invasive plant species; researchers estimated whitetail deer density across the eastern US forests. Results indicate that deer density may be an additional driver of tree seedling abundance when analyzed along with stands attributes such as aboveground biomass, relative density, and stand age. This study shows the abundance of whitetailed deer is an important attribute in the development of forest understories.
- Researchers submitted a petition for the experimental release of Root-Mining Weevil Ceutorhynchus scrobicollis for the biological control of garlic mustard. This petition is due to a study on the management of garlic mustard that started in 1998. It is currently under review by the USDA-APHIS Technical Advisory Group and if approved could begin in 2019.

**Extension's** natural resources team recruits, trains and supports Minnesotans who volunteer for citizen science projects statewide. These programs mobilized 1,355 volunteers in 2016, and these volunteers committed 82,769 hours to citizen science projects. Three citizen science projects form the core of the natural resources work. 1) The Driven to Discover program provides tools, resources and curricula for youth group leaders and program managers who plan and carry out citizen science-based research. 2) The Minnesota Bee Atlas, which was initiated in 2016, combines volunteer observations with historical records to create a statewide list of native bees found in Minnesota and tracks how bee populations are changing. 3) The Minnesota Master Naturalist program promotes awareness, understanding and stewardship of Minnesota's natural environment by training volunteers around the state.

Significant efforts have been made to engage people of color in citizen science projects, and 15 percent of the 4,700 participants in Natural Resources programs are persons of color. An example of culturally relevant educational efforts include the development of a curriculum called Nando-gikenimindwasa -- Getting to Know All of Creation. This book was used in the American Indian Higher Education Knowledge Bowl competition in 2016 and will be used in the 2017 Minnesota Indian Education Knowledge Bowl and classrooms. It has received support from many Indian education coordinators who bring science education to Native Youth.

**2. Brief description of the target audience**

**MAES research and Extension** programs reach: 1) Concerned citizens and volunteers who are trained to serve in a variety of volunteer roles as citizen teachers and scientists, 2) Minnesota professionals 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 2016, 15 percent of participants in Natural Resource Management programs were persons of color.

**3. How was eXtension used?**

In eXtension's "Ask an Expert" offering, the work of Minnesota Extension's monarch specialist is referenced in several responses related to milkweed.

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 4220 | 164068 | 496 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 7 | 36 | 43 |

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

**Output Target**

**Output #1**

**Output Measure**

- Number of Master Naturalists trained and supported in Minnesota.

| Year | Actual |
|---|---|
| 2016 | 1355 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Citizens will explore their natural environment, resulting in increased knowledge and meaningful discovery about Minnesota's environment and environmental issues. (Target expressed as percentage of program participants reporting new knowledge.) |
| 2 | Citizen stewards will commit time to exploring and conserving the environment, and teach others about the environment and stewardship. (Target expressed as number of hours reported by volunteers and others involved in programs.) |
| 3 | Citizens will, through exploration, conservation and education, influence environmental conditions on significant land acreage in Minnesota. (Target expressed as number of acres Master Naturalists report that they influence each year.) |
| 4 | Researchers will apply tools and knowledge gains from other fields to assist with animal conservation efforts around the globe. |

**Outcome #1**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 82769 |

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

**Issue (Who cares and Why)**
Citizens who care about the environment can be on-the-ground resources that connect valuable information to local groups making decisions that affect local ecosystems. They can also educate others about science.

**What has been done**
Extension recruits, trains and supports volunteers who find projects that benefit communities. Pam and Michael Pagelkopf, a couple who completed the Minnesota Master Naturalist Big Woods, Big Rivers program, generated a significant outcome for Minnesota's school forest sites.

**Results**
The Pagelkopfs were inspired to donate materials and labor to create field desks for students who conduct field studies in school forest sites. In addition to a clipboard writing surface, field desks serve as a container that students use to transport study materials to the field. The Pagelkopfs originally committed to purchasing materials and building 300 field desks over a three year period. As of 2016, they will have built and delivered 812 field desks to 30 Minnesota School Forest sites

and driven over 4,000 miles to deliver them. These field desks facilitate learning outcomes for Minnesota's school forest sites.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 903 | Communication, Education, and Information Delivery |

**Outcome #3**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 801589 |

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

**Issue (Who cares and Why)**
Lake associations, tourism initiatives, watersheds, park boards and communities all need active engagement in, and knowledge of, natural habitats as they establish policies and make decisions about community projects.

**What has been done**
Minnesota's Master Naturalists are filling these roles in communities, bringing extensive training from Extension to bear on local issues and decisions. Master Naturalists contribute to the health and betterment of lands and waters by serving on local lake associations, as SNA stewards, and members of advisory committees for tourism initiatives and park sites. Hatch-funded research focused, for example, on climate change and invasive species, are used by Master Naturalists in their community outreach.

**Results**
In 2016, Master Naturalists self-reported having an impact on 801,589 acres of natural land in the State of Minnesota.

**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 apply tools and knowledge gains from other fields to assist with animal conservation efforts around the globe.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 0 |

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

**Issue (Who cares and Why)**
Pandas are one of most beloved and most endangered animals on the planet. Inbreeding and relatedness in wild panda populations are important parameters for panda conservation. Habitat loss and fragmentation are expected to increase inbreeding but the actual inbreeding levels in natural panda habitats have remained largely unknown.

**What has been done**
Using methods of genetic analysis often used for livestock species, animal science researchers at the University of Minnesota applied their technique to analyze wild and captive panda populations in China.

Their study revealed that wild pandas from the four largest habitats were genetically unrelated and most pandas from 200km apart shared no common ancestral alleles. However, the Qinling wild panda population, which is known to have habitat loss, and the Linagshan wild panda population both had high levels of inbreeding.

**Results**
The results provide a genomic quantification of the actual levels of inbreeding and relatedness among pandas in their natural habitats, provide genomic confirmation of the relationship between genetic diversity and geographical distances, and provide genomic evidence to the urgency of habitat protection.

Based on these findings, researchers developed three habitat-controlled breeding plans to minimize the risk of hidden-inbreeding and to increase the representation of the smallest wild panda populations in the captive population.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 136 | Conservation of Biological Diversity |

## V(H). Planned Program (External Factors)

### External factors which affected outcomes

- Other (No external factors affected outcomes.)

### Brief Explanation

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

### Evaluation Results

In its early stages of program development, Extension's volunteer training programs conducted extensive evaluation to demonstrate that training that was provided by Extension effectively prepared Master Naturalists and other citizen science program participants with the information they need to work effectively on behalf of the environment in communities. Having demonstrated that, the program is now tracking yearly engagement of these volunteers.

Extension citizen science programs mobilize volunteers yearly to work in communities on behalf of protecting the natural environment. Volunteers who are educated by Extension continue to receive support from Extension and their Master Naturalist peers as they do work in communities. They report to Extension about their hours of service and the number of acres of land they seek to affect. In 2016, 1,355 volunteers reported that they contributed 82,769 hours to community projects and affected 801,589 acres of land.

### Key Items of Evaluation

**Extension.** In 2016, 1,355 Extension-trained volunteers reported that they contributed 82,769 hours to citizen-science community projects and affected 801,589 acres of land.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- National Science Foundation
- Minnesota DNR
- USGS- National Water-Quality Assessment Program
- State Wildlife Grants Program
- Grant-in-Aid

- National Institutes of Health

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

**Program # 11**

**1. Name of the Planned Program**

Forestry and Forest Products

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 123 | Management and Sustainability of Forest Resources | 25% | | 40% | |
| 124 | Urban Forestry | 25% | | 20% | |
| 125 | Agroforestry | 25% | | 20% | |
| 133 | Pollution Prevention and Mitigation | 25% | | 20% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 6.9 | 0.0 | 26.6 | 0.0 |
| **Actual Paid** | 15.0 | 0.0 | 9.6 | 0.0 |
| **Actual Volunteer** | 3.9 | 0.0 | 0.0 | 0.0 |

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

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 754158 | 0 | 78163 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 1849734 | 0 | 1012176 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 739615 | 0 | 694987 | 0 |

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

### 1. Brief description of the Activity

**MAES**. Minnesota provides a unique location to study forestry and the forest products industry. With over 17 million acres of forests and a $8.9 billion forestry and forest products industry researchers are focused on protecting this key economic resource for our state.
Research highlights from 2016 include:

- An MAES supported researcher has been chosen as a co-lead for a new national institute known as the Rapid Advancement in Process Intensification Deployment (RAPID). RAPID seeks to address key challenges in energy-intensive manufacturing process industries - including forestry and forest products. Specifically, he is a co-lead of the renewable bioproducts team and will assist with the strategic road mapping for what needs to be accomplished and encourage industry participation in the effort.
- New tree diseases continue to threaten Minnesota's forests and urban trees. Heterobasidion root rot, a recently discovered disease in Minnesota, has the potential to cause serious losses in red and white pine. To date, surveys have focused on conifer plantations in southeastern and east central Minnesota.
- A new, real-time PCR system, DNA diagnostic method is being used for surveying diseased trees. This new method is more sensitive and able to quantify the amount of DNA of the pathogen in each sample analyzed.
- Researchers are currently evaluating different cultivars for resistance to Raffaelea lauricola which is causing Laurel wilt in the southern US. Finding trees with disease resistance will play a major role in controlling this disease.
- Work continues to evaluate elm genotypes and cultivars for their resistance to Dutch Elm Disease. New elm selections with strong resistance will provide much needed diversity in Minnesota for this important native tree species.
- A research project exploring how various payment methods affect the cost of timber found that perceptions of ecological and economic impacts of timber payment method often exceed the actual impact. Specifically, the study found that timber payment method did not impact post-harvest ecological conditions, gross stumpage revenue, or stumpage price bids. Given the strengths and weaknesses of various pricing systems, researchers recommend allowing agencies flexibility to select the approach that best fits their needs.
- A project focused on regeneration of Minnesota's peatland forests conducted both field and greenhouse-based studies. Analysis of these studies in still underway, but early results suggest a strong overlap in the mycorrihizal fungal communities associated with tamarack and spruce, suggesting that mycirrhizae may be able to mediate the interactions between these two hosts in a way that could facilitate the regeneration of black spruce in areas where ericaceous shrubs are abundant.

**Extension.** In 2016, the forestry team of educators and specialists continued to advance the role of citizen forest owners and community volunteers who can protect and nurture Minnesota's forest lands. Programs such as Wasp Watchers and the Forest Pest First Detectors mobilized Minnesotans to effectively identify invasive species early and to find solutions to Emerald Ash Borer threats. (See outcome #3.) At least 68 communities are formally working with the forestry team to develop urban forest management plans and keep trees healthy. Trained forest owners and natural resource professionals appreciate the sophisticated network of educators, professional advisors, volunteers, owners and community members that are trained to use and share information about forests, agroforestry, silvopasture (the use of grazing to manage forestland), and the adoption of other sustainable forest management practices.

### 2. Brief description of the target audience

**Extension's** primary audiences include farmers and woodland owners, loggers, wood processors and marketers, natural resource and green industry professionals, volunteer educators, and local and state government personnel engaged in forestry, parks and recreation and soil and water conservation. A secondary audience is youth.

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

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 10783 | 305952 | 67 | 0 |

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

**Patent Applications Submitted**

Year: 2016

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 10 | 8 | 18 |

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

**Output Target**

**Output #1**

**Output Measure**

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

| Year | Actual |
|---|---|
| 2016 | 147 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Program participants (landowners) will learn new information that helps them manage forest land. (Target expressed as percentage of participants.) |
| 2 | Program participants will improve forest management on a significant number of acres. (Target expressed as number of acres on which management was improved.) |
| 3 | Citizen Wasp Watchers and Forest Pest First Detectors have proactively identified problems and solutions related to invasive species that harm Minnesota's forests. (Outcome is the number of citizen-led discoveries.) |

**Outcome #1**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

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

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 1900 |

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

**Issue (Who cares and Why)**
Minnesota has more than 429,000 acres of unproductive and unmanaged wooded pasture, according to the 2012 USDA Census of Agriculture. Decreasing this number requires training and in-depth consultation with forest owners who can take advantage of forests more wisely for their livestock while increasing their stewardship.

**What has been done**
In 2016, the forestry team provided in-depth consultation to an owner of 1,600 forested acres, and partnered with him in the development of a demonstration site for best practices management. The farmer attended educational programs and partnered with Extension to establish an on-farm silvopasture demonstration trial. In addition, UMN offered a hybrid online/in-person course on forest stewardship. This course focused on woodland owners in southeastern Minnesota.

**Results**
Together, these efforts created significant changes in forest management and sustainability for 1,900 acres of Minnesota forest land. Beyond these effects on these particular acres, the silvopasture demonstration is providing concrete, observable differences in forest health, and also

positively affected the health of grazing livestock. This demonstration site is being used to train and inspire other land owners.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 123 | Management and Sustainability of Forest Resources |
| 125 | Agroforestry |

**Outcome #3**

**1. Outcome Measures**

Citizen Wasp Watchers and Forest Pest First Detectors have proactively identified problems and solutions related to invasive species that harm Minnesota's forests. (Outcome is the number of citizen-led discoveries.)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 32 |

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

**Issue (Who cares and Why)**
Smoky winged beetle bandit wasps (cerceris fumipennis) prey on emerald ash borer (EAB) and similar beetles. This means that wasps can be used as an early detection tool for EAB. But EAB is only one invasive species that can overtake Minnesota forests. Other pests include the gypsy moth, Asian longhorned beetle, and Oriental bittersweet.

**What has been done**
Extension and the Minnesota Department of Agriculture provide online training and online interface with community volunteers, asking these "Wasp Watchers" to search for new cerceris fumipennis sites in their communities, and to adopt a site and collect the wasp's beetle prey. Similarly, Forest Pest First Detectors are trained by Extension to identify the occurrence of forest pests.

**Results**
In 2016, Wasp Watcher participants searched 219 new sites, up from 87 last year, and discovered 29 new cerceris sites, up from 13 last year. They captured twice as many buprestid

beetles as last year, which will help slow down the spread of EAB. In addition, Forest Pest First Detectors identified three new locations in eastern Minnesota where Oriental bittersweet -- a devastating forest killer -- was growing. Early eradication can prevent infestation of additional forestland.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 123 | Management and Sustainability of Forest Resources |
| 124 | Urban Forestry |

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Other (No outcomes were affected in 2016. )

**Brief Explanation**

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

**Evaluation Results**

Outcomes for Extension's forestry and forest products programs are evaluated both by measurement of learning, and by monitoring the effectiveness of citizen stewards as they identify, report and eradicate invasive species. Programs are also evaluated by how citizen stewards utilize effective forest management practices (such as pruning trees in communities, incorporating silvopasture, and more.) In 2016, a broad network of citizen volunteers and land managers, all trained through Extension, worked actively in 68 communities and identified instances of emerald ash borer and other infestations. In all, 1,244 volunteers committed 8,126 hours to protecting and preserving Minnesota's forests.

**Key Items of Evaluation**

In 2016, a broad network of citizen volunteers and land managers, all trained through Extension, worked actively in 68 communities and identified instances of emerald ash borer and other infestations. In all, 1,244 volunteers committed 8,126 hours to protecting and preserving Minnesota's forests.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- Department of Energy

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

**Program # 12**

**1. Name of the Planned Program**

Housing

☐ Reporting on this Program

Reason for not reporting

For the 2017 Plan of Work, we removed the Housing planned program and began to shift our research and Extension work typically reported under this planned program to Community Vitality and Public Finance and Building Strong, Healthy Families.

Minnesota Extension continues to provide national leaders in two areas -- bed bugs and radon mitigation. To that end, bed bug education was translated into fact sheets into eight new languages this year and courses are being offered throughout the country. Participant outputs (n=4,373 adults) are incorporated into totals in the executive summary, and the outreach to underserved audiences is noted. However, no significant new impacts are available for reporting.

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 804 | Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures | 100% | | 100% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 2.7 | 0.0 | 2.5 | 0.0 |
| **Actual Paid** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Actual Volunteer** | 0.0 | 0.0 | 0.0 | 0.0 |

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

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 0 | 0 | 0 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 0 | 0 | 0 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 0 | 0 | 0 | 0 |

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

### 1. Brief description of the Activity

### 2. Brief description of the target audience

### 3. How was eXtension used?

eXtension was not used in this program

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

### 1. Standard output measures

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 0 | 0 | 0 | 0 |

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

**Patent Applications Submitted**

Year: 2016

Actual: 0

**Patents listed**

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| Actual | 0 | 0 | 0 |

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

**Output Target**

**Output #1**

**Output Measure**

- Educational courses will be delivered to the target audiences.

| Year | Actual |
|---|---|
| 2016 | 0 |

**Output #2**

**Output Measure**

- New research will result in the development of new and revised educational materials. (Target expressed as the number of new or revised curriculum materials.)

| Year | Actual |
|---|---|
| 2016 | 0 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Improve the durability of new homes by working with builders. (Target expressed as the number of builders trained.) |
| 2 | Improve the availability of healthy and affordable housing through the mitigation of indoor environmental risks. (Target expressed as number of homes affected.) |

**Outcome #1**

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #2**

1. **Outcome Measures**

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

Not Reporting on this Outcome Measure

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Natural Disasters (drought, weather extremes, etc.)
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

**Brief Explanation**

{No Data Entered}

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

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

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

**Program # 13**

**1. Name of the Planned Program**

Horticulture

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships | 20% | | 15% | |
| 132 | Weather and Climate | 0% | | 5% | |
| 201 | Plant Genome, Genetics, and Genetic Mechanisms | 0% | | 25% | |
| 204 | Plant Product Quality and Utility (Preharvest) | 20% | | 5% | |
| 205 | Plant Management Systems | 20% | | 20% | |
| 211 | Insects, Mites, and Other Arthropods Affecting Plants | 20% | | 20% | |
| 213 | Weeds Affecting Plants | 20% | | 10% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 13.4 | 0.0 | 43.6 | 0.0 |
| **Actual Paid** | 17.3 | 0.0 | 56.9 | 0.0 |
| **Actual Volunteer** | 69.0 | 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** |
| 820467 | 0 | 376195 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 2051067 | 0 | 5141745 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 989032 | 0 | 4663230 | 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 cold-hardy and disease resistant plants, studying pests and diseases affecting crops, and uncovering new technologies that could revolutionize the horticulture industry.

Research highlights for 2016 include:

- Researchers visited over fifteen tomato production farms, surveyed them for diseases, and collected tomato leaf mold fundi isolates for further testing. Thus far the diseases with the most impact on tomato production in MN are Botrytis Gray mold, Fusarium Crown and Root Rot, and Fusarium Wilt.
- Research on the genomics of wild potato varieties revealed that plants regulate disease resistance in different organs at a transcriptional level, with stronger expression of a disease resistance gene correlating with better disease resistance. This observation opens avenues for future research such as tweaking the expression of native disease resistance genes by modifying promoter regions using gene editing.
- Researchers performed descriptive analysis of Frontenac gris (UMN release) and Briana wine grapes. About 40 sensory descriptors for the grapes and 50 sensory descriptors for sampled wines were generated by the analysis. These lexicons can now be used by other wine researchers and winemakers to improve their ability to communicate with marketers and consumers.
- A new badnavirus occurring in roses was identified and is being propagated following tissue culture. Further tests will include transmission studies and genomic characterization.
- A formal two-year survey of hop yards across the state was completed in 2016. It showed that downy mildew is widespread across Minnesota and has systematically infected every hop yard surveyed. This indicates the pathogen was likely spread through diseased cuttings provided by propagators. Additionally, knowledge surveys revealed most hop growers cannot accurately differentiate between various hops diseases and most do not have the skills to be effectively selecting and using fungicides.
- After three years of research on perennial ryegrass in northern Minnesota, researchers found that economically viable second year perennial ryegrass seed production is possible when using current winter hardy commercial varieties, proven agronomics, and correct residue management post first-year harvest. These results could have significant environmental and economic impact in northern Minnesota.
- Two new dwarf tomato lines were chosen for further evaluation. During nutrient analysis it was revealed that one of them, MTX851, is not only dwarf and high yielding, but also a variety that produces fruits with better quality (higher protein and sugar) than previously released varieties.
- Researchers identified how a plant infested with aphids can communicate with non-infested adjacent plants to turn on their natural defenses to reduce pest proliferation. The ultimate goal is to develop techniques to turn on natural plant defenses of non-infested plants to limit the need to use pesticides.

• Bee researchers developed a "blood test" for bees that indicates colony health and floral landscape quality within a two-mile radius of the colony. These blood tests provide an additional tool to assist beekeepers and policymakers hoping to improve floral habitats and bee health.
• A research study has revealed that certain atrazine-free weed management systems are comparable in performance to standard atrazine-containing systems. This confirms that non-atrazine alternative management is possible near sensitive water areas or where label set-backs to protect water quality restrict the use of atrazine.
• Our apple breeders have teamed up with University experts in robotics to develop crop monitoring devices for apple orchards. Thus far, they have successfully developed a UAV system, along with navigation and obstacle avoidance algorithms that allow them to fly in orchard rows in windy conditions and an accurate apple detection and counting system using only camera input.
• As mentioned last year, University breeders have released a new apple tree for commercialization patented as MN55. We can now report that the apples from MN55 will be marketed as "Rave" nationally and "First Kiss" in Minnesota.

**Extension.** In 2016, Master Gardeners and horticulture educators and specialists responded to current issues in growing while continuing to work in communities to create and support creative and welcoming green places. This year, we report on the significant presence of Master Gardener volunteers in Minnesota, as well as the economic impact and industry growth spurred by cold-hardy grapes. The University of Minnesota played a significant role in the development of wineries and vineyards in the Northern regions of the United States.
Other activity in 2016 has focused on honey bees and wild bees, which pollinate more than 70 percent of Minnesota's fruit and vegetables. Their value is estimated at $16 billion in U.S. farm income. Since 2007, an average of 30 percent of all U.S. bee colonies have died every winter due to disease, parasites, lack of plant diversity, pesticides and a flowerless landscape. In response, Extension's Master Gardeners disseminate information statewide about native plants and flowers that can support the bee population. The UMN's nationally recognized Bee Lab/Squad joined with two other universities in 2016 to launch the US MiteCheck Interactive Map to share information among beekeepers about the varroa mite population, a destructive parasite.
Two new sets of curriculum and teaching resources are helping Master Gardeners and Master Naturalists address critical concerns. The "Water Wisely" curriculum addresses water waste in lawns and gardens. The "Pollinators and Native Plants" teaching package was developed and will be used by Master Gardeners and Master Naturalists in 2017 to educate the public on the issue of pollinator habitat preservation and protection.

**2. Brief description of the target audience**

Notably, in 2016 almost 7 percent of those served by Extension's horticulture team and its volunteers were persons of color. This reflects the team's strong efforts to bring volunteers and professionals to new neighborhoods and immigrant communities in the Twin Cities and throughout the state of Minnesota. Community gardens and parks are adding green space to communities, and they can be sustained through local efforts because of Extension education. Audiences include:

1. Fresh market producers, including growers of fruits and vegetables for processing, the processing industry, associated agribusiness turf professionals, nurseries and garden centers and landscape professionals. Several of these groups have high numbers of new immigrants.
2. Consumers of horticultural information for yards, gardens and landscapes. These include audiences where information is needed in a timely fashion and those who want to build basic knowledge about horticulture and environmental stewardship over time. Community-based initiatives mobilize schools, neighborhoods and non-profit organizations to create and maintain green spaces.
3. Community volunteers who can educate and act to keep yards, gardens and green spaces healthy.

### 3. How was eXtension used?

Three Minnesota Extension educators / specialists taught nine Integrated Pesticide Management webinars that are available on the eXtension website. A new pollinator conservation website managed by Extension also links to those nine webinars.

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

### 1. Standard output measures

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 487422 | 9952171 | 62243 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 7 |

**Patents listed**

Robotic Surveying of Fruit Plants: 15/131,745 - 4/18/16
Sports of Honeycrisp Apple: B42-3-16A: 16-9001 - 8/31/2016
Method to Measure Relative Utilization of Aerobic Glycolysis by Positional Isotopic Discrimination: 62/352,165 - 6/20/2016
Grape Vine Plant Named "Itasca": 62/387,956 - 1/11/2016
Apple Tree Named "LJ-1000": 20160781.3 - 5/24/2016
MN55 Apple Variety: 16-9056 - 12/13/2016
Apple Tree Named "MN55": PP26,412 - 2/16/2016 (ISSUED)
FF Rhododendron Plant Named "UMNAZ 493": PP26,600 - 4/12/2016 (ISSUED)
FF Rhododendron Plant Named "UMNAZ 502": PP26,601 - 4/12/2016 (ISSUED)
Apple Tree Named "MINNB42": PP26,64 - 4/26/2016 (ISSUED)

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 19 | 35 | 54 |

## 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 |
|---|---|
| 2016 | 2306 |

**Output #2**

**Output Measure**

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

| Year | Actual |
|---|---|
| 2016 | 12 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Participants of Horticulture program events will achieve significant learning gains regarding horticulture. (Target expressed as the percentage of participants who achieved learning gains.) |
| 2 | Participants of Horticulture program events intended to improve participant horticulture practices will improve practices as a result of attending events. (Target expressed as a percentage of participants that changed one or more horticulture practice.) |
| 3 | Research will support new horticultural crops' growth. |
| 4 | Volunteers will commit time to creating and improving Minnesota's green spaces, using training and expertise from Extension educators. (Target expressed as number of volunteer hours committed by Master Gardeners this year.) |
| 5 | Horticultural research in cold-hardy grapes, and education to producers, has driven a new industry in the Northern United States. (Outcome is the 2015 economic impact of cold-hardy grapes in Northern States.) |
| 6 | Research and Extension efforts to improve pollinator health will lead to new laws and regulations at the state level (expressed as the number of new laws, executive orders, or policies released). |

**Outcome #1**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

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

Not Reporting on this Outcome Measure

**Outcome #3**

**1. Outcome Measures**

Research will support new horticultural crops' growth.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 1 |

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

**Issue (Who cares and Why)**
Minnesota has seen rapid growth in its wine industry, particularly in the past decade. To continue this growth, vineyard owners are in constant need of new and better products and varieties to boost their industry and keep wine lovers interested.

**What has been done**

The University of Minnesota is recognized as having one of the top wine grape research programs in the country, with the goal of developing high-quality, cold-hardy, and disease-resistant wine grape cultivars. The wine grape breeding program began in the mid-70s, and in 2000 an enology lab and research winery opened at the Horticultural Research Center.

Today more than 12,000 experimental vines are cultivated on 12 acres. Thousands of seedlings are produced each year using a diverse genetic base that includes classic Vitis vinifera cultivars, quality French hybrids, and hardy, disease-resistant selections based on V. riparia, Minnesota's native grape.

**Results**
In 2016, the University of Minnesota released Itasca, the first dry-white wine grape for northern growers. It will allow northern growers to offer white wines along the lines of sauvignon blanc and pinot grigio, the largest segment of the white wine industry, providing a huge boon to the industry.

**4. Associated Knowledge Areas**

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

**Outcome #4**

**1. Outcome Measures**

Volunteers will commit time to creating and improving Minnesota's green spaces, using training and expertise from Extension educators. (Target expressed as number of volunteer hours committed by Master Gardeners this year.)

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 143408 |

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

**Issue (Who cares and Why)**
Gardens and green spaces in communities and homes promote healthy landscapes, healthy foods and healthy lives. While green spaces are trending across America culture, the skills to create and sustain green spaces are no longer a fundamental skill in communities. Trained

volunteers can fill that gap and strengthen skills among all community members so that gardens and green spaces are created and sustained.

**What has been done**
After training, Master Gardeners provide 50 hours of service in their first year, an additional 25 hours annually, and participate in continuing education to maintain certification. Master Gardeners teach classes, answer inquiries, assist with county Horticulture Days, demonstrate horticulture techniques in community and school gardens, teach youth, conduct media interviews, hold plant clinics at garden centers and farmers markets, and teach horticulture in hospitals, nursing homes and retirement centers.

**Results**
In 2016, a total of 2,371 volunteers provided 143,408 hours of time to community education, the equivalent of 68.95 full-time employees. They reached 151,287 adults, 59,519 youth, and 36,696 individuals from under-represented audiences. Minnesota Master Gardeners were involved with 105 community gardens and 56 school-based gardens. Their effort resulted in 12,832 pounds of produce donated to food banks and pantries.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 132 | Weather and Climate |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 211 | Insects, Mites, and Other Arthropods Affecting Plants |
| 213 | Weeds Affecting Plants |

**Outcome #5**

**1. Outcome Measures**

Horticultural research in cold-hardy grapes, and education to producers, has driven a new industry in the Northern United States. (Outcome is the 2015 economic impact of cold-hardy grapes in Northern States.)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|

2016 539200000

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

**Issue (Who cares and Why)**
Rural economies need to diversify. Commodity agriculture no longer spurs strong employment. Tourism, local foods and new horticulture products support economic diversification.

**What has been done**
Cold-hardy grapes contribute a new agricultural product to the Northern U.S. In the mid-1990s, the University of Minnesota, along with other private and public breeders, began releasing these grape varieties. As a result, vineyards and wineries across the northern region are developing an industry that combines product sales with tasting experiences, events venues and more. The first examination of the economic impact and industry status of vineyards and wineries of the north was conducted in 2013. It was updated in 2016.

**Results**
In 2016, Extension's economic analyst examined the economic impact and the industry progress of cold-hardy grapes and wineries in 11 states. Comparing 2011 results to 2015 showed an overall shift from a young, fast-growing industry to a mature one. The industry generated an estimated 539.2 million of economic activity in these states. This is a 34 percent growth over 2011. Wineries generated nearly half of this economic contribution. Employment in the industry grew by 24 percent between 2011 and 2015, representing a shift from volunteer to paid labor. A leader in this industry, University of Minnesota grapes account for 52 percent of the red variety cold hardy grapes examined in this study, and 65 percent of white varieties.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 204 | Plant Product Quality and Utility (Preharvest) |

**Outcome #6**

**1. Outcome Measures**

Research and Extension efforts to improve pollinator health will lead to new laws and regulations at the state level (expressed as the number of new laws, executive orders, or policies released).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2016 | 1 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Insect pollinators provide essential services to growers of US fruits, vegetables, nuts and seeds and honeybees are their star performer accounting for over two-thirds of the agricultural output attributed to insect pollination. But since the mid-2000s honeybees have been struggling to survive and beekeepers have had to resort to costly management tools to keep their hives going.

**What has been done**
The University of Minnesota is a national leader in research and extension related to honeybee management and health. In recent years, groundbreaking research has been conducted on hygienic bees and other non-chemical ways to improve pollinator health. Extension programs have included outreach to both beekeepers and green space lovers on how they can protect their hives and positively impact colony health.

**Results**
At the 2016 Minnesota State Fair Governor Dayton announced an executive order (Executive 16-07) that will make Minnesota a leader in protecting pollinators. The executive order outlines action steps for state agencies to minimize the negative impact on bees and other insect pollinators.

Policymakers plan to work closely with farmers, commercial gardeners, and homeowners to refine and put the any new standards into effect.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 205 | Plant Management Systems |
| 211 | Insects, Mites, and Other Arthropods Affecting Plants |

## V(H). Planned Program (External Factors)

**External factors which affected outcomes**
- Other (No external factors affected outcomes.)

**Brief Explanation**

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

**Evaluation Results**

**Extension** has evaluated, over time, the effectiveness of trained citizens to teach and guide fellow community members as they grow and sustain lawns, gardens and community green spaces. Carefully designed training, and ongoing in-services, is mobilizing thousands of volunteers every year. Program leaders track volunteers' yearly efforts and track some of the major influences volunteers have in communities.

In 2016, a total of 12,371 volunteers provided 143,408 hours of time to community education, the equivalent of 68.95 full-time employees. They reached 151,287 adults, 59,519 youth, and 36,696 individuals from under-represented audiences. Master Gardeners were involved with 105 community gardens and 56 school-based gardens. Their effort resulted in 12,832 pounds of produce donated to food banks and pantries.

A 2016 study also examined the impact of the vineyards and winery industry in 11 Northern sates. In 2016, Extension's economic analyst examined the economic impact and the industry progress of cold-hardy grapes and wineries in 11 states. Comparing 2011 results to 2015 showed an overall shift from a young, fast-growing industry to a mature one. The industry generated an estimated 539.2 million of economic activity in these states. This is a 34 percent growth over 2011. Wineries generated nearly half of this economic contribution. Employment in the industry grew by 24 percent between 2011 and 2015, representing a shift from volunteer to paid labor. A leader in this industry, Minnesota grapes account for 52 percent of the red variety cold hardy grapes examined in this study, and 65 percent of white varieties.

## Key Items of Evaluation

**Extension.** In 2016, a total of 2,371 Extension volunteers provided 143,408 hours of time to community education, the equivalent of 68.95 full-time employees. They reached 151,287 adults, 59,519 youth, and 36,696 individuals from under-represented audiences. Master Gardeners were involved with 105 community gardens and 56 school-based gardens. Their efforts resulted in 12,832 pounds of produce donated to food banks and pantries.

In 2016, Extension's economic analyst examined the economic impact and the industry progress of cold-hardy grapes and wineries in 11 states. Comparing 2011 results to 2015 showed an overall shift from a young, fast-growing industry to a mature one. The industry generated an estimated 539.2 million of economic activity in these states. This is a 34 percent growth over 2011. Wineries generated nearly half of this economic contribution. Employment in the industry grew by 24 percent between 2011 and 2015, representing a shift from volunteer to paid labor. A leader in this industry, Minnesota grapes account for 52 percent of the red variety cold hardy grapes examined in this study and 65 percent of white varieties.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- MnDRIVE
- Rapid Agricultural Response Fund
- USDA- NRI
- Extension MacArthur Fellowship
- USDA-OREI
- USDA-SARE
- Specialty Crop Block Grant

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

**Program # 14**

**1. Name of the Planned Program**

Agricultural Business Management

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 601 | Economics of Agricultural Production and Farm Management | 50% | | 40% | |
| 602 | Business Management, Finance, and Taxation | 50% | | 20% | |
| 603 | Market Economics | 0% | | 20% | |
| 604 | Marketing and Distribution Practices | 0% | | 10% | |
| 610 | Domestic Policy Analysis | 0% | | 10% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 7.1 | 0.0 | 7.4 | 0.0 |
| **Actual Paid** | 19.9 | 0.0 | 18.8 | 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** |
| 814724 | 0 | 193790 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 2554185 | 0 | 1514105 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 1075066 | 0 | 3103381 | 0 |

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

### 1. Brief description of the Activity

**Extension**. Through educational events, consultations and online resources, Extension's Agricultural Business Management programs provide education about farm business transfer and estate planning, agriculture tax issues, land rent data, machinery management, strategic planning and business planning, earning a living on a modern farm, current events in agricultural business management and agricultural lending.

In 2016, efforts shifted to the development of new, responsive focus areas. The team developed three new program areas:

1. Taking Charge of Your Finances: How to Survive and Thrive. Interactive and in-depth workshops provide financial tools that help agricultural business managers make better management and financing decisions.
2. Leadership for Successful Employee Management, a new labor management program, was developed in 2016 and will be launched in 2017.
3. Women in Agriculture. This program provides education while generating network connections among women that enhance leadership and strengthen management and production abilities.

This year, Extension is reporting its impacts in increasing the profitability of producers and protecting their assets during this time of profits being lowered by the market.

**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.
Research highlights for 2016 include:

- A five-year multi-regional assessment of precision zonal management (PZM) in cereal production systems has demonstrated that PZM constitutes high-performance conservation tillage that is superior to other conservation tillage options for the upper Midwest and Eastern Corn Belt.
- A new model was developed to analyze the effect of federal crop insurance programs on farmer adoption of pesticide resistance management. It is now being used to explore alternative ways to redesign these insurance programs to promote increased pesticide resistance management efforts.
- A study looking at the effectiveness of a commercial fly trap (TRAP) in organic dairy production systems found TRAP was effective in reducing horn fly numbers on cows and reducing horn fly growth rates during the pasture season but it did not improve milk production.
- Researchers developed an additional six decision case studies on the decision to transition to organic production systems. In total, nine case studies have been completed with plans to add more on areas farmers having indicated they encountered problems including marketing and business planning.
- A research study comparing emergency grazing options for horse pastures and alternative options for extending the forage season discovered horses preferred winter wheat, annual ryegrass, and spring wheat. Of these, annual ryegrass was the highest yielding option making it a good choice for horse owners looking to extend the grazing season or in need of emergency forage during the summer and fall seasons.

### 2. Brief description of the target audience

Target audiences for Ag Business Management programs continue to include:

- Minnesota 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 policymakers

In 2016, a new focus on women involved in agriculture shifted outreach and recruitment efforts.

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 9585 | 128465 | 2 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 1 | 20 | 21 |

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

**Output Target**

**Output #1**

**Output Measure**

- Number of educational events.

| Year | Actual |
|---|---|
| 2016 | 161 |

### V(G). State Defined Outcomes

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Participants of Agricultural and Business Management workshops and conference sessions intended to improve business management practices will significantly improve management practices as a result of attending the program. (Outcome is the percentage of participants that change one or more of their business management practices as a result of attending an educational event. |
| 2 | Participants of program will increase profitability as a result of decisions made with Extension information. (Outcome is a dollar amount of profitability made by the program.) |
| 3 | Informed decisions by farm managers will protect the business and personal assets of producers. |

**Outcome #1**

**1. Outcome Measures**

Participants of Agricultural and Business Management workshops and conference sessions intended to improve business management practices will significantly improve management practices as a result of attending the program. (Outcome is the percentage of participants that change one or more of their business management practices as a result of attending an educational event.

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

Participants of program will increase profitability as a result of decisions made with Extension information. (Outcome is a dollar amount of profitability made by the program.)

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 151828786 |

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

**Issue (Who cares and Why)**
About 90,000 land owners and dairy producers 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 2016, these market forces include dramatic price drops for commodities and fluctuating rental value for farmland.

**What has been done**
Extension educators and faculty delivered educational programming and disseminated information to support the profitability of agricultural business managers in 2016. For example, Extension organized marketing groups of farmers who agree to work together over an extended time period to market the agricultural products they produce. Also, land rent workshops assure that land rental markets remain viable.

**Results**

Extension marketing groups generated revenue in surplus of income to meet expenses and cover the costs of family living by an average of $68,066 per farm. With 55 farm operations involved in the groups, total positive revenue streams reached $3,743,630 due to Extension efforts. In addition, 5 percent of Minnesota corn and soybean acres were represented by attendees at the land rent workshops. Based on participants' responses (both farmers and landlords), the total rental value of farmland affected by Extension education would be $148,085,156. These dollars circulate through the 63 counties where the participants work and live. The quantitative outcome above represents a sum of these two program outcomes.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |
| 604 | Marketing and Distribution Practices |

**Outcome #3**

**1. Outcome Measures**

Informed decisions by farm managers will protect the business and personal assets of producers.

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2016 | 45462000 |

**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 create long-term health care plans as well as farm transition and estate plans. In 2016, evaluation data was collected to understand the impact of long-term planning for 27 farm units.

**Results**

Based upon follow-up evaluation sent three months after the long-term health care workshop, participants stated they developed and implemented long-term health care plans. They reported that these plans protect an average of $1,162,000 in assets per participant. Range in self-reported asset amounts for the five participants reporting was $500,000 to $1,810,000. This outcome represents $7,236 worth of financial impact for every dollar in program costs. Farm transition and estate planning workshops showed that 22 farm units implemented transition plans. Total asset value self-reported by participants was $44.3 million. A total of $9,321 of financial impact was generated for every 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**

- Economy
- Competing Public priorities

**Brief Explanation**

Ag Business Management programs focused on the development of new program offerings to address challenges in farm profitability in 2016. These efforts replaced the high-volume efforts placed on farm bill education done in 2015. Therefore, program outputs related to program participants were halved.

## 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 impacted their farm management decisions. As dollar value impacts on profitability and asset management are assessed, program managers are assured that producers are able to continue to feed the world.

In 2016, evaluations related to profitability and asset management demonstrated that investment in Extension programs resulted in more than $197 million of impact.

**Key Items of Evaluation**

In 2016, evaluations related to profitability and asset management demonstrated that investment in **Extension** programs resulted in more than $197 million of impact for farm managers and food producers.

**MAES.** Examples of non-NIFA research funds and grants leveraged by PIs in this program are:

- Legislative-Citizen Commission on Minnesota Resources (LCCMR)
- USDA-AFRI

- USDA-SARE

# VI. National Outcomes and Indicators

## 1. NIFA Selected Outcomes and Indicators

| | |
|---|---|
| **Childhood Obesity (Outcome 1, Indicator 1.c)** | |
| 0 | Number of children and youth who reported eating more of healthy foods. |
| **Climate Change (Outcome 1, Indicator 4)** | |
| 6 | Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits. |
| **Global Food Security and Hunger (Outcome 1, Indicator 4.a)** | |
| 2020 | 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)** | |
| 8 | Number of new or improved innovations developed for food enterprises. |
| **Food Safety (Outcome 1, Indicator 1)** | |
| 5 | Number of viable technologies developed or modified for the detection and |
| **Sustainable Energy (Outcome 3, Indicator 2)** | |
| 0 | Number of farmers who adopted a dedicated bioenergy crop |
| **Sustainable Energy (Outcome 3, Indicator 4)** | |
| 0 | Tons of feedstocks delivered. |