

2013 University of Minnesota Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

This report highlights accomplishments of the University of Minnesota's Agricultural Experiment Station (MAES) and Extension in 2013. Fifteen programs provide the organizing structure to report both MAES and Extension outcomes and address NIFA priorities. In MAES the research reported under all of the programs, including the NIFA priorities, describe research conducted within the five U of M colleges that receive MAES funding. In many cases the research is interdisciplinary and integrated with Extension outreach efforts. Increasingly, this research involves partners from other states and stakeholder groups. Only one program in this joint Extension and MAES report--4H--has no MAES components.

MAES: Summary of 2013 Activities

2013 saw the fruition of several areas of long-term MAES-supported research efforts, and the increased visibility of others. It also saw MAES administrative changes, with the resignation of the MAES Director and Deputy Director in late summer, and the naming of an Interim MAES Director and Interim Deputy Director. The MAES interim director, Brian Buhr, is also Interim Dean of the College of Food, Agricultural and Natural Resource Sciences. The MAES interim deputy director is Michael Schmitt, who is also Associate Dean for Extension, providing a closer coordination between research and outreach programs.

Last year we reported that U of M President Eric Kaler had established a new university research initiative to focus on four high priority issues. In 2013, the Minnesota Legislature authorized an \$18 million annual investment in these issues. Three of the four had already been identified as emerging and high priority research issues for MAES. They are: 1) Robotics, sensors and advanced manufacturing, 2) Securing the global food supply, and 3) Advancing industry and conserving our environment. Among the goals of the initiative are to: strengthen the partnership with Minnesota's food and agribusiness community; improve market access for Minnesota agriculture; improve animal health and well-being; and reduce food contamination and public health threats. MAES-supported colleges redirected research efforts towards the new initiatives, and leveraged public funding to increase private investment in research. In CFANS, sixteen new faculty were hired, and the College of Biological Sciences hired 10 new faculty.

As recent MAES supported research in public funding of agricultural research and agricultural growth has shown, there is a lag of about 50 years between R&D spending and productivity growth while funding for the basic research that makes U.S. agriculture a world leader in innovation and production is stagnant if not in decline. Meanwhile the world's population is growing and there is comparatively less land to bring into agriculture. MAES research has responded to the need to be smarter and more efficient in its research investments. It continues seek out new models of research effectiveness, while building on the understanding that strengthening the research partnerships between producers, private industry and education is critical.

- A growing understanding of the globalization of agriculture and the food industry has increased the need to broaden the view and scope of research to include an international focus.

- The continuing impact of climate change is focusing the need for more research on disease and insect resistance, and increasing the importance of biological science research in genetic selection, as well as refocusing research on agricultural management practices to respond to the effects of climate change.
- An increased awareness of ecosystem health is placing increasing emphasis on surveillance, biosecurity, and new control and eradication strategies for economically significant diseases of crop and animal populations
- Continuing change in Minnesota demographics has led to increased research into housing issues of a growing aging population, finding best practices for supporting new Minnesota immigrants, and investigating best strategies to help Minnesota rural communities experiencing population shifts and employment stress.
- The maturation of sustainable energy research has led to a more realistic understanding of the potential for biomass crops, and the environmental and economic tradeoffs of potential sustainable energy sources.
- In 2013, research emphasis across disciplines increased in life cycle analysis, using a holistic approach, and taking advantage of innovations in technology and greater access to data.
- Growing awareness in healthy diets for youth, as well as shifting consumer attitudes continues to increase the importance of long term MAES nutrition research. At the same time, there is increased emphasis on research on functional foods and new processes to maintain food safety. There is also increasing understanding that the information from animal health studies has implications for human health.

Extension: Summary of 2013 Activities

Service levels: In 2013, Extension program teams delivered programming to over 860,000 Minnesotans. This includes programs funded by federal, state, local, and grant funding, nutrition education (EFNEP and SNAP-Ed) and Farmer Lender Mediation programs. "Indirect contacts" are defined differently by each program area, but typically refer to unique visits on educational web sites, social media sites, listserves or other outreach efforts.

In 2013, Extension continued to enhance the use of technology to reach constituents, as called for in the 2012 strategic plan. Extension programs and initiatives now host 50 social media sites (increased from 44 in 2012). Using Google's criterion, U of M Extension is the highest-placed listing with a search for "Extension Service." Every planned program now employs some web-based educational delivery option to enrich or expand outreach to audiences. In 2013, several programs (for example, Food Safety, Building Strong, Healthy Families and Youth Development) replaced face-to-face orientation or certification programs with online options. Extension's horse team updated its education for horse owners by developing a mobile app that help owners precisely determine how much hay to purchase and feed their animals. Family development educators developed webinars, podcasts, apps and mp3 audio recordings on 45 topics, increasing Extension's accessibility parents and professionals.

Extension mobilizes volunteers across Minnesota and Extension education, giving them the capacity to serve and protect Minnesota's land, water, children, families and communities. Extension volunteers provided at least 1,245,384 hours of service in 2013, the equivalent of 598.73 full-time staff. According to the Independent Sector, this service should be valued at \$27,286,363,. This includes volunteerism for Master Gardener and Master Naturalist programs, 4-H, Regional Sustainable Development Partnerships and other Extension programs.

Outreach to underserved audiences: While Minnesota is still not as racially diverse as the nation, it is becoming more so. Almost 18 percent of Minnesota's residents are now persons of color, compared to only one percent in 1950 (mncompass.org). Several planned programs design and deliver programming that is culturally relevant and targeted to these underserved audiences. As a result, minorities were near or greater than 18 percent of participants of four Extension planned programs: Childhood Obesity (37 percent); Building Strong, Healthy Families (30.34 percent); Community Economics (24 percent); and

Food Safety (17 percent).

Other programs managed successful outreach efforts to, or on behalf of, underserved audiences, as well. For example:

1. 13.5 percent of 4-H program participants were youth of color. Promise Fellows grants, Urban 4-H programs, and other targeted efforts are diversifying the 4-H population.

2. Horticulture programs are reaching minority youth through community gardens, schools and neighborhood gardening and "green space" projects. As a result, 17 percent of the youth served by the horticulture team are youth of color.

3. Extension programs often address diversity by preparing employers and professionals to work across cultures. For example, Agricultural Business Management workshops educate agricultural employers who employ Latino workers. Leadership programs are preparing community leaders to address diversity in communities and groups.

Multi-state engagement. All Minnesota planned programs are engaged in projects, initiatives, program evaluations or gatherings with other land grant institutions. For example, the Youth Development team is part of national and North Central region teams that are increasing the quality of volunteer training and management strategies for 4-H and youth development programs. Minnesota's Leadership and Civic Engagement team is managing the North Central Leadership Development program, and have changed the curricula of the program as Minnesota's leadership models have emerged.

Six of the 15 planned programs report using eXtension in some way. A contract with the University of Iowa allows the U of M to provide "Answer Line" services to Minnesotans at a low cost. In 2013, Iowa's Answer line responded to 5,448 calls and 142 Answer Line emails that came from Minnesota.

Strategic plan. In 2013, Extension charted its progress in developing and implementing multi-disciplinary issue areas, as determined in its strategic plan. An analysis examined work currently underway in Extension and throughout the University. These assessments led to the continued and expanded work of the educational disparities and food systems issue areas that have already tapped multi-disciplinary contributions. The clean energy issue has been consolidated with the Clean Energy Resource Team (CERT) work. CERT will henceforth drive the work in this area, as described in NIFA Accomplishments Reports of 2012 and 2013.

Staff expertise. In 2013, 134 (133.75 FTE) highly specialized Extension educators delivered planned programs described in this report. In county offices, 29 local educators (26.2 FTE) and 120 (105.6 FTE) program coordinators deliver programs.

Merit review. Since 2008, an academic promotion process has been in place to monitor and reward educators' performance and scholarship. In 2013, 16 regional educators and five local educators were promoted after rigorous peer review of their scholarship, teaching and program leadership, as described in "Merit Review Processes."

Academic ties. Partnerships with six academic affiliations assure funding or partial funding for 79 faculty, supporting 31.78 FTEs with Extension funding.

County positions. Extension offers contracts to each of Minnesota's 87 counties so that local educators can be assigned to develop, deliver and evaluate county-based program delivery in alignment with local priorities. This county system works alongside Extension's regional system in Minnesota, and benefits from the research and program planning of statewide specialists and educators. The degree to which counties invest in these positions demonstrates local endorsement for the value of Extension's work, especially as county governments make difficult budget decisions. While contract prices rose by 1.5 percent in 2013, investment in Extension programs for 2014 increased by 2.3 percent, with 74 of

Minnesota's 87 counties (85 percent) increasing their county allocation to Extension. With these contracts in place, the number of Extension FTEs assigned to counties increased from 113.84 in 2013 to 116.45 for programming in 2014.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	313.5	0.0	370.3	0.0
Actual	298.1	0.0	476.9	0.0

II. Merit Review Process

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

- 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 2013, 14 MAES-supported researchers in the College of Food, Agricultural and Natural Resource Sciences were granted promotion. Nine were promoted from assistant professor to associate professor with tenure, and five 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. Each project receives a primary and a secondary reviewer. In 2013, the MAES-related funding was evenly distributed across two signature programs: Research in Emerging and Zoonotic Disease, and Population Systems. The competition awarding these funds was open to all CVM faculty with MAES-related research. The College of Biological Sciences has a similar review process to select research projects for MAES funding.

Extension. In 2013, U of M Extension continued to manage its academic promotion process for educators. In all, 21 educators were promoted -- 16 regional educators and five local. Efforts to assist staff through the promotion process included peer learning groups and mentorship from those who have successfully navigated the promotion process.

There are seven criteria reviewed for promotion: 1) program leadership, 2) Extension teaching, 3) program management, 4) scholarship, 5) technical assistance, 6) engagement, and 7) service. These seven criteria are weighted differently for Extension educators with rank (regional educators) and Extension educators without rank (county educators.) Candidates choose which criteria will be the primary emphasis of their promotion dossier. Candidate dossiers are reviewed by peers in Minnesota and in other states. Responsibility for the Extension promotion decision rests with the Dean of Extension, based on recommendations from a promotion review committee, Center Associate Deans and Extension's Senior Associate Dean.

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

III. Stakeholder Input

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

- 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
- Other (One-on-one interactions)

Brief explanation.

MAES. The research that MAES supports is defined by the five colleges that receive MAES funding. Those decisions are guided by stakeholders' input gathered through each college's research advisory committees. Feedback is also gathered from stakeholder groups on specific research areas. Besides the formal processes in place to identify stakeholders and gather input, other strategies are in place to elicit input for research decisions. For example, all the projects selected to receive Rapid Agricultural Response research project funding in 2013 had to demonstrate external stakeholder support, as did the projects selected to receive 2013 Small Grains Initiative research project funds. Both those funds are managed by MAES. Other research-related committees bring stakeholders to the table for input and decision-making, such as the Agronomic and Horticultural Variety Review Committee and the Plant Licensing Task Force, which meet yearly under the leadership of the MAES director..

Each Research and Outreach Center across the state, supported by MAES funding, has an advisory committee which reflects the composition and interests of the local area. Also at the Research and Outreach Centers there are other specific stakeholder groups advising on particular programs. For example, the Southwest Research and Outreach Center has a program that is guided by an Advisory Committee of conventional and organic farmers, researchers and educators.

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

Extension. Extension's stakeholders are encouraged to provide formal feedback to Extension at the local level through County Extension Committees, which are instrumental in making local choices for funded programming. Minnesota counties must, by law, have an Extension committee in place. Program areas write stakeholder assessments into their program business plans, identifying targeted audiences who inspire, co-design and assess program strategies. Statewide, the dean convenes Citizen Action Committees from a broad spectrum of Extension interests, and manages legislative action days at the state level.

Regional Sustainable Development Partnerships (RSDP) also play a key role in connecting Extension to stakeholders throughout the state. Regional Sustainable Development Partnerships have always been a University partner, but as of 2012 they became a department within Extension, giving them a presence on Extension's leadership team and facilitating stronger collaboration within Extension statewide. RSDP is governed and guided by five community-university boards and supportive work groups. There is also one statewide board. Board members are community members who are well connected to RSDP's areas of focus: 1) sustainable agriculture and local food, 2) tourism, 3) resilient communities, 4) natural resources, and 5) clean energy.

Engaging stakeholders is core to RSDP's mission . **In 2013, Extension's Regional Sustainable Development Partnerships leveraged 14,142 hours from volunteers who work in their regions and statewide to connect Extension and the University of Minnesota to regional needs and opportunities. This is the equivalent of 6.8 FTEs.** Stakeholder input is systematically gathered in a number of ways. For example:

- Governing boards are composed of 75 percent community members and 25 percent faculty members. They meet throughout the year in each region and direct the work and programming of each Regional Partnership. Extension and other University of Minnesota resources are tapped to assist regions in those projects whenever appropriate.
- Focus area work groups set regional priorities annually, review ideas and proposals, and make recommendations to RSDP boards.
- Forums are coordinated to discuss current topics. For example, in 2013 a series of farm-to-school gatherings were convened in each region, drawing hundreds of participants to stimulate feedback, attention and action that informed farm-to-school programming in Extension and the University.
- Projects build community-University partnerships and serve as catalysts for sustainable development. To date, over 500 projects have been conducted.
- Focus area networks manage and facilitate local initiatives. The most active networks are working together on sustainable agriculture and local foods.

Community stakeholders are also engaged through educational events and meetings, as well as conferences that build the capacity of stakeholders to address issues through knowledge and connections to resources.

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.

Extension. Local county Extension committees are selected from representatives of local stakeholder groups including 4-H volunteers and parents, other programmatic stakeholders, and city and county leaders and elected officials. These stakeholders are in a position to advise use of local dollars for Extension programming. Statewide advisory committees are selected through outreach to the general public and through program stakeholder groups. Meetings with statewide associations and the legislature are used to identify and educate interested stakeholders.

Regional Sustainable Development Partnerships (RSDP) solicit input from people throughout regions using local connections and local outreach. Outreach methods include internet listservs, paid advertising, earned media (such as radio spots and local paper news stories), social media, and current networks of past and present board members and work group members.

The RSDP partners with organizations and agencies that have complementary goals and project objectives. Through cooperation and collaboration, RSDP increases the visibility of meetings, events, projects and opportunities such as the Farm-to-School forums discussed above.

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
- Meeting with 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. Besides collecting stakeholder input through advisory committees and informal researcher contacts, there are other more formal opportunities for collecting this input. For example, the College of Veterinary Medicine hosts an annual Research Day that is open to the public and

serves as a chance for outside stakeholders to interact with CFM research faculty. The College of Food, Agricultural and Natural Resource Sciences also hosts an annual "Classes Without Quizes" event, which presents current research to the public and invites their questions and feedback.

Last year we reported on The College of Food, Agricultural and Natural Resource Sciences followed up on a workshop on landscape health that invited Native American and African American community leaders to engage in a dialogue with faculty and researchers. They challenged them to consider the implications of culturally different knowledge systems within the context of their work. A 2013 symposium continued the discussion between Western and Anishinabe cultural views.

College of Veterinary Medicine faculty and administrators regularly interact with stakeholders from the swine, dairy and poultry industries. Stakeholder input is sought at high-profile events such as the Allen D. Lemman Swine Conference, an annual educational event for the global swine industry. Each year hundreds of participants from over 20 countries attend the Lemman Swine Conference held on the St. Paul campus. College of Veterinary Medicine centers such as the Swine Disease Eradication Center have industry advisory boards consisting of groups including breeding stock companies, pharmaceutical and biologics companies, production companies and other associations. The Swine Disease Eradication Center has a very strong collaboration with the swine industry and an Industry Advisory Board composed of 10-to-12 swine-related companies. The Board meets once a year with the Center's faculty and provides input and critique on their research progress, as well as insight on directions for new research initiatives.

MAES supported researchers in the College of Human Development and Education participate in the Common Ground Consortium, which supports advanced graduate work in education by students of culturally diverse backgrounds. MAES supported family social science researchers seek input into family and community research needs by connecting with under-served populations in Minnesota including economically disadvantaged and new immigrant groups.

A new advisory group was formed in 2013 specifically to get stakeholder input into research efforts in the new priority areas of MNDrive. Two listening sessions were held to identify stakeholder interests and needs to focus research projects to meet those needs.

Extension Centers invite key stakeholders to be part of legislative interactions, choosing from among

program alumni, sponsors and key supporters. Citizens' Advisory Committee members are selected through a process that invites applications from across the state. These applications are reviewed and candidates are selected after considering whether the composition of the final membership represents a balance of geographic and content perspectives. County Extension Committees invite participation from local constituents of programs who can support programs and assess the need for additional ones.

RSDP board members and staff reach out to communities, constituents, and organizations in order to establish priorities for a given region. Board and staff seek out innovators and early adopters, build community-University partnerships, and solicit ideas for projects. One venue is the RSDP Idea Form, available on Extension's RSDP website (www.extension.umn.edu/rsdp/) and is disseminated by staff in each region. Community stakeholders are also engaged in educational and outreach events, meetings and conferences.

Each RSDP region brings together groups of local stakeholders in its focus areas to form working groups. Working groups create action plans that identify regional priorities and connect University resources to community needs and goals.

RSDPs also solicit comments and public response through their website and social media.

Surveys, listening and comment sections are used to collect specific responses to question about project design or priorities.

3. A statement of how the input will be considered

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

Brief explanation.

MAES. Research has been redirected to high priority areas by stakeholder input not only in decisions on the use of the Rapid Agricultural Response Fund and the Small Grains Initiative Fund, but in many other areas. As a result of CFANS faculty and Anishinaabe interactions, four ongoing working groups have been formed to address issues critical to the Native Indian population of Minnesota, including wild rice research. New research in the areas of global food security, the environment and robotics and sensors have been the direct result of stakeholder input.

Extension. Outreach by program areas is considered as educators and specialists tweak, change and grow programming in response to "customer" demands and needs. County Extension Committee input is used to put new local programming in place or to change and continue existing programming. Statewide, information from legislatures and Citizens' Advisory Committees guide the strategic direction of the organization.

Stakeholder input gathered through Regional Sustainable Development Partnership boards and work groups is used to prioritize the actions of University-Community partnerships, including those managed by Extension. For example, in the area of sustainable agriculture and local foods, work groups in Southeast Minnesota prioritized educating the public on life skills related to food, as well as improving food environments through policy, systems and environmental changes. This input inspired a collaboration between the community and Extension's Nutrition Education programs (See Childhood Obesity). In the Northeast part of the state, stakeholders prioritized efforts to make more local food available at retail outlets and institutions, increasing youth involvement in food system activities, and increasing local food production. Extension's agriculture and youth development programs supported that effort.

Knowing the priorities for each focus area, the board solicits project ideas through the Idea Brief, and is able to invest responsively in community-University partnerships. At the end of FY2013, the Partnerships had an active portfolio of 139 projects among the five regions and the statewide office, including the Clean Energy Resource Team seed grants (See Sustainable Energy).

RSDP projects involve Extension educators and faculty to deliver programming. For example, Extension educators and faculty hosted Farmer's Market and Farm-to-Cafeteria workshops and conducted economic analysis of the grape and wine industry in Minnesota. RSDP solicitation and support are often Extension's first forays into a given topic or solution, and result in later institutionalization of programming efforts within the University, especially Extension.

Brief Explanation of what you learned from your Stakeholders

Extension. County Extension Committees generated support for Extension programming, ultimately producing county investments described earlier. Citizen Advisory Committees were mobilized to make constituent visits to the legislature, providing personal perspectives and education about Extension's work.

In 2013, RSDP stakeholder involvement processes found a strong interest across Minnesota in promoting and facilitating local food systems, even in Minnesota's winter months. In response, deep winter greenhouse projects, including a manual for building greenhouses and growing crops, were conducted in several regions.

Clean energy work groups discovered a strong interest in exploring solar options for sustainable energy, and a decreased emphasis on wind projects than in other years.

Tourism work groups turned the focus on using tourism to diversify the economies of towns under 1,500. With involvement from the University of Minnesota Tourism Center and Community Economics Extension educators in 2013, local leadership teams began to assess and leverage local assets, and to promote interaction and enjoyment of communities without destroying the resources, culture, or community networks that exist in those small towns.

Natural resource work groups were interested in understanding and shifting the impact of development and agriculture on water quality locally and "downstream." Workshops provided training in how to use LiDAR GIS and Terrain Analysis to examine what happens "downstream" to water drainage as well as contaminants. This led one participant to apply for and receive a \$425,000 grant to increase conservation efforts.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
8100001	0	5759735	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	7862455	0	6622923	0
Actual Matching	27298617	0	31271556	0
Actual All Other	28393131	0	49769326	0
Total Actual Expended	63554203	0	87663805	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	863188	0

V. Planned Program Table of Content

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

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		10%	
204	Plant Product Quality and Utility (Preharvest)	10%		5%	
205	Plant Management Systems	10%		10%	
206	Basic Plant Biology	5%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%		5%	
212	Pathogens and Nematodes Affecting Plants	5%		5%	
213	Weeds Affecting Plants	5%		5%	
216	Integrated Pest Management Systems	5%		5%	
301	Reproductive Performance of Animals	5%		5%	
302	Nutrient Utilization in Animals	8%		5%	
304	Animal Genome	2%		5%	
305	Animal Physiological Processes	5%		5%	
306	Environmental Stress in Animals	2%		5%	
307	Animal Management Systems	15%		10%	
311	Animal Diseases	10%		10%	
315	Animal Welfare/Well-Being and Protection	3%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

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

Actual Paid Professional	26.3	0.0	169.4	0.0
Actual Volunteer	0.7	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
798097	0	2933547	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2212757	0	13102626	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
812604	0	17821760	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

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

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

showed that they could decrease the number of airborne viral particles in swine housing systems by half, and therefore should be considered as part of strategies to mitigate influenza transmission in pandemic preparedness plans.

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

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

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

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

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

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

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

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

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

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

- Newcastle disease is world-wide in distribution and a major cause of death in poultry. Two Newcastle disease variants are considered a substantial threat to commercial turkeys. Also of concern is the potential for either of these viruses to infect the increasing numbers of free range and backyard poultry. In 2013, researchers conducted serological analysis for Newcastle antibodies on predatory birds, including bald eagles, great horned owls, peregrine falcons and red-tailed hawks. Results led to researchers to predict a higher disease infection rate in 2014, allowing for fair warning and preparation.

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

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

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

2. Brief description of the target audience

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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

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

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

Patent Applications Submitted

Year: 2013

Actual: 4

Patents listed

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

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	56	179	235

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Output #2

Output Measure

- Number of Extension learning opportunities.

Year	Actual
2013	640

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	83

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

213	Weeds Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
304	Animal Genome
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	60

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

Results

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

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

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

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

Results

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

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

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

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

Key Items of Evaluation

Behavior change that resulted from new knowledge influenced almost 348,000 acres of farmland in 2013, and influenced 450,000 beef cattle.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Sustainable Energy

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
131	Alternative Uses of Land	0%		10%	
401	Structures, Facilities, and General Purpose Farm Supplies	5%		10%	
402	Engineering Systems and Equipment	5%		10%	
501	New and Improved Food Processing Technologies	5%		0%	
511	New and Improved Non-Food Products and Processes	5%		40%	
601	Economics of Agricultural Production and Farm Management	0%		10%	
605	Natural Resource and Environmental Economics	80%		10%	
610	Domestic Policy Analysis	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	36.7	0.0
Actual Paid Professional	16.2	0.0	50.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
273725	0	267560	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1927991	0	2112500	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1466096	0	5452157	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Research in this program area in 2013 showed results on several fronts. Research is providing a better understanding of the trade-offs and intersections of this opportunities of sustainable energy with agricultural productivity and environmental health. The promise of various crops for their use as biofuel is being tempered by a better understanding of the complexity of natural systems, and competition from various sources of energy. Biofuel production and use affects and is affected by climate change, air quality, water quality, biodiversity and many other environmental factors. Increasing understanding of these multiple factors is also providing convincing evidence that research has a significant role to play in helping to assure Minnesota's energy health and sustainability. Among the results and impacts of MAES supported research in sustainable energy in 2013:

- An analysis of federal expectations for achieving renewable fuel standards by 2022 revealed large implications for Minnesota agriculture. For example, the analysis showed the USDA projects Minnesota will produce 750,000 to 1 million acres of grasses in 2022, while the DOE and EPA project none. Evaluating external scenarios from federal agencies helps in developing realistic scenarios of bioenergy landscapes. Researchers used an input and risk assessment model to current bioenergy production data and tested the model in Southern Minnesota.
- A project on producing hydrogen from co-fermenting molasses with liquid swine manure in an anaerobic sequencing batch reactor confirmed the feasibility of producing biohydrogen from the two waste streams through fermentation.
- There is an urgent need to create ways to transform lignins produced in biorefineries into a range of useful materials, particularly versatile thermoplastics. MAES supported bioengineering researchers have made progress in identifying promising genes identified by comparing white and brown rot fungal secretomes in host organisms, and evaluating the resulting enzymes.
- Other research to increase the value of biomass through converting forest or crop residues into industrial products, has developed processes for thermal plasticization of wood waste into self-reinforced composites, without the need to add synthetic polymer binders.
- Biomass derived oils show promise as a renewable substitute for fossil fuels, if the quality of the oil could be improved. Researchers developed a lab device and processes that improved the heating value of biomass oils, reduced oxygen and nitrogen content, and removed pigments from the oils. Further work also showed that bio-oils could be renewable sources for making rigid polyurethane foams.
- As we reported here last year, progress on the use of biomass into acrylic technologies led to a patent application on a new technology entitled, "Pressure-Sensitive Adhesives having High Bio-Mass Content and Macromonomers for Preparing the Same." Researchers are now close to having a new patentable biomass technology for sealant and adhesive applications.
- Research on the use of byproducts from ethanol production for use in livestock feed has been

ongoing for several years, and these results reported in previous years. As a result of this research, poultry and swine producers have been using dried distiller's grains, a byproduct of corn processing for ethanol in their feed to lower feed costs. Nutrient studies have confirmed the feed additive's utility. However, a problem of manure foam fires at swine farms has raised the possibility that the foam could be related to the animals' diet. Researchers have found that the distillers grains contain high levels of fatty acids that pass through the pigs' digestive system and help form bubbles in the manure that causes the foam. Researchers have been collaborating with agricultural engineers at several universities to understand the effects of dietary components on manure foaming and biogas production and have learned that fiber type and size, as well as lipid composition of the manure appear to be significant risk factors.

- Perennial crops are being investigated as a bioindustrial feedstock because of their environmental and ecological benefits. Researchers have found that prairie cordgrass and a polyculture planting were the highest producing herbaceous crops in an alley cropping configuration. A management information system is being developed for storing and analyzing crop productivity in alley-cropping as well as monoculture biomass systems.
- We reported last year that researchers showed that ventilation fans in swine buildings cooled with a geothermal system reduced energy use compared to non-cooled rooms. They have now received funding to install and test the geothermal system at a commercial swine operation.

Extension. Sustainable Energy programming from U of M Extension is primarily carried out through the Clean Energy Resource Team (CERTs). CERTs is the clean energy program of the Regional Sustainable Development Partnerships. CERTs is a statewide partnership with a shared mission to connect individuals and their communities to the resources they need to identify and implement community-based clean energy projects.

In 2013, the CERTs team conducted campaigns, programs, and events that supported clean energy goals. The teams partnered with others for the "Recycle Your Holidays" campaign to encourage use of LED holiday lights, through which 163,000 pounds of electrical cordage from holiday lights were collected and recycled. In September of 2013, CERTs completed a campaign to get energy and water-efficient pre-rinse spray valves, faucet aerators and shower heads operational in organizations and homes across Minnesota. CERTs hosted its biennial conference in February of 2013 where nearly 500 Minnesotans from residential, business, school, government and farm sectors came together to discuss and work on renewable energy and energy efficiency issues and projects. Of the 53 seed projects CERTs funded in 2012, 26 were completed in 2013. Of these, 11 implemented clean energy by incorporating renewable energy, energy efficiency or both. Six performed research and eight conducted education and outreach. Finally, CERTs funded over \$132,500 to 34 new seed grants to projects across the state. Work on these projects will be completed in 2014.

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 target audiences include all of those, and also forest products industry, academic

researchers including bio-engineering and forestry researchers, and energy and land use economists. Also, agriculture and natural resources industry representatives, biotechnology company representatives, policymakers, state and federal agency representatives, private citizens, and new energy entrepreneurs.

3. How was eXtension used?

Although CERTS has not submitted materials to be shared on the eXtension portal, it has been a useful resource when trying to find examples of energy efforts from other Extension programs.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	26626	67393	2464	0

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

Patent Applications Submitted

Year: 2013

Actual: 1

Patents listed

8,394,618--Lipase Containing Polymeric Coatings

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	1	29	30

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Workshops and consultation will provide unbiased information to the target audiences.

Year	Actual
2013	56

Output #2

Output Measure

- Number of stakeholders participating in programs on production, harvesting or storage systems that adopted BMPs for production, harvesting or storage systems.

Year	Actual
2013	0

Output #3

Output Measure

- Number of stakeholders participating in programs on production, harvesting or storage systems that adopted BMPs for production, harvesting or storage systems.

Year	Actual
2013	0

Output #4

Output Measure

- Dollar amount of seed grants awarded in 2012.

Year	Actual
2013	132500

Output #5

Output Measure

- Number of CERTs newsletter / list serve subscribers.

Year	Actual
2013	11020

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research will provide information on new uses for ethanol byproducts.
2	Research will provide information on technologies for use of on-farm energy sources.
3	Research will provide better understanding of the economic impact and environmental trade-offs of renewable energy sources.
4	Number of new business systems created to provide new industry growth.
5	Measure of biofuels (gallon / acre).
6	Measure of BTUs/acre produced in energy production.
7	Number of new production or logistic practices developed.
8	Research will increase knowledge and understanding of the biofuels supply chain. (Measure: Numbe of new production/logistics practice developed)
9	Average percentage of participants of workshops and users of developed decision-making reports who report that they were able to make informed decisions about sustainable energy production and use.
10	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.)
11	CERTs research will inform state efforts to achieve energy conservation and efficiency goals. (Target expressed as number of state projects with impact.)

Outcome #1

1. Outcome Measures

Research will provide information on new uses for ethanol byproducts.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Research will provide information on technologies for use of on-farm energy sources.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Fertilizer accounts for roughly 14 percent of the carbon footprint of corn production. If fertilizer can be produced in a renewable way, it would be good for the environment, and good for farmers.

What has been done

In the summer of 2013, the U of M's West Central Research and Outreach Center officially launched a process believed to be one-of-a-kind, which takes the energy from wind, converts it to hydrogen, and then to ammonia that can be used as fertilizer on surrounding farmlands. Making fertilizer from wind has been on the center's agenda since before 2005, when the first 1.65 megawatt wind turbine was installed at the center. Annually, the center will produce about 25 tons of fertilizer and sell it to farmers via local area co-ops. Researchers are using life-cycle analysis models to evaluate exactly how much fossil fuel can be saved by using the system.

Results

Members of the World Wildlife Fund, which is working with companies like General Mills and Coca-Cola that are responding to consumer demand for sustainable products, recently visited the center. A growing field to market movement within agriculture and the food sector is working

toward sustainability throughout the food chain. A plant like this could produce enough fertilizer for a group of farms or a small-town cooperative.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management

Outcome #3

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of new business systems created to provide new industry growth.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Measure of biofuels (gallon / acre).

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Measure of BTUs/acre produced in energy production.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Number of new production or logistic practices developed.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Research will increase knowledge and understanding of the biofuels supply chain. (Measure: Numbe of new production/logistics practice developed)

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Average percentage of participants of workshops and users of developed decision-making reports who report that they were able to make informed decisions about sustainable energy production and use.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	72

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Clean Energy Resource Teams help Minnesota communities advance clean energy projects by hosting educational forums, workshops and tours. These events aim to: 1) educate target audiences about specific topics; 2) provide venues for networking and sharing stories (both successes and failures); and, 3) provide opportunities for a hands-on look at clean energy technologies and projects.

What has been done

CERTs hosted or presented at 56 events in 2013, reaching farmers, small businesses, residents, local units of governments and utilities. Events included educational content about topics ranging from efficient lighting, to biomass energy, major mechanical upgrades, solar energy, and actions that Minnesotans can take to advance clean energy.

Results

Surveys evaluated the success of each CERTs event. Of the 56 events, three were intensely assessed to determine how attendee's knowledge changed as a result of the event. At the 2013 CERTs conference, 70 percent of survey respondents reported they left the conference with clean energy project ideas they would put to use. At the Utility Forum, 77 percent of respondents attending the six topic sessions at the forum felt they understood topics more after the event than before, or found topics to be "useful" or "very useful." Among farmers and utility representatives attending Poultry Field Day, each of the survey respondents reported they understood LED lighting for poultry applications more after the event than before.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies
605	Natural Resource and Environmental Economics

Outcome #10

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
2013	20415

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Minnesota's energy supply is not as clean efficient, reliable and affordable as it could be. Minnesotans spent \$16 billion and consumed a total of 1,852.2 trillion BTUs of energy (electricity, natural gas, petroleum products, coal and biomass) in 2010 to supply energy needs. Energy use spreads across four main sectors: Transportation (26 percent total use covering

buses, automobiles), residential (23 percent total use), commercial (19 percent total use) and industrial (32 percent total use).

What has been done

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

Results

CERTs quantifies the total BTUs of energy saved annually through its campaigns, technical assistance, utility support and seed grants. The total is 20.4 billion BTUs in annual energy savings. Among these efforts, 4.6 billion BTUs were saved by upgrading to LED holiday lighting during the recycling campaign. Seed Grant Programs saved 1.6 billion BTUs by funding local energy efficiency and renewable energy projects. Twelve poultry producers are saving 1.2 billion BTUs of energy by retrofitting barns with LED lighting. CERTs assistance to utilities' conservation programming resulted in 2.6 billion BTUs of energy savings. A program offering a discount price for spray valves, faucet aerators and shower heads in commercial and institutional settings saved 8.5 billion BTUs.

4. Associated Knowledge Areas

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

Outcome #11

1. Outcome Measures

CERTs research will inform state efforts to achieve energy conservation and efficiency goals. (Target expressed as number of state projects with impact.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
-------------	---------------

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Minnesota Department of Commerce, Division of Energy Resources Staff is committed to increasing energy literacy throughout the state of Minnesota. Raising awareness of energy efficiency best practices and energy source options increases the likelihood that Minnesotans will adopt those practices and options. Adoption helps the state meet its energy efficiency goal of saving 1.5 percent of annual retail electric and gas sales each year and its renewable energy goal of producing 25 percent the year 2025.

What has been done

The Minnesota State Fair -- "The Great Minnesota Get Together" -- welcomes over 1.7 million people each year. The Minnesota Department of Commerce staff makes a point to have a big presence at the state fair in order to increase energy literacy in Minnesota. Exhibits on home heating, windows, lighting and more educate Minnesotans on the energy issues of their homes.

Results

CERTs assisted the Minnesota Department of Commerce staff as they prepared for lighting displays at the fair. CERTs used behavior change science to influence the layout of, as well as the information included in the lighting display. CERTs also gained an understanding of issues around choosing energy efficient lighting through the development of the CERTs Right Light Guide. From this research, CERTs developed a set of Frequently Asked Questions around efficient household lighting. Lastly, CERTs provided training to the Minnesota Department of Commerce staff on effective communication strategies (again, applying behavior change science concepts). The Right Light Guide, Lighting FAQs and the communication strategies served as invaluable references for staff to use while talking to the public at the state fair.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (New swine facility problem use required new research)

Brief Explanation

MAES has been working for several years on the use of dried distillers' grains, a byproduct of ethanol production, as an additive in animal feed. This research has provided ethanol producers with a use for this byproduct and lowering feed costs for animal producers. Several nutrition studies have proven its effectiveness as a feed additive. However, the new phenomenon of pig manure pit explosions has led to the need to redirect that research towards determining if distillers' grains could be implicated. As a

result, we are not reporting under the outcome: "Research will provide new uses for ethanol." The results of this new research is summarized under "Activities."

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As noted earlier, the overriding charge of CERTs is to help Minnesota meet its energy efficiency and renewable energy goals by connecting communities with the resources they need to identify and implement energy efficiency and renewable energy projects. The metrics of effectiveness employed by the CERTs team considers the efficacy of the educational outreach, as well as the efficacy of programs to meet energy efficiency and renewable goals. Surveys and observations examine whether program participants take action to change their energy sources or decrease their energy use. Using information about the effectiveness of such campaigns, the team has established a way to quantify the annual energy savings in BTUs.

Campaigns, educational programming, technical assistance, utility support and seed grants have resulted in actions that have saved 20.4 billion BTUs annually."

Key Items of Evaluation

Campaigns, educational programming, technical assistance, utility support and seed grants have resulted in actions that have saved 20.4 billion BTUs annually."

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Climate Change

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	20%		20%	
104	Protect Soil from Harmful Effects of Natural Elements	20%		10%	
123	Management and Sustainability of Forest Resources	20%		30%	
132	Weather and Climate	20%		20%	
605	Natural Resource and Environmental Economics	20%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	25.7	0.0
Actual Paid Professional	0.0	0.0	13.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	148214	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	540319	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1314667	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. In 2013 five U of M researchers testified before a joint committee hearing in the Minnesota House of Representatives about the climate change before us, and how current science can help inform investment decisions. Much of this research is and has been supported by MAES funding. MAES research expertise ranges from climatology to forestry to water resources and agricultural products. Much of it is broad-based and interdisciplinary. Research has focused on three areas: building understanding on what is happening to our climate; mitigation--discovering ways to prevent the warming from getting significantly worse in the future; and adaptation--building resilience into forest and agricultural systems so they are less susceptible to disruption by changing climate. Results of research in 2013 include:

- Forest researchers have concluded that it appears very likely that spruce, fir and aspen forests will move north into Canada over the next several decades as the state warms.
- Other forest research has shown that afforestation and reforestation for the purposes of climate change mitigation is likely not possible because the biophysical impacts of forests far outweigh the carbon sequestration benefits of most forests. While there are small regions where forest placement can provide a climate benefit, these areas only make a small dent in the overall carbon reduction necessary to stave off significant climate change. Researchers are now focusing on management practices that can be adopted for a given location to minimize those biophysical impacts. Researchers refined a numerical model to simulate the climatic effect of forest placement and have used the model to identify the regions where afforestation for carbon sequestration can be successful to benefit the climate system.
- Six years ago MAES researchers established trace gas monitoring networks at the Research and Outreach centers across the state to track the spatial and temporal variability of carbon dioxide, nitrous oxide, methane, and water vapor. A key feature of the network is a 244m tall tower located at one of the centers that provides a regional perspective of greenhouse gas concentration. The recently completed analysis of the project summarized the significant contributions to understanding the greenhouse gas budget of agricultural ecosystems typical of the Upper Midwest.
- Climate change is stressing plants and bringing new pests and diseases into Minnesota. Japanese beetles were seen in fields two months earlier than previously, causing more defoliation in soybean fields, for example. Warm and wet field conditions also increase the risk of phytophthora rot. Researchers are studying new seed treatment fungicides and biological seed treatments to meet the new pressures in agricultural fields resulting from climate change.
- Horticulturists are improving "fine fescues" grasses to develop more sustainable and drought-resistant turf grasses, both for home lawns and public spaces. The fine fescues also need require less effort and inputs to maintain.
- A climate trend analysis on the effect of climate change on the productivity of barley and oats in Minnesota was completed and showed that climate change has already had an effect on the productivity of both barley and oats. It predicted future changes will even further reduce yield potential for barley and oats in Minnesota. Wheat and barley breeders are focusing on creating new varieties that will better tolerate Minnesota's climate trends.
- A team of researchers studying plants assembled the largest dated evolutionary tree, using it to show the order in which flowering plants evolved specific strategies, such as the seasonal shedding of leaves. Their conclusions were publishing in the journal Nature in 2013. The research shows the whens, hows and whys behind plant species' trait evolution and movements around the globe. The information will help build better models of what's going to happen with vegetation in the future as the climate changes.

Extension. Extension's Climate Change initiative is a multi-disciplinary approach, mobilizing

relevant Extension programming and research that address climate change adaptation. Extension and research teams involved in the climate change initiative include forestry, environmental science education, water, crops, horticulture and more. While Extension FTEs are not formally aligned with the Climate Change program area, outcomes and outputs will be described here in order to track Extension's progress in addressing the NIFA priority area.

The year 2013 was a bellweather year for this initiative, because three initiative activities were enthusiastically embraced by stakeholders in Extension, the University, Minnesota and beyond.

1. On November, 2013, Extension hosted a state conference on climate adaptation and received an enthusiastic response. The conference exceeded expectations regarding registration, ultimately turning potential registrants away after attracting 250 participants. Evaluations demonstrated that this conference filled a gap for bringing education and discussion to those who want to find successful climate adaptation strategies for Minnesota's economy, communities, and residents. The conference generated significant popular press, and will become an annual event.

2. Program leaders initiated a sustained effort to train and deploy statewide phenology volunteers who are now monitoring key climate indicators. Thirty-seven (37) volunteers were recruited and trained in 2013. Over the next decade, this effort should result in data that is useful to decision-makers throughout the region regarding climate change rates/amplitudes.

3. Extension staff and national colleagues are now confident that climate change adaptation is an issue that is ripe for more active educational offerings in Minnesota.

2. Brief description of the target audience

In 2013, effective outreach drew together a large group of Minnesotans who expressed a desire to receive education and address adaptation issues in their homes, communities and disciplines. Of the over 250 persons who participated in the November 7th climate change conference, most worked in government (60 percent); one in five worked in education (18 percent), and one in ten worked in non-profit organizations.

Targeted audiences for both MAES research and Extension programming are those with whom we can make a difference, and who can benefit from research-based information. Primarily, these include audiences whose production systems will be influenced by climate change, as well as those who consult or influence the decision-makers of these growers and producers. Other audiences to be considered will be decisionmakers and leaders responsible for preparing communities for change. This includes local government jurisdictions, state and local elected officials, producers and environmental groups, forestry groups, human health services, FEMA, and Extension educators working in food and nutrition, family and community life. It also includes other researchers in agriculture, forestry and natural resources, climate scientists, biologists and climate change policymakers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	277	4764	0	0

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

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	23	23

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of current year climate relevant educational program offerings.

Year	Actual
2013	14

Output #2

Output Measure

- Number of climate relevant social media products, web-based products and communication tools (smart phone apps, facebook, twitter).

Year	Actual
2013	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Of program participants, the number that increase knowledge of management practices under climate variability and change.
2	Of participants, the number that employ climate adaptation strategies in various production and natural ecosystems, including strategies for biodiversity.
3	Number of acres under recommended adoption strategies for production agriculture and natural resources management, including invasive species, pest management, pollutant loads and wetlands.
4	Of participants, the number that adopted recommended adaptation strategies for production agriculture and natural resources management, including invasive species, pest management, pollutant loads, wetlands.
5	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)
6	Volunteers are mobilized to actively monitor seven key indicator species to examine climate variability. (Outcome is the number of volunteers who are engaged in reporting data to a web portal.)

Outcome #1

1. Outcome Measures

Of program participants, the number that increase knowledge of management practices under climate variability and change.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	90

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

As climate changes, a growing group of concerned citizens and professionals are eager to move beyond controversy to address how to adapt and prepare for the effects of climate change on individuals, economies, and communities.

What has been done

Minnesota's first climate change conference was conducted on November 7, 2013. The event exceeded expectations regarding interest. Twelve presentations were offered on a diverse group of topics that presented information about climate change and ideas for adaptation -- urban ecosystems, stormwater, water quality, extreme events, as well as public health, agriculture, highways, community water, and Twin Cities issues.

Results

For each of the twelve sessions, participants "agreed" or "strongly agreed" that the session gave new information. More importantly, a strong majority of those who were in a position to act reported that the information they received gave them ideas for further action (90 percent or more).

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

Of participants, the number that employ climate adaptation strategies in various production and natural ecosystems, including strategies for biodiversity.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of acres under recommended adoption strategies for production agriculture and natural resources management, including invasive species, pest management, pollutant loads and wetlands.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Minnesota's forest, land, and water resources face pressure from climate change. Geospatial science, including remote sensing and geographic information systems, provides a useful set of tools with which to characterize and detect changes in landscape. Mapping Minnesota's resources and monitoring potential negative effects is of critical importance to retaining their presence and function for future generations.

What has been done

Researchers have developed multiple methods to map wetlands using both imagery and other geospatial data showing the changing likelihood of an area being a wetland over time. These new ways of viewing the temporal dynamics of wetlands allow for much more sophisticated management decision-making than is possible with a map based on a single time, such as the widely used National Wetlands Inventory. The results of this research have been incorporated into the ongoing creation of an updated wetlands inventory for Minnesota

Results

The improved mapping techniques resulting from this work are being used by wetland mapping teams, which is resulting in significantly better accuracy estimates than with previous methods. The ability to map and monitor wetlands more quickly and accurately is allowing stakeholders to make more informed decisions in the face of increasing land use and climate pressures. Other audiences served by the results of this research include those interested in mapping and monitoring Minnesota’s natural resources for conservation. The project has served the climate change research community by developing a novel algorithm to map changes in forest cover over large areas.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Of participants, the number that adopted recommended adaptation strategies for production agriculture and natural resources management, including invasive species, pest management, pollutant loads, wetlands.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
-------------	---------------

2013 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Weed management strategies that have been developed over the last fifty years are being substantially challenged by climate changes. It is critical that adaptive strategies be developed to meet new realities facing growers. Strategies are needed that will not only help control new weeds in growers' fields, but could help maintain growers' profitability

What has been done

Pennycress was evaluated as an oil seed crop when grown in a double crop system with soybean. Results showed that pennycress provides excellent control of spring emerging weeds, and reduced weed biomass by 80-to-100 percent. With pennycress's early harvest date, a full season soybean can be grown on the same acreage immediately following harvest with no loss of yield.

Results

The most productive U of M lines of pennycress currently produce seed with approximately 30-40 percent oil by weight with a composition that is suitable for conversion to biodiesel, aviation biofuels and other industrial products. Planting pennycress as a winter annual double-crop has the potential to add an additional profit for corn and soybean producers, besides out-competing new invasive weeds due to climate change.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate

Outcome #6

1. Outcome Measures

Volunteers are mobilized to actively monitor seven key indicator species to examine climate variability. (Outcome is the number of volunteers who are engaged in reporting data to a web portal.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
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3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Phenology, a branch of science dealing with the relationship between climate and periodic biological phenomena (such as bird migration or plant flowering), provides an opportunity to monitor the effects of changing climate. The USA National Phenology Network "encourages people of all ages and backgrounds to observe and record phenology as a way to discover and explore the nature and pace of our dynamic world."

What has been done

Extension developed and piloted a program that engages volunteers to monitor and report phenology that indicates climate variability in Minnesota. Eighteen experts were enlisted to identify potential species to monitor in Minnesota. Citizen phenologists were surveyed to rank a final list of species that are easy to identify and known to be sensitive to climate variability: the Loon, Red Maple, Tamarack, Lilac, Monarch, Bluebird and Ruby Throated Hummingbird. National protocols (www.usanpn.org) were adapted to create monitoring guidelines.

Results

Training and presentation materials reached 37 adults. A web portal was developed for online data entry and review. Every participant reported learning to monitor seven key indicator species for climate variability; 80% reported on post-workshop surveys that they have a realistic plan to monitor these species and report data to the web-based reporting system. Resulting data can inform and empower scientists, resource managers, and the public in decision-making and adapting to variable and changing climates and environments.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Minnesota was second among states with high catastrophe losses in 2007 and ranked third in 2008. As more climate events have affected the U.S. and Minnesota, readiness to discuss climate change and consider adaptation has increased. This has created a groundswell of support for multi-disciplinary education for those working in government,

agriculture, business, and other sectors.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

To date, evaluation has tracked the usefulness and relevance of information shared with those interested in adaptation, as well as the intention of participants in events to act in some way. As efforts to educate and mobilize volunteers grow in maturity, changes in behaviors and conditions for adaptation to climate change can be measured.

Key Items of Evaluation

In 2013, Extension mobilized and trained 30 citizen phenologists who will monitor and record changes in species that are to identify and known to be sensitive to climate variability: the Loon, Red Maple, Tamarack, Lilac, Monarch, Bluebird and Ruby Throated Hummingbird. This new effort will result in the availability of information and resources to scientists and others who are considering the degree and impact of climate change.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Childhood Obesity

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	0%		40%	
701	Nutrient Composition of Food	0%		40%	
703	Nutrition Education and Behavior	100%		10%	
704	Nutrition and Hunger in the Population	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	9.5	0.0	34.5	0.0
Actual Paid Professional	24.3	0.0	31.1	0.0
Actual Volunteer	9.2	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
287864	0	459498	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1475643	0	2732403	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
9458175	0	3136633	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. The research reported under this program covers all the aspects of MAES efforts to improve the health of Minnesota children and their families. It includes progress on understanding the health benefits of various foods as well as results of work to develop processes to improve food industries' ability to increase food quality. Several studies reported new knowledge gained in 2013 of the food consumption preferences of individual groups of Minnesotans, including ethnic, aging and low-income groups. Some examples of results and progress in 2013 include:

- Researchers investigated what simple yet significant changes in the food supply could be made to increase children's whole grain consumption. One promising route is focusing on foods children already like to eat: pasta and pizza. The researchers studied their consumption of whole grain pizza and pasta in both restaurant and school lunch settings and found that children consumed as much of the whole grain foods as the original refined grain versions. These positive liking and consumption outcomes could serve as the foundation for future work with large, national restaurant chains.
- A study of how food and nutrient intake differed among a national sample of midlife women revealed that those who were cooking for others consumed more refined grains and higher fat foods indicating the women nurturing others had less healthy dinner meal intakes. To help women make better choices, researchers are now developing a self-directed online intervention and are not pilot testing it.
- Another study on food choices and food insecurity with low income women indicated that nutrition knowledge and healthy behaviors common in lean/normal women help them avoid the obesity-food insecurity connection. This emphasizes the role of nutrition interventions to lessen the impact of food insecurity and assist with weight maintenance in low-income women.
- Research into the effect of various whole grains consumption on diabetic control focused on processed wheat bran. In studies with mice, results indicated that wheat bran processed to increase the bioavailability of ferulic acid led to slowing the progress of diabetes with obesity by improving insulin resistance.
- Osteoporosis is not generally regarded as a childhood disease. Yet the origins of osteoporosis occur at the much younger age of 10 to 13 years during the period of peak bone acquisition. Increasing the consumption of calcium-rich milk products in children is an important nutrition goal. Researchers identified the social and family barriers to increased milk consumption and a multi-state team developed messages to motivate parents to promote the consumption of calcium rich foods to early adolescents.
- An apparel research project has had health impacts by focusing on the changes to body symmetry due to breast cancer therapies. Body scanning technology was used to collect data from patients as they participated in posture restoration therapy at a Minnesota physical therapy clinic. Patients and physical therapists used the body scan image to assess and improve therapies.
- Tagatose is probably the most desired sugar replacer of food manufacturers as it is safe, low calorie and has almost identical functional characteristic to sucrose. The current production process however is expensive, limiting its use in foods. Researchers have made progress in developing a one-step process for bioconversion of lactose into tagatose by using two new genetic modifications to *Lactococcus lactis*.
- Food scientists developed processes to lower sodium in cheese, while maintaining flavor. Researchers investigated a 25 percent reduction of salt in blue cheese. The blue cheese was surface salted by hand rubbing, so the migration of the sodium to the center of the cheese was monitored at different locations, as well as chemical indices of ripening. A consumer sensory panel rated all samples to be equally acceptable, indicating that a 25 percent reduction in sodium chloride in blue cheese can achieve a similar consumer liking score.
- Other food science research identified the main mechanisms that produce bitterness in wheat bread, providing useful information to increase consumption of foods considered key components of a healthy diet.

Extension. Nutrition education programs at the University of Minnesota Extension leverage federal, state, and local funding to provide programs that reach low-income households. The goal is to increase the motivation of parents, heads of households and decision-makers in community settings to create more nutritious meals. By changing expectations and options for eating healthy in homes, schools and other community spaces, children develop lifelong habits that make a difference for their health.

A significant evaluation effort in 2013 measured the impacts of three interventions that come with three different "price points" in public dollar expenditures for nutrition education programs. By measuring the relative impacts of those three interventions, future investments will be better informed.

These evaluations are especially important given recent shifts in funding for SNAP-Ed programs. In January of 2014, Extension restructured its Health and Nutrition Programs, including the federally funded SNAP-Ed program for low-income audiences. The new regional model for SNAP-Ed allows for expansion and contraction based on the actual funding available, and are a sustainable management solution in light of insecure funding at the federal and state level.

The new regional SNAP-Ed program uses Extension's regional delivery model. Educators will serve multi-county areas, with staffing levels driven by income-eligible populations, schools with high numbers of students eligible for free and reduced lunch, levels of nutrition-related health disparities and other factors. Regional educators will work with community partners to tailor programs and complementary policy, systems and environmental approaches.

MAES research will be conducted to develop better understanding of the nutritional content and health benefits of various foods, as well as developing methods to help the food processing industry provide healthy food.

2. Brief description of the target audience

Under the conditions of the regional model adopted in January of 2014, we anticipate significant reduction in the number of participants that will receive direct education from Health and Nutrition education programs in Minnesota. In some areas, we estimate as much as a 75 percent reduction in direct education numbers, as staff learn their new roles, as new staff are hired and trained, and as the educational focus moves to adults and professionals who work with children. Ultimately, the goal of the new regional education system will be to change the conditions and culture that establish lifetime eating habits for children. By reaching parents, guiding schools to develop healthy menus, training volunteers to deliver nutrition education and reaching other institutional outcomes, our vision is that every community in Minnesota will "make the healthy choice the easy choice."

The target audiences for MAES research also include researchers in diet, nutrition, and health, health practitioners such as dietitians, nurses and physicians, food industries, and the public.

3. How was eXtension used?

Health and nutrition educators were part of eXtension's "Ask an Expert" series in 2013. They are active on communities of practice, and they search for information on topic related to health and nutrition.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	21896	307662	50266	178530

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

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	3	72	75

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2013	4279

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	84

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Individuals, families, schools and communities benefit when they make smart food choices and build environments that support healthy habits.

What has been done

Nutrition education classes promote healthful eating choices for families, in schools, and in community settings.

Results

Based on evaluations of 14,385 youth and adults who attended a minimum of six hours of classes, 84 percent of participants of health and nutrition programs reported increased knowledge that they could take into their food and lifestyle choices. Resulting effects on behavior change are reported in outcomes two and three of this report.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	90

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

People with limited resources often run short of food at the end of the month. Some may not realize they can make healthier choices at the store. The choices and habits that children experience in their home environment are known to affect eating habits throughout a lifetime, ultimately impacting health and well-being.

What has been done

Three programs, each requiring different degrees of program investment, target healthy food consumption. Cooking Matters MN empowers low-income families with skills and knowledge to create healthy, delicious and affordable meals. It combines Extension's expertise with the time and talents of local chefs. Simply Good Cooking is an adaptation of Cooking Matters for areas where program and food resources are limited. The Simply Good Eating program provide six hours of education in community settings.

Results

Overall, 90 percent of young adults and adults participating in one of these three programs reported changes in behavior. A study of 184 participants in the three available educational interventions found that all three made statistically significant gains in meal planning habits, including: 1) thinking about healthy food choices when deciding what to feed the family; 2) making meals that include at least three groups; 3) shopping with a grocery list; and, 4) comparing prices before buying food. Other meal planning and shopping outcomes were achieved, as well, by one or two of the programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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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
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	55

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

People with limited resources often run short of food at the end of the month. Some may not realize they can make healthier choices at the store. The choices and habits that children experience in their home environment are known to affect eating habits throughout a lifetime, ultimately impacting health and well-being.

What has been done

Three programs, each requiring different degrees of program investment, target healthy food consumption. Cooking Matters MN empowers families at risk with skills and knowledge to create healthy, delicious and affordable meals. It combines Extension's expertise with the time and talents of local chefs. Simply Good Cooking is an adaptation of Cooking Matters for areas where program and food resources are limited. The Simply Good Eating program provide six hours of education in community settings.

Results

Overall, 55 percent of participants in these programs reported improved healthful eating. In comparing the effects of these programs, the 2013 study found that all three showed statistically significant positive change in: 1) cups of fruit eaten most days; 2) cups of vegetables eaten most days; and, 3) the amount of dark-colored vegetables eaten. Cooking Matters and Simply Good eating resulted in participants eating at least 2.5 cups of vegetables per day. Simply Good Cooking and Simply Good Eating showed change in: 1) eating at least two cups of fruit per day; 2) eating low fat or fat-free dairy products more often. Finally, Cooking Matters and Simply Good Eating increased participants' consumption of lean meat, chicken and fish. These results can be

used to refine approaches and use resources more wisely in communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #4

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Recently, health literacy has emerged as an important research area due to its significant association with health disparity. A recent study showed that one in four parents have limited health literacy skills and only one in seven parents have proficient skills.

What has been done

Researchers investigated the health literacy related to children among Asian American immigrant and refugee parents. The goal was to customize educational messages and future intervention strategies aimed at raising parents' health literacy regarding their children, to enhance children's health and welfare.

Results

Based on the outcomes from the research findings, a two-hour, online health literacy module was developed to train social workers working with immigrant children and families.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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701	Nutrient Composition of Food
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There are about 10,000 taste buds in the human tongue, as well as texture and temperature receptors. All of these combined with smell create what we think of as flavor. It is a complex equation that involves thousands of chemical reactions in every mouthful. Food scientists study the flavor of food in efforts to increase the consumption of healthy foods.

What has been done

The U of M's Flavor Research and Education Center is the only center of its kind in the U.S. It is using cutting-edge technology and new analytical techniques to address current flavor challenges in the food industry. Researchers are pioneering a research approach they have named 'flavoromics'. It uses data collection to separate and identify thousands of compounds in food and then statistically associate those compounds with changes in flavor perception.

Results

The food industry has traditionally solved flavor questions empirically. This new approach to flavor problems seeks to understand the complex stimuli involved in different flavor perceptions and to map the chemical differences between them. The power of this method is that it provides tools to find things that there has been no previous way to find except through serendipity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

As noted in the overview of 2013 activities, federal and state allocation have created a volatile funding climate for Extension's health and nutrition programs. In response, Extension is applying its regional program model to health and nutrition programs. This will more easily align staffing to dollars available. One impact of the regional system will be a decrease in the number of youth and families that receive direct education in schools. Instead, the regional system will direct all of its resources to changing the systems and family decisions that ultimately result in changes in the availability of healthy foods and nutritious choices where children live, learn and play. This strategic shift is likely to impact outputs and outcomes until all systems are in place.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation staff of the Extension Center for Family Development conduct in-depth research in how interventions at the child, family and systemic level ultimately result in changed behavior related to health and nutrition. In 2013, the team completed an important study of three program interventions -- Cooking Matters, Simply Good Cooking and Simply Good Eating. Because these interventions have greater and lesser resource allocations, the team was interested in the degree of outcomes that each intervention achieved. The study examined the effects of each program related to: 1) a family's confidence in planning, preparing, shopping and making healthy meals, 2) actual planning and shopping for healthy meals; 3) healthy food consumption and eating habits, and 4) overall impact and satisfaction with health and nutrition.

The study discovered that each program created statistically significant outcomes related to each category of outcomes, but that different programs were able to achieve greater results in specific outcome measures. For example, each program influenced participants' consumption of dark-colored vegetables with statistical significance. However, the program with the most resources had a higher impact than the other two programs. Inversely, low-cost programs were able to get results in eating low-fat and fat-free dairy in ways that the higher resourced program did not.

Key Items of Evaluation

By examining the relative impacts of three types of health and nutrition programs in Minnesota, health and nutrition program leaders will be better able to direct resources toward educational objectives, and will be able to inform decision-makers about the

investment of public and philanthropic dollars. A key discovery is that both high-cost and low-cost programs offered by University of Minnesota Extension achieved impacts with statistical significance when it comes to 1) planning and shopping for healthy meals, 2) cooking healthy meals at home; 3) healthy food consumption and eating habits, and 4) overall satisfaction with health and nutrition. These outcomes were maintained at a follow-up over time, meaning effects are not lost.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	30%		60%	
503	Quality Maintenance in Storing and Marketing Food Products	30%		40%	
504	Home and Commercial Food Service	40%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	8.5	0.0	6.9	0.0
Actual Paid Professional	13.1	0.0	10.5	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
431024	0	104538	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1342980	0	323742	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1159589	0	863987	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. With advances in technology, food safety research has become more complex and more interdisciplinary. The needs remain great, to assure a safe food system for consumers who have increasing expectations for high quality food. In 2013 MAES research on food safety issues provided new information and strategies to growers, processors, and manufacturers. Some highlights of research progress in 2013 include:

- Researchers are using NMR and MRI techniques to develop a sensor method for rapid detection of foodborne pathogens, a critical step in identifying pathogen sources during food processing and distribution in minutes to hours instead of days. The benefits of timely detection and corrective actions to producers, processors, distributors and consumers are enormous. The new technology embraces nanotechnology, immunology, microbiology and advanced NRM/MRI techniques.
- Food scientists have examined the effects of desiccation stress on survival of *Escherichia coli* K-12 and have extended these studies to *E. coli* B and to *Salmonella enterica*. Several different conditions of desiccation and recovery have been studied including the length of drying time, temperature of drying and rehydration, growth conditions prior to desiccation, and composition of the rehydration media. In collaboration with mechanical engineers, they have measured changes in membrane fluidity during rehydration.
- *Escherichia coli* 0157 is a foodborne pathogen that can be transmitted by contaminated ground beef and is shed naturally in cattle feces. Researchers studied the fecal prevalence of *E. coli* 0157 in cattle fed diets containing distillers' grains to see if there was a connection, and found that DGS had no effect on the pathogens' prevalence in cattle populations.
- *Clostridium difficile* is a spore-forming bacillus that causes antibiotic-associated diarrhea in hospitalized patients. Recent findings have suggested that this organism can be transmitted through meats from animals to humans. Researchers compared animal and human strains at the physiological level and found that strains of the bacteria isolated from animals tend to grow faster than human strains at 37 degrees C. The methodology was proven to be effective in recovering the bacteria from inoculated meats.
- Lower sodium cheese has health benefits, but there has been a concern that reducing sodium, which also acts as a preservative, might make the cheese more susceptible to contamination. However, a study of the ability of *Listeria* bacteria to survive in low-sodium commercial sliced process cheeses showed that sodium reduction in processed cheese did not promote the growth of *Listeria* at any temperature or brand tested.
- Using non-thermal processes to pasteurize liquid and solid foods is an area of increasing interest to food processors, as they offer the possibility of preparing fresh-like, minimally processed safe food. Bioengineering researchers are developing non-thermal plasma and concentrated high intensity electric field based methods for low temperature pasteurization of both liquid and solid foods. In 2013 a prototype system was built and researchers used the process for low temperature pasteurization of whey protein beverages. The results were successful and showed that the new process maintains the physical and chemical properties of whey protein beverages while killing microbes.

Extension. In 2013, Extension continued to play a significant role in keeping Minnesota safe from food-borne illness in homes, community events and businesses. Food safety education is provided through at least six program offerings:

- Food Safety for Food Service Managers and Employees
- Cooking Safely for a Crowd
- Food Safety for Consumers
- Food Preservation Food Safety for Entrepreneurs and Home Growers

- Farm to School/Market

In 2013, the team sought to make food safety education available to more people efficiently through online offerings. To that end, the team developed and delivered three online courses, including an online food manager certification course, an online Serve It Up Safely food manager certification renewal course, and a food allergen training for food service employees. By the end of 2013, five new online educational offerings were available. 1) A 15-minute Cooking Safely for a Crowd educational presentation that helps volunteer groups train their groups and meet the requirements of state food safety laws. 2) Twenty food preservation five-minute mini-modules that teach consumers about food preservation; 3) a Twitter feed that disseminates news about current Food Safety topics; 4) a Food Safety e-News publication for individuals in the food service industry; and, 5) a food preservation e-News for individuals interested in food preservation.

2. Brief description of the target audience

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

Audiences for **Extension** offerings include food managers needing re-certification, persons interested in working in the food service industry, consumers and producers for locally-grown food markets, home food preservers, high-risk audiences such as seniors, caregivers and daycare providers, local producers and school districts engaged in farm-to-school initiatives, and volunteers who cook for a crowd. Often, compliance with state laws motivates the target audience to participate in programming. As noted above, online offerings are making food safety training more accessible to these audiences and the general public. Seventeen percent of program participants are persons of color. This is largely due to the team's outreach to food service workers and to cultural adaptations for Minnesota's growing Latino population.

3. How was eXtension used?

In 2013, the program team used eXtension to search for educational resources and to research issues related to Food Safety.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2456	528046	10	0

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

Patent Applications Submitted

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	2	7	9

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of individuals who learn about prevention, detection, control and intervention technologies.

Year	Actual
2013	216

Output #2

Output Measure

- Number of food handlers receiving food safety training and education in safe food handling practices.

Year	Actual
2013	567

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of reported changes in prevention, detection, control and intervention technologies.
2	Number of growers, producers and food workers completing GAPs, GMPs, HAACP, food safety certification (like ServeSafe), and on farm BMP programs to increase food safety.
3	Number of food handlers adopting recommended hand washing practices.
4	Number of food handlers reporting taking steps to reduce cross-contamination.
5	Research will increase number of viable technologies to improve food safety. (Measure: number of viable technologies developed or modified for the detection and characterization of food supply contamination from foodborne threats)
6	Research will increase understanding of the ecology of threats to food safety from microbial and chemical sources. (Measure: Number of projects focused on increased understanding of preharvest and postharvest process impacts on microbial and chemical threats)

Outcome #1

1. Outcome Measures

Number of reported changes in prevention, detection, control and intervention technologies.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of growers, producers and food workers completing GAPs, GMPs, HAACP, food safety certification (like ServeSafe), and on farm BMP programs to increase food safety.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	406

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Significant numbers of first generation Latino Minnesotans are employed in the food industry. Moreover, significant entrepreneurship is happening in the food industry within the Latino culture. To maintain the reputation and credibility of this culture as they integrate into Minnesota's communities, food establishments must stay safe from food-borne illnesses.

What has been done

Spanish Certified Food Manager classes were implemented to meet the needs of significant numbers of Latino food service workers in the state.

Results

The quantitative outcome above describes the outcome of all Food Safety programs. Assessment of the Spanish Four-Part Certified Food Manager Class indicated that 81 percent of students obtained passing grades with an average passing score of 85 percent. This can be compared to national average passing rates (73 percent) and passing test scores (80 percent). In a preliminary 2-3 week follow up survey, most new managers reported increased frequency of hand-washing, use of a calibrated thermometer, and preparation and monitoring of sanitizer containers. A one-

month post training observation showed that a wider variety of people were sources of information, with the information "hub" narrowed to a single food manager.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Number of food handlers adopting recommended hand washing practices.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	557

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

According to the latest Centers for Disease Control statistics, one of six Americans will get sick from foodborne illness every year. Places of risk include food establishments, public events and festivals and homes.

What has been done

Almost all foodborne illness can be prevented by practicing safe food handling practices, including simple hand-washing during food preparation. Food safety educational programs for all target audiences respond to critical junctures of food processing when behavior change makes a difference.

Results

Employees in food service establishments who attended Food Safety training reported statistically significant improvement in behaviors related to food safety including handwashing, glove use and bare-hand contact of ready-to-eat food. When asked about perceived restaurant behaviors, statistically significant changes were reported in understanding enforcement of food safety policies and important management practices.

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

Number of food handlers reporting taking steps to reduce cross-contamination.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	649

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

For the most recent year of data available (2005), there were 41 known foodborne illness outbreaks in Minnesota. Of these, 31 were known to be the result of problems in food service establishments (76 percent).

What has been done

Most food-borne illness can be prevented if managers and food service workers handle food correctly and prevent contamination on surfaces where food is handled.

Results

Employees in food service establishments who attended Food Safety training reported statistically significant improvement in behaviors related to safety, including bare-hand contact with ready to eat food and cleaning and sanitizing of food contact surfaces. When asked about perceived restaurant behavior, statistically significant changes were reported in use of temperature log sheets, enforcing food safety policies, and overall management practice and knowledge. Those who received specific courses on food allergens reported they will change food handling practices, create a plan and train other key individuals at the food service establishment on safe food handling practices as well as what to do when someone is having a reaction.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Research will increase number of viable technologies to improve food safety. (Measure: number of viable technologies developed or modified for the detection and characterization of food supply contamination from foodborne threats)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Consumers demand safer, healthier and higher quality food products. In order to satisfy those expectations, food scientists and engineers must be able to understand the problems caused to food products by processing and storage and develop solutions. NMR and MRI based methods are unique because they are non-destructive, non-invasive, and fast compared with conventional food safety tests.

What has been done

Researchers studied NMR and MRI based techniques to characterize and evaluate the shelf stability of food products as affected by formulation, processing and storage conditions. This has led them to develop an NMR/MRI based nano-particle sensor method for rapid detection of foodborne pathogens. This method will allow the identification of foodborne pathogen sources during processing and distribution in minutes to hours instead of days.

Results

The benefits of timely detection and corrective actions to producers, processors, distributors, regulators and consumers are enormous. Conventional detection methods involve multiple time-consuming and labor-intensive steps due to the difficulties in isolating the pathogens from the food and the fact that pathogens are usually present in extremely low numbers. The new methodology combines nanotechnology, immunology, microbiology, and advanced NMR/MRI techniques. It represents a new approach to a complex problem.

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 #6

1. Outcome Measures

Research will increase understanding of the ecology of threats to food safety from microbial and chemical sources. (Measure: Number of projects focused on increased understanding of preharvest and postharvest process impacts on microbial and chemical threats)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Highly unsaturated oils, due to heat treatments including frying and baking, produce highly toxic compounds which absorb into food.

What has been done

Researchers studied the formation of toxic aldehydes in heat treated fats and fatty foods. They compared the formation of these toxic substances in both high and low polyunsaturated fatty acid vegetable oils, fats and fatty foods. They then compared the retardation of the toxic aldehyde formations in the presence of various concentrations of added natural and synthetic antioxidants.

Results

The results have provided food scientists with information about corn, soybean, peanut, and canola oils as well as lard and beef tallow, and how to retard the formation of toxic compounds when producing fried and baked foods.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes

Brief Explanation

Staffing shifts have changed the degree to which Extension provides consultative services to industries regarding food handling technologies and systems; therefore, we are not reporting on outcome #1 in 2013.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

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

Key Items of Evaluation

Food safety training and program evaluation appears to demonstrate that implementing culturally sensitive and language appropriate interventions result in improvements in knowledge, behavior and restaurant level system and communication. In fact, in 2013 participation in a Spanish Four-Part Certified Food Manager class resulted in passing rates eight percent higher than national passing rates, and scores that were five percent higher than the average of national passing scores.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Community Economics

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
602	Business Management, Finance, and Taxation	20%		50%	
608	Community Resource Planning and Development	80%		50%	
Total		100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	15.0	0.0	6.9	0.0
Actual Paid Professional	15.7	0.0	4.0	0.0
Actual Volunteer	0.3	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
421916	0	159985	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2035531	0	244989	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
485005	0	320309	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES supported Community Economics research in 2013 focused on the impact of public policies, and the impact of change on rural, suburban and urban communities and businesses. Research also studies community and business challenges and opportunities related to demographic changes. Community-related research is also reported under other program areas in this report where applicable, for example, under Housing. Results from research in 2013 include:

- Researchers completed an analysis of default rates on Minnesota's postsecondary loan program. This program contributes significantly to enhancing access to higher education in the state. To ensure that the program continues to function properly, researchers investigated the causes of non-repayment from its borrowers and conducted analysis aimed at predicting default rates. The results of the study was shared with the Minnesota Office of Higher Education
- In response to recent changes in immigration policy at the state and sub-state level, researchers studies the importance of immigration reform for jobs in rural areas.
- An investigation of the relationship between the timing of SNAP participation and timing of spells of consumption poverty and food insecurity was completed. The study confirmed that SNAP is an effective component of the social safety net.
- A study of the linkages between counties in Minnesota comparing where workers live and where they work showed that half of all Minnesota workers work in a different county from where they reside. The research showed that local labor markets in Minnesota cover a broader geographic area than is often used for local economic development policies, and is informing the work of county and community planners and regional economic developers.

Extension. Work in communities is achieved through the efforts of Extension Educators and campus Extension faculty, researchers at the Department of Applied Economics, and the staff of the University of Minnesota Tourism Center. An important niche of Extension's Community Economics is applied research that is used by communities to examine the strengths and opportunities of their retail sector, assess the needs of local businesses, and examine assets from which tourism could grow and diversify economies. In 2013, over 70 such applied research reports were delivered to business and community leaders and residents, who used these reports to solve problems and make decisions.

2. Brief description of the target audience

Primary audiences for community economics programs include chambers of commerce, the tourism industry, economic development officers, local governments, and nonprofits that make decisions about local economic development efforts. Most programs are delivered in Greater Minnesota and to rural economies that are making critical decisions about their future. An important target audience of MAES research is state policy makers, particularly those responsible for shaping the state's tax system.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4164	22698	39	0

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

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	5	2	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2013	148

Output #2

Output Measure

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

Year	Actual
2013	73

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants in Community Economics programs will increase their knowledge of relevant community economic development topics. (Target expressed as the percentage of participants reporting increased knowledge.)
2	Participants in applied research (e.g., Business Retention and Expansion, Retail Analysis Development, Economic Impact Analysis, Tourism Development) will apply the new research-based knowledge to business and/or community improvements that affect the local economy. (Target expressed as a percentage of participants in applied research programs initiated in prior three years who report that they applied new research-based knowledge.)
3	Communities engaged in Extension applied research 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. (Outcome expressed as the average number of effects identified by communities.)
4	Research will provide state policy makers with state economic data that will support legislative decision-making.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	91

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Local leaders, businesses and organizations must act knowledgably to maintain and strengthen local economic growth, and to respond to economic shifts.

What has been done

Applied research and educational programming was delivered in communities throughout the state. Education about community economics helps local decision-makers understand their local economic strengths and weaknesses, as well as connections among businesses and communities that are part of a functioning regional economy. This education serves to replace assumptions, rumors and partisan opinions with research-based understanding of what might strengthen local economic growth.

Results

Outcome data regarding knowledge gain were collected from Community Economics workshops during the 2013 calendar year. A total of 1,525 participants completed evaluations; 91.4 percent (1,502) of these participants reported learning gains, as measured by the comparison of their average retrospective pre-test scores to their average post-test scores across all session learning objectives.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

Participants in applied research (e.g., Business Retention and Expansion, Retail Analysis Development, Economic Impact Analysis, Tourism Development) will apply the new research-based knowledge to business and/or community improvements that affect the local economy. (Target expressed as a percentage of participants in applied research programs initiated in prior three years who report that they applied new research-based knowledge.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	88

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Local leaders, businesses and organizations must act knowledgably to support local economic growth and to understand the nature of their regional economy. Research-informed education about community development and the dynamics of local economies can prevent local leaders from acting based on assumption, partisan understanding or rumors.

What has been done

To encourage concrete responses to the knowledge gained in workshops, participants are encouraged to name the ways that they plan to use community economics education to manage economic development or business decisions at the local level.

Results

A survey about behavior change was conducted with participants in educational workshop offerings. Each survey participant was asked in the end of workshop survey to list a specific action step they intended to make as a result of the educational program. In December of 2013, participants received an online survey reminding participants of their intended action steps and asking them to report on their progress. The survey was mailed to 21 program participants from earlier programming and 87.5 percent of respondents indicated they had followed through.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #3

1. Outcome Measures

Communities engaged in Extension applied research 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. (Outcome expressed as the average number of effects identified by communities.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	272

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

All communities have resources that can be reduced or dissipated, saved for future use, or invested to create new resources. These are referred to as "community capitals" (Flora and Flora, 2009). Community capitals include financial capital, social capital (bonds and bridges among people in a town), built capital, political capital, human capital, cultural, health and natural environment. The aim of community development programming is to strengthen and grow these capitals.

What has been done

After community economics programming was completed in four Minnesota communities, Extension re-engaged groups in those communities for ripple effect mapping sessions. Ripple Effect Mapping (REM) is a participatory group method for examining the impact of in-depth programs or complex collaboration. The method helps community stakeholders reflect on progress and visually map their story (Mayne 1999). Beyond evaluating results, REM stimulates additional community action by enhancing a community's sense of self-efficacy.

Results

Upon completion of maps in these four communities, effects were coded using the community capitals framework. The community economics initiatives were found to generate a total of 272 enhancements to community capitals. The most typical benefit strengthened financial capital (n=84), followed by social capital (n=78), improving built capital (n=49), civic capital (n=46), as well as human, cultural, health and natural environment effects. For example, tourism assessment programs resulted in the development of a local farmers' market in one community, development of a new campground to enhance lodging options in another, and a new environmental learning center in a third.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Research will provide state policy makers with state economic data that will support legislative decision-making.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

State and local economies are continually evolving. Minnesota, like all states, is facing major demographic changes as the baby boom generation moves into retirement years. Government priorities will shift, and budget pressures are likely to intensify. Policymakers need better revenue models to make budgeting decisions.

What has been done

Economic researchers studied revenue volatility to determine the appropriate level for the state budget reserve. They estimated the volatility of segments of the state's income, sales and corporate tax bases. Yearly deviations from trend growth were computed for 7 components of the individual income tax base, 19 components of the state sales tax base, corporate profits and other revenues. The volatility of the tax base was then calculated. With a measure of the volatility of the state's tax base they then could compute the size of the state budget reserve needed.

Results

The study concluded that a budget reserve of five percent of annual revenues would be necessary to provide protection to the state in economic downturns. The information was provided in briefings with the Governor and key legislative leaders, in testimony at hearings of key legislative committees and presentations to three major bonding agencies. The analysis is being used by the major bond rating agencies to establish standards in their analysis of quality of

credits issued by Minnesota and other states. The volatility study estimate of the amount of reserves needed to protect funding for essential services has influenced state policies dictating how short term surpluses should be used.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of community economics programs combines end of workshop surveys, a post-program investigation into whether participants acted on new knowledge, and ripple effect mapping sessions to understand whether longer-term community initiatives resulted in an enhancement of community capitals. Evaluation results in 2013 discovered a strong degree of learning and action based on that learning. More importantly, in four communities where in-depth program had been provided, the communities grew a myriad of local strengths that could be leveraged for the future. Specifically, 272 effects on community capitals were found.

Key Items of Evaluation

Through Extension's community economics programming, communities strengthened the knowledge and engagement that they brought to decision-making. Measuring the growth of community capitals in the year or two after in-depth programming was delivered, 272 positive effects were discovered in four communities. This includes 84 financial capital benefits; 78 social capital benefits; 49 built capital effects; 46 political enhancements, 44 human capital effects, 43 cultural, 20 health-based effects and 11 assets for the natural environment.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Leadership and Civic Engagement

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
608	Community Resource Planning and Development	50%		60%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	50%		40%	
Total		100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	13.9	0.0	1.0	0.0
Actual Paid Professional	15.9	0.0	1.5	0.0
Actual Volunteer	0.6	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
574302	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1726196	0	142503	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
529925	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

In 2013, the Leadership and Civic Engagement team continued to emphasize work in community cohorts that learn and work together over time. These cohort groups strengthen leadership skills, increase the number of leaders available to communities, and create connections that strengthen social capital in communities and among communities. This, in turn, leverages other community capitals that are critical to community vitality (Flora and Flora, 2009). In 2013, 26 such cohorts met.

A strong focus in 2013 was the development of University of Minnesota models for both leadership and civic engagement education. To that end, the team designed program activities, learning objectives and educator curriculum around core leadership competencies such as developing others, questioning skills, problem-solving, valuing diversity, positive psychology, teamwork, followership, improving processes, and more. These will become curricula available for national dissemination over time.

There is a small amount of MAES effort tracked to this planned program, most of it in support to research projects related to community leadership, restorative justice and social work research in encouraging youth participation in community leadership.

2. Brief description of the target audience

Leadership and Civic Engagement programs are designed with organizations or community groups that sponsor a program for their emerging or existing leaders. Program cohorts are convened to address a need or opportunity defined by that sponsoring organization or group. The curriculum design for each of these cohorts is then woven around content that helps the cohort. In 2013, the 26 cohorts that were convened addressed the following issues and communities.

1. Local Community Development -- County or City (8)
2. County/Regional issue-based cohorts, including water (7), food access (1), violence prevention (1), public health (1), sustainable development (2) and regional emerging leaders (3)
3. Statewide Community and Rural Leaders (1)
4. National Extension Leadership Program (2)

3. How was eXtension used?

eXtension was used in two ways in 2013. The leadership community of practice was a resource to participants of the North Central Extension Leadership Development program (NELD), which is currently being managed and led by the University of Minnesota Extension.

Also, a Leadership and Civic Engagement educator contributes to the Enhancing Rural Communities community of practice. She is a member of the team that is creating, reviewing, and posting materials focused on leadership, facilitation, civic engagement and community capitals.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1647	760	40	0

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

Patent Applications Submitted

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	3	9	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2013	26

Output #2

Output Measure

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

Year	Actual
2013	64

Output #3

Output Measure

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

Year	Actual
2013	11

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants in Leadership and Civic Engagement programs will increase their knowledge of relevant leadership and civic engagement topics. (Target expressed as the percentage of participants reporting increased knowledge.)
2	Structured community gatherings such as public meetings, forums or planning sessions are more productive. (Target expressed as percentage of participants who report in follow-up surveys that participation in Leadership and Civic Engagement programming led to improvements in structured community gatherings.)
3	Community leadership cohort members will increase the intensity of their leadership. (Target expressed as the percentage of evaluated participants who increase their involvement in at least one of their organizational roles.)
4	Communities will work across sectors and interests to address public problems. (Target expressed as percentage of participants who report in a follow-up survey that the Extension program created a bridge between sectors or interest groups.)
5	Research in restorative justice will support families and communities
6	Research will increase knowledge and capacity of social agencies to help build leadership capacity of low income youth.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	88

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Confidence and competence are essential to the success of existing leaders. By investing in leadership education, communities encourage potential and emerging leaders to step up and lead in their communities and organizations.

What has been done

In leadership education cohort groups, emerging and existing leaders experienced educational content that helped them to assess their own style, lead others, manage effective groups and meetings, solve conflicts, think critically about problems, think differently about diversity, and manage other key tasks of leadership.

Results

During 2013, LCE conducted end-of-workshop evaluations with 336 participants. Of these participants, 87.5 percent (207) increased their knowledge across all relevant learning objectives in each workshop, as measured by retrospective pre-and post survey.

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 such as public meetings, forums or planning sessions are more productive. (Target expressed as percentage of participants who report in follow-up surveys that participation in Leadership and Civic Engagement programming led to improvements in structured community gatherings.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Because community gatherings, forums, committees and working groups are essential to the success of democracy, community leaders must have a strong capacity to lead such groups and meetings in a way that stimulates productivity. These skills must be available among existing local leaders in every day settings so that communities effectively solve problems and choose their future.

What has been done

Leadership and civic engagement cohort curriculum are designed to build both the competence and the confidence of those who lead, especially related to making meetings, planning sessions or committees more productive.

Results

An online follow-up survey was conducted with alumni of leadership cohorts that ended in 2013. Of the 51 respondents to the survey, 100 percent reported that participation in the Extension leadership program had helped them to make meetings, planning sessions, or committees more productive at least "to a slight extent"; 60.1 percent reported they were effective "to a moderate extent" and 31.4 percent said they were effective "to a great extent."

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	67

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

An important task of any community is to find the next generation of leaders. Research Fellow Ben Winchester sought to better understand the need for leaders in Minnesota. He considered the number of board and elected positions needed by government and nonprofit entities, and estimates that one in 34 must serve in a leadership positions in very rural areas. In metropolitan areas, one in every 143 residents must serve. According to the Blandin Foundation's Rural Pulse Survey, only 41 percent of rural Minnesotans say they have been asked to serve.

What has been done

The leadership and civic engagement team at the University of Minnesota Extension offers organizations, sectors and local groups the opportunity to sponsor leadership education programs. By doing this, program sponsors actively ask others to accept new leadership roles, and invest in the opportunity to grow the confidence and competence of those who are asked to lead. In 2013, 26 such cohort groups were sponsored.

Results

During 2013, leadership role change data were collected with 141 participants in six leadership cohort programs. Of the participants, 66.7 percent 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.)

4. Associated Knowledge Areas

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

Communities

Outcome #4

1. Outcome Measures

Communities will work across sectors and interests to address public problems. (Target expressed as percentage of participants who report in a follow-up survey that the Extension program created a bridge between sectors or interest groups.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	61

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Rural communities must look beyond community borders and find civic and economic alliances within a region. State and federal governments have handed more responsibility to communities and counties. Local governments and sectors must pool resources to attract business and funding. Changing economies put pressure on rural communities to build assets that compete. Cooperation with other communities help communities thrive.

What has been done

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

Results

Participants in bridging leadership cohort programs -- 67 individuals from three different county programs -- responded to a set of questions about their interactions with other communities both before and after the program. Items in these two scales asked how often they had worked or collaborated with people in other communities, attended events in other communities, or patronized businesses in other communities. At the end of the program 61.2 percent (41) of the 67 participants had increased their overall level of bridged social capital from the beginning to the end of the program.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Research in restorative justice will support families and communities

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

With the difficulties presented by conflict and violence in families, communities and nations, there is a growing interest in understanding and applying restorative justice principles and practices. A MAES supported social scientist has been examining the growing impact of restorative justice dialogue programs in Minnesota and beyond. He has been studying the impact of restorative dialogue in responding to violent crimes, hate crimes, human rights violations and political violence in the U.S. and other countries.

What has been done

The methods of case study analysis, data collection and analysis has provided a broader multi-dimensional conceptual framework for theory and practice in restorative dialogue, moving far beyond its origin in the criminal justice system.

Results

The project is having an increasing impact upon practitioners and policy makers in Minnesota, other states and other countries. The Turkish Ministry of Justice is implementing national legislation to develop victim offender mediation services throughout the country, based on the results and recommendations of this research. The researchers is providing technical assistance and training to the Facing Forward Project in the Republic of Ireland. Similar assistance and training was given to the Ministry of Justice officials and community activist in Peru. Of particular local impact, the results of this research are being used by community leaders and member of the local Muslim community and the Liberian community in Minnesota who are committed to using restorative justice principles and practices to help with the healing process within their families

and community following the massive civil conflict in their country and the scars of which have been carried by those Liberians who fled their country and came to Minnesota.

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 #6

1. Outcome Measures

Research will increase knowledge and capacity of social agencies to help build leadership capacity of low income youth.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

President Obama and Congress have called on Americans of all ages to voluntarily serve their neighborhoods, communities and nation. Too often, younger people have been invited to participate but do not. This is especially difficult with teenagers in poverty at relatively high risk to violence as victims and perpetrators, facing poor school outcomes and limited life-choices. Researchers have been studying best ways to build groups of youth and youth workers who learn to practice civic work in low income communities.

What has been done

Researchers have been studying best ways to build groups of youth and youth workers who learn to practice civic work in four urban low income communities. They established relationships with a local nonprofit educational group exploring alternate training for aspiring teachers alone and jointly with recreation workers, librarians, and for police officers under the guidance of the new youth worker trainers. A youth co-led gang prevention group was established and met regularly with the researchers.

Results

Violent youth crime rates in the communities where the work is being done is now lower than it had been, and lower than in comparable St. Paul and Minneapolis neighborhoods. A youth job initiative is being developed. The researchers have published a book on Civic Youth work and, on co-creating democratic youth spaces, with a supporting preface by the Mayor of St. Paul supporting the work that is being done, and a new set of training and policy development with recreation workers and their supervisors in being developed based on the positive results of this applied research project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (None)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of Leadership and Civic Engagement programs measure knowledge gains after training, and look closely at whether the program has effectively resulted in participants providing more leadership in their organizations and communities. For in-depth efforts, evaluators look longitudinally at whether the program strengthened community capitals. This year, the program looked at whether social capital was strengthened among communities in counties in Southern Minnesota. The study found that 61.2 percent of participants had increased their interactions with towns near them because of the leadership and civic engagement program led by Extension.

Key Items of Evaluation

Leadership and Civic Engagement programs at University of Minnesota Extension were shown to increase the levels of leadership provided by program participants, and to increase the level of interaction participants had with other communities in their region. Of participants who completed leadership programs in 2013, 66.7 increased their level of involvement in at least one of their organizational roles. And 61.2 percent of those in "bridging" leadership programs reported they had increased their interactions with businesses and individuals in nearby communities as a result of the program.

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%		60%	
806	Youth Development	20%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	21.4	0.0	7.6	0.0
Actual Paid Professional	23.2	0.0	11.0	0.0
Actual Volunteer	0.9	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
622954	0	231174	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2073539	0	1017639	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1343985	0	59825	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES research in 2013 to build strong healthy families focused on both economic and social issues facing Minnesota families and the knowledge and training needs of the professional social service agencies that support them. The research focused on specific social and economic challenges facing youth, elders and various minority groups in Minnesota. The information from research was delivered to policy makers and service agencies. Several new MAES research projects have begun in the last two years, as a result of stakeholder input, to respond to new challenges facing Minnesota families due to social, demographic and economic changes. They include a study to assess how military families communicate around emotional issues, on parents' use of social media, and on the caregiving capacities of relatives to meet the needs of frail elderly family members. Some examples of results of research in 2013:

- Research on the experience of children with disabilities in child welfare has shown that child welfare agencies have no standard practices relating to children with disabilities within their system. They found that parents with disabilities whose parental rights were terminated were not getting services modified as is required under the Americans with Disabilities Act. As a result, researchers are now evaluating a specific parental modification to parents and their findings are being used as a basis for recommendations for policy practice.
- Persons 65 years and older are a growing proportion of the Minnesota population, and by 2030 they will constitute 24 percent of the population. Researchers are integrating the results of a long term project on vital aging into the practice of the emerging profession of service-enriched housing for seniors.
- Researchers are supporting the growing elder mediation field by developing a series of vignettes on the challenges of making inheritance decisions that have been tested with groups. The vignettes have proved useful as a method to illustrate the meaning of interpersonal social justice in inheritance.
- Researchers completed a study of the benefits of couple therapy in helping couples decide a reconciliation path in their marriage when divorce is on the table.
- Family social science researchers have forged collaborative relationships with refugee groups in the state and have conducted families' needs assessment with them. With the results of that effort, they have developed parent and family level interventions to meet their specific cultural needs. In 2013, a pilot parenting intervention was conducted and is now being disseminated to professional audiences.
- Building on the results of a study on foster children transitioning out of the child welfare system, researchers have developed accessible online modules for them to learn about money management, specifically revolving around credit reports and credit scores.

Extension. In 2013, program teams committed to family development and family financial literacy continued to design, deliver and evaluate community-based programs while creating new online resources for families and professionals who serve them. Materials development in 2013 included the development of webinars, podcasts, "apps" and mp3 audio recordings on 45 personal finance topics. The team also developed online education sites to enhance long-standing face-to-face training such as Parents Forever, a long-established program known to reduce parenting conflict in the midst of contentious divorce. Some programs are being built solely for online delivery, including the 2013 development of a children's mental health case study training for professionals.

2. Brief description of the target audience

Building Strong, Healthy Families programs serve professionals in collaborating agencies such as mental health organizations, parent educators, schools, courts, family service agencies, health care settings, organizations and businesses. The program also serves parents and caretakers. 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.

The educational team seeks to address stresses that currently affect families. To that end, program curricula has been designed for immigrant families, especially those who need to understand how to navigate the school system. Other curriculum design is addressing the concerns of unmarried parents seeking effective co-parenting relationships.

Research target audiences also include Extension educators, community action participants, family social scientists, social workers, marriage counselors, and caregivers. Other research target audiences include all of the above, and other family resource management researchers, governmental public policymakers, and economic development professionals.

3. How was eXtension used?

Educators in the Building Healthy, Strong Families Program have connected to eXtension in a variety of ways, including:

- being active in Communities of Practice;
- being part of the "Ask the Expert" board;
- answering questions on resource management around health care reform, military financial learning, and disaster preparedness work;
- searching eXtension for research and educational resources; and,
- promoting University of Minnesota Extension educational curricula and teaching events.

V(E). Planned Program (Outputs)

1. Standard output measures

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

Patent Applications Submitted

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	15	10	25

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of publications distributed.

Year	Actual
2013	3657

Output #2

Output Measure

- Number of community-based workshops held.

Year	Actual
2013	907

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Professionals who work with parents and families will improve their skills. (Outcome expressed as a percentage of participants who report improving skills.)
2	Parents will improve their parenting practices. (Outcome is the percentage of participants reporting improvement.)
3	Parents who are mandated to participate in Parents Forever because of contentious divorce situations will reduce conflict in front of their children following divorce. (Outcome expressed as percentage of parents who report reducing conflict.)
4	Individuals, families and employees who participate in Resource Management programming will report they have increased confidence (increased efficacy) in financial management, decision-making and planning for later life. (Outcome expressed as percentage of participants who report increasing efficacy.)
5	Individuals, families and employees who participate in Resource Management programming will report they have used the knowledge and materials provided by the program to change behaviors related to targeted financial management goals. (Outcome expressed as a percentage of participants who reported making behavior change.)
6	Mothers and fathers in co-parenting relationships will negotiate relationships in order to provide more resources to children in terms of time and money. (Outcome expressed as average percentage of child support paid by the co-parenting father.)

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	83

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Parents and families interact with a host of public, non-profit and health care services as they care for their child. These formal and informal settings create an opportunity for parents to receive "just-in-time" education and technical assistance about child-rearing, family management, financial literacy and co-parenting.

What has been done

In order to bring quality parenting education and support to parents, Extension reaches out to professionals and paraprofessionals to provide curriculum and research-based information. Of the almost 21,000 adults served by this program area in 2013, 8,560 were professionals who work with families. Professional conferences, online education, and face-to-face trainings bring evidence-based parent development practices to adult education settings throughout Minnesota.

Results

Evaluations of program effectiveness included pre-post and follow-up survey design, 6-12 month follow-up interviews, as well as experimental and quasi-experimental design impact studies where appropriate. In evaluations, 83.4 percent of professionals who received education reported that their skills were enhanced through the training.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	91

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Family management and parent involvement is linked to a host of positive outcomes for youth. Well-documented studies acknowledge that dollars spent to create positive settings for child development prevent a host of problems in their later life.

What has been done

Family relations programs at the University of Minnesota Extension strengthen parent-child relationships by improving parenting skills, communication, decision-making, and child guidance. Targeted programs serve families with teens, new Americans creating relationships with school systems, and parents during and after divorce.

Results

Programs are evaluated in a variety of ways using pre-post and follow-up survey design, as well as 6-12 month follow-up interviews. Where appropriate, experimental and quasi-experimental design impact studies are conducted. Examination of all programs in 2013 demonstrated that 91 percent of parent participants improved their parenting practices in ways appropriate to the situation.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	52

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

People understand and use money within the context of culture and life experiences. Families need more than just information and practice. They need to learn how to make changes in managing their personal finances.

What has been done

DollarWorks2 is UMN Extension's signature financial literacy education program. It provides educators and service providers who assist families with knowledge, tools, and strategies that help adults manage resources, attain personal goals, and increase financial stability. The curricula teaches basic economic concepts that strengthen skills in managing personal finances and making sound decisions with money.

Results

This program continues to result in impressive outcomes for participants. For example, 501 low-income participants who participated in a six-session series and completed three month follow-up surveys, showing statistically significant changes in a host of critical outcomes. They paid bills on time, started emergency funds, saved more, set a debt-reduction goal, kept a balance between income and expenses, and managed a spending plan. One participant noted, "I can now get a grip on my finances without filing for bankruptcy... I am finding ways to clear up my credit, and I'm repairing damaged credit."

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Mothers and fathers in co-parenting relationships will negotiate relationships in order to provide more resources to children in terms of time and money. (Outcome expressed as average percentage of child support paid by the co-parenting father.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	86

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nationally, about 40 percent of children are born to unmarried parents, most of whom are in low-income households. Without family support services, these children are likely to lose contact with fathers, and face increased risk of negative outcomes such as teen pregnancy, dropping out of

high school, and involvement in the juvenile justice system.

What has been done

Co-Parent Court is a collaboration between the Fourth Judicial District, Hennepin County Child Support, U of M Extension and seven Hennepin County non-profit organizations. (Hennepin County is Minnesota's most populated county.) Referred parents participate in a series of co-parenting workshops, are offered social support services for basic needs like health care and housing, and receive assistance in developing a joint parenting plan that is approved by the court. The project has served over 500 parents since 2010.

Results

Fathers completing the Co-Parent Court program pay an average of 86 percent of their child support, compared to 69 percent by fathers in a control group -- an improvement of 17 percent. Fathers completing the program reported increased satisfaction with involvement in their children's lives. Mothers report that fathers completing the program spend an average of 58 hours more per month with their child, and report significantly improved co-parenting relationships. Control group parents did not show improvements in any of these key measures. The program's effectiveness prompted nearly unprecedented bi-partisan support to fund the program in Minnesota's most populated county.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges

Brief Explanation

Evaluation studies of two well-established programs -- Parents Forever and Resource Management -- were not conducted this year in order to invest in evaluations of newer programs for Spanish-speaking parents and for unmarried, co-parenting adults. These two programs have already established their effectiveness in prior evaluation studies.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In-depth examination of Extension program approaches to parent education, family development and financial literacy programming make it possible for other professionals to replicate effective curricula and approaches. In 2013, the team conducted pre-post and follow-up survey designs, 6-12 month follow-up interviews, and experimental and quasi-experimental design impact studies where appropriate.

In 2013, ongoing evaluation discovered that financial literacy programs are creating statistically significant changes in a host of critical family management outcomes, including paying bills on time, starting an emergency fund, saving, setting a debt reduction goal, keeping a balance between income and expenses and managing a spending plan. An in-depth look at a co-parenting program that served over 500 low-income, unmarried parents found that a combination of services increased the average percent of child support payments by 17 percent. Moreover, mothers report fathers completing the program are spending an average of 58 hours more per month with their child and are improving co-parenting relationship. Control group parents did not show improvements in any of these key measures.

Key Items of Evaluation

In 2013, ongoing evaluation discovered that financial literacy programs are creating statistically significant changes in a host of critical family management outcomes, including paying bills on time, starting an emergency fund, saving, setting a debt reduction goal, keeping a balance between income and expenses and managing a spending plan.

An in-depth look at a co-parenting program that has served over 500 low-income, unmarried parents found that a combination of services increased the average percent of child support payments by 17 percent. Moreover, mothers report fathers completing the program are spending an average of 58 hours more per month with their child and are improving co-parenting relationship. Control group parents did not show improvements in any of these key measures.

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	50%		0%	
806	Youth Development	50%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	61.4	0.0	0.0	0.0
Actual Paid Professional	58.5	0.0	0.0	0.0
Actual Volunteer	477.7	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1443937	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
3543220	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
8966962	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. 4-H programs in Extension manage youth development opportunities in each of Minnesota's 87 counties. In 2013, 4-H programs in Minnesota determined that science, engineering and technology would become its largest strategic investment. This builds on a strategic niche already held by 4-H, but also addresses an important need for higher education and workforce development in Minnesota.

Progress has been made regarding diversifying and enhancing club membership. Since 2004, club membership increased from 26,000 to 31,323 in 2013. A ten year partnership with the Minnesota Alliance with Youth has grown the number of clubs and the diversity of clubs through AmeriCorps Promise Fellows. In 2012-13, a total of fifteen Promise Fellows worked with community partners to provide high quality programs in and out of school. They mobilize caring adults to work with youth, and created service learning opportunities as a key curriculum component. Programs led by Promise Fellows serve diverse and underserved populations including Native American, Somalian, Vietnamese, African American, Hispanic, and Colombian youth and volunteers. There are also youth involved from Togo and Sudan. Another Promise Fellow was located on the Fond du Lac reservation in 2013, which has been a goal for several years. Promise Fellows started 13 new 4-H clubs through their year of service with the AmeriCorps program. As noted in the report summary, 15.5 percent of 4-H Youth participants are youth of color.

In 2013, Extension's service to professionals and volunteers who work with youth developed more online learning sessions, thus increasing accessibility. Ten training topics are now available in e-forum Adult Learning modules. Five online volunteer training modules were developed, and 4-H volunteers participated in 242 online volunteer trainings in 2012-13.

With its recent investments in volunteer training and professional development, Minnesota has served other states that are working collaboratively to enhance training for 4-H volunteers and staff. Partners in the North Central Region, for example, are adopting quality standards and tools developed in Minnesota to establish and train local leaders in volunteer management processes for local leaders.

2. Brief description of the target audience

The target market for 4-H clubs is youth. Training and resources to support staff and volunteers assure that they create quality learning environments that are inviting, accessible and welcoming to a broad range of Minnesota youth. The Urban Youth audience includes adults working with schools, agencies and organizations, and volunteers interested in building sustainable youth programs. Youth leadership programs target young learners who are working in the context of their neighborhood or community to make a difference. Promise Fellows grants have strengthened Extension's ability to reach the growing diversity of communities in Minnesota.

The Youth Work Institute serves individuals, organizations and systems that work with and on behalf of youth. This includes those who interact with youth through community-based programming as well as decision-makers who can improve the quality and quantity of opportunities for youth to be involved in out-of-school activities.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

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

Patent Applications Submitted

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	3	0	3

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
2013	61

Output #2

Output Measure

- Number of organizations participating in technical assistance that adopt quality improvement strategies for their youth-serving organizations and networks.

Year	Actual
2013	227

Output #3

Output Measure

- Percentage of parents of youth participants (fifth grade and lower) who report being satisfied with their child's first year of participating in 4-H programming, thus making long-term engagement more feasible.

Year	Actual
2013	80

Output #4

Output Measure

- Number of lead adult volunteers in 4-H clubs will be trained to work with Minnesota's young people who participate in 4-H program activities.
Not reporting on this Output for this Annual Report

Output #5

Output Measure

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

Year	Actual
2013	18

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Youth involved in Minnesota's 4-H programs over a significant period of time will report mastery of a topic of interest as a result of their 4-H investment. (Outcome expressed is a percentage of highly involved youth who report mastery.)
2	Youth involved in Minnesota 4-H programs at high participation levels will report contributions to their community as a result of their 4-H involvement. (Outcome is the percentage of highly involved youth who report community contributions.)
3	Adult participants in educational offerings will report that they increased their understanding and knowledge of a given youth development topic. (Outcome expressed as a percentage of participants in agreement.)
4	Youth development organizations participating in consultation and technical assistance will increase program quality. (Outcome expressed as a percentage of organizations that improved one or more dimensions of program quality.)
5	Adult participants in educational offerings will report that they will be able to apply what they learned to their work. (Outcome expressed is percentage of those participants in agreement.)
6	Programs participating in quality improvement efforts will measure program quality with a validated assessment tool. (Outcome is the number of organizations and funding sources utilizing the validated assessment tool.)

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	76

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth have diverse interests, some of which school hours are not able to develop as schools must commit themselves to academics. It is up to the field of youth development to offer a rich array of opportunities for youth to understand their own skills, abilities, and interests, and to develop those to the fullest extent possible. One example of a program that addresses mastery of topics is the Citizen Science project. Parents of 4-H participants are in a position to observe their child's new interest and skills.

What has been done

The Citizen Science Project deepens youth involvement in science by providing opportunities for youth to identify questions, form testable hypotheses, design a procedure, create graphs, create display of results, analyze results and use results to answer a question. Assessment of all 4-H programs includes a query to parents in the early of years of youth participation in order to understand whether youth are on their way to mastering a topic.

Results

In 2013, a summative evaluation of the Citizen Science project was conducted by an outside evaluator. Self-ratings of inquiry skills among 133 youth showed statistically significant increases from pre- to post-program. In the parents' report, we charted progress of 768 youth; 76 percent of these youth were rated by their parents as having become very good at a project or skill they worked on during their first year of 4-H programming.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

4-H encourages youth to contribute to their communities. One example is the peer teaching program. Research suggests that through peer programs, teen teachers obtain a feeling of "social usefulness" and a sense of control considered to be an important factor in preventing social problems such as substance abuse, teen pregnancy and delinquency (Riessman, 1990; Black, Tobler & Sciacca, 1998 and Forneris, et. al. 2010). In addition, citizen science projects provide opportunity for youth to contribute science research in communities.

What has been done

4-H provides opportunities for youth to become peer teachers, and to serve roles as community volunteers.

Results

In 2013, 1,047 youth worked in public school settings to teach younger youth about healthy living choices. Of those surveyed in the 2012-2013 Driven to Discover, Citizen Science project, 80 percent of youth participants (n=133) reported that they "contribute to a citizen science project." Citizen science is public participation in scientific research. Further, 5,459 youth reported that they volunteer in their program through 4-H opportunities.

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
2013	88

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research is the backbone of effective youth development programs. It is critical that practitioners understand the latest youth development research and related best practices. Earlier research noted disparities in youth worker training and staff development options, pointing to a need for education.

What has been done

Youth worker training offerings are grounded in the latest youth development research. They bridge research with practical ways to apply it to best practice.

Results

Evaluation summaries of youth work trainings in 2013 demonstrated that 88 percent of respondents (N=757) agreed that their understanding and knowledge of the session topic increased.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Youth development organizations participating in consultation and technical assistance will increase program quality. (Outcome expressed as a percentage of organizations that improved one or more dimensions of program quality.)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Adult participants in educational offerings will report that they will be able to apply what they learned to their work. (Outcome expressed is percentage of those participants in agreement.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	91

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research is the backbone of effective youth development programs. It is critical that practitioners understand the latest youth development research and relate it to their practice. Earlier research has noted disparities in youth worker training and staff development options, pointing to a need for more applied research.

What has been done

Youth development worker trainings are grounded in the latest youth development research, bridging research with practical ways to apply it to practice.

Results

Evaluation summaries of all youth worker training participants in 2013 (N=757) demonstrated that 91 percent of respondents agreed that what they learned would be applied to their work with youth.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Programs participating in quality improvement efforts will measure program quality with a validated assessment tool. (Outcome is the number of organizations and funding sources utilizing the validated assessment tool.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	286

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Staff development and quality assessment have not been used consistently across youth organizations in Minnesota. As described last year, youth development trainers are "hard wiring" training and assessment into Minnesota's youth-serving organizations.

What has been done

Training for individual sites is accompanied with consultation to systems. In 2013, specialists consulted with 48 organizations, 24 of which resulted in the roll out of assessment processes in sites across the region.

Results

In 2013, 286 youth organization sites adopted the Youth Program Quality Assessment. The high number of sites is attributed to adoption of the tool within youth development support systems such as public schools and United Way.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (Migration to online learning)

Brief Explanation

In 2013, statewide 4-H management systems created online learning as the vehicle through which 4-H volunteers can be oriented and trained. This system was rolled out in 2013. This changed the outputs that can be counted, as well as the timing in which it could be reported. To date, only one region of the state has implemented this change. New output measures will be addressed in future years.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

All workshops and events delivered to adult youth development workers are evaluated through end-of-session surveys. Besides results described in outcome measures, the evaluation examines the effectiveness of instruction, applicability to work settings and participants' understanding of the topic at the end of the workshop.

4-H programs at the local level are examined to determine whether precursors to larger public value impact, such as youth going on to higher education and developing skills for the 21st century workforce, are being achieved. In 2013, two studies examined whether youth were mastering skills as a result of 4-H programming. These studies found statistically significant increases in citizen science skills as a result of targeted projects. In parent reports about youth progress, 4-H reported that 76 percent of youth had become very good at a project or skill they worked on in their first year of 4-H.

Key Items of Evaluation

In 2013, a summative evaluation of the Citizen Science project was conducted by an outside evaluator. (See output #4.) Youth's self-ratings of their inquiry skills for 133 youth showed statistically significant increases from pre- to post-program. In the parents' report, we charted progress of 768 youth; 76 percent of these youth were rated by their parents as having become very good at a project or skill they worked on during their first year of 4-H programming.

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
135	Aquatic and Terrestrial Wildlife	20%		50%	
136	Conservation of Biological Diversity	20%		50%	
903	Communication, Education, and Information Delivery	60%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	5.4	0.0	17.1	0.0
Actual Paid Professional	16.2	0.0	25.6	0.0
Actual Volunteer	26.3	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
420144	0	284864	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1827549	0	1175521	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
618559	0	2428226	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Minnesota's waters--its lakes, river, streams and groundwater, are an important part of the state's economic strength and even its identity. But these waters are under constant demands by competing interests, and face new threats from invasive species, climate change, and land and population change. MAES research helps support Minnesota's water resources from several perspectives.

Highlights of research results and outcomes in 2013 include:

- A study of local stakeholders perspectives on water use examined constraints to community engagement in water resource protection and restoration. The study resulted in strategies to better engage the community in these issues, which were shared with natural resource agencies and community stakeholders across the state.

- Attempts to control invasive Eurasian watermilfoil has led to suppression of native water plants. Researchers studied methods of reestablishing native aquatic plant communities after invasive species control and found that they could transplant native plants into lakes with success. Poor water clarity, however, did inhibit native plant recovery and expansion in some lakes.

- To meet EPA standards for lower arsenic concentrations in well water, work is needed to find better methods to detect and analyze the biogeochemical cycling of arsenic through soil and groundwater. Researchers developed a method to quantify arsenic in water using hydride generation atomic absorption spectrometry. They also completed a large incubation experiment using freshly collected glacial sediments. The result is a better understanding of the chemical and microbial factors contributing to arsenic release to groundwater.

- Land management changes such as tile drainage, cultivation, and cropping practices have been blamed for recent increases in river flows and increased bank erosion. Researchers analyzed river flow data in the Upper Midwest to decipher climate and land management effects on river. They compared recent data to earlier data before tile drainage systems were installed in fields. They found any upward shift in erosion due to land management changes, such as tile drainage systems, was relatively small compared to the upward shift from recent wet climate.

- In studies of the interactions between surface waters and groundwater, especially in urban areas, researchers looked at whether captured storm water could be re-directed to augment water flow in urban creeks and rivers. Results indicated that it might be a better strategy to re-evaluate the groundwater pumping management in the area. The study showed that as water is flowing into deep aquifers, most of the surface aquifer recharge ends up in the deep aquifer rather than discharged into the area creeks. The information is useful to urban water managers.

- A study of the quality of sub-surface water under active compost sites was undertaken to develop a set of standards for evaluating compost media for use in dairy barn composting bedding systems. Researchers conducted one of the most comprehensive studies of leachates from a single compost site, including not only pH, nitrogen, phosphorus and potassium, but fecal coliform, total phenolics, pesticides, herbicides and others. The results will provide direction on what needs additional study on these compost facilities to maintain ground water quality.

- We have reported in previous years about a spreadsheet decision tool that MAES water quality researchers and economists developed to compare the effectiveness and cost of potential best management practices to reduce the nitrogen load entering surface waters from cropland. This year we can report the continued impact of this decision tool. It is serving as a key part of the Minnesota Pollution Control Agency's statewide nitrogen reduction plan, and was instrumental in the agency's decision to set a 20 percent reduction milestone for 2015

Extension. Extension's Master Naturalist programs contribute community-based volunteers to natural resource and environmental issues for Extension and for other community and statewide organizations. The Master Naturalist program team recruits, prepares, and supports Master Naturalists. By investigating the best ways to mobilize citizen stewards for the environment, this team contributes a strong workforce to address issues and achieve impacts in other planned programs. For instance, invasive species impacts reported in Forestry, shoreland best practices education reported in Water, and citizen phenologists described in "Climate Change" were staffed by volunteers because of the

efforts of the Master Naturalist program.

The league of 1,618 Master Naturalists delivered 54,628.5 hours of service to citizen science and science education in 2013. This is the equivalent of 26.26 full-time equivalents.

Support from Extension to Master Naturalists is accomplished by the following activities: 1) providing curriculum and sponsored workshops for educators and natural resource professionals in best practices for design and delivery of environmental science programs; 2) training and supporting interested citizens (Master Naturalists) to participate in citizen science, stewardship and environmental science education in community settings.

In addition, the Forest, Wildlife and Conservation team trains Native American Youth through culturally-adapted summer programs.

2. Brief description of the target audience

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

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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	288958	0	549	0

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

Patent Applications Submitted

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	1	24	25

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Master Naturalists trained and supported in Minnesota.

Year	Actual
2013	1618

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 ESE 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 ESE programs.)
3	Citizens will, through exploration, conservation and education, influence environmental conditions on significant land acreage in Minnesota. (Target expressed as number of acres ESE program participants report that they influence each year.)
4	Citizens and professionals will be more connected with others in regional communities of interest through exploration, teaching and conserving natural resources. (Target expressed as percentage of ESE participants who report new network connections.)
5	Research will provide information and strategies to help control fish invasive species.

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 ESE program participants reporting new knowledge.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	99

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Volunteer-led interpretive programs provide a citizen workforce available to educate and act on a variety of topics. The readiness of Master Naturalist volunteers helps Extension and other organizations across the state act more quickly to address environmental concerns. But volunteers must be armed with: 1) good training in environmental sciences; and 2) an ability to communicate and teach other Minnesotans.

What has been done

Master Naturalists receive a 40-hour class to prepare them to be citizen stewards. The goal of the training is to provide volunteers with a strong knowledge of Minnesota ecosystems, to increase their awareness of the natural world and environmental issues, to expand volunteers' conceptions of nature and to increase their awareness of ways they could use skills and knowledge in volunteer opportunities.

Results

In a multi-year study of the effectiveness of the Master Naturalist program, volunteers agreed that the training gave them moderate levels of confidence in presentation skills and their ability to engage with the public, with 84 percent reporting the class prepared them for volunteer service. Those who participated in programs led by Master Naturalists were asked to assess their guide's skills. The vast majority agreed that the volunteers were knowledgeable (72 percent agreed strongly) and that they presented information in a way that was understandable (64 percent agreed strongly). Observation data provided evidence that the MNAT-volunteer led interpretive programs were effective across a variety of settings and for a range of audiences.

4. Associated Knowledge Areas

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

Outcome #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 ESE programs.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	54628

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

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

What has been done

Through collaborative relationships within Extension programs and with other agencies, Master Naturalist staffs mobilized their corps of volunteers to current issues in need of citizen action. In 2013, Master Naturalist volunteers were tapped to: 1) identify and eradicate invasive species; 2) monitor and report the effects of climate change with seven species as citizen phenologists; and, 3) deliver environmental education to 4-H youth.

Results

Results reported by other planned programs are directly attributable to preparation of Master Naturalists. See:

- Planned Program 3 -- Climate Change; Outcome number 6
- Planned Program 12 -- Forestry; Outcomes 1 and 4.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1015206

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Community visions for land and civic connections to the environment become a reality when volunteers are available. When environmental issues are addressed in these arenas, the knowledge and skills of these volunteers are critical to success.

What has been done

Master Naturalists are asked to commit time to any local organizations or initiatives that need environmental guides. Partnering organizations call on Master Naturalists to support work in interpretive centers, trails, water projects and more.

Results

In 2013, Master Naturalists collaborated with natural resource organizations and community organizations to support environmental projects, affecting over a million acres of Minnesota land. In a study completed in 2013, responding organizations noticed that the quality of MNAT volunteers was higher than that of their general volunteers, and that they used MNAT volunteers to lead initiatives more often.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Research will provide information and strategies to help control fish invasive species.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Shallow freshwater ecosystems across the country have become seriously degraded by the common carp, an invasive species of fish introduced from Europe in the late 1800s. The only means formerly available to control the common carp was to poison or drain entire ecosystems, an expensive and unsustainable practice. What is needed is a sustainable integrated pest management scheme for the control of carp.

What has been done

As we reported last year, as a result of the previous, successful work of U of M researchers on invasive species, the Minnesota Legislature funded the Minnesota Aquatic Invasive species Research Center at the U of M. The center is creating a sustained, scientifically coordinated response not only to bigheaded carp, but also to zebra mussels, invasive water weeds, and other organisms threatening Minnesota's lakes and rivers. Specific research to eliminate carp from

Minnesota lakes has taken a multi-strategy approach, including the use of acoustic barriers and food attractants. Carp have sensitive hearing and can be repelled by sound. Some types of plankton or bluegreen algae may help lure carp into traps. Researchers are also investigating the release of sterile bigheaded carp, equipped with radio tracking tags and pheromone implants to attract other carp so a whole group can be harvested.

Results

Researchers have already had great success in controlling the carp in identified lakes. For example, they shut down the breeding and removed 75 percent of the carp in selected lakes in the Twin Cities area.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Master Naturalist programs at Extension monitor their ability to recruit Master Naturalist volunteers, to train them in citizen science knowledge and to connect these volunteers to meaningful projects that make a difference. A longitudinal evaluation was completed in 2013 demonstrated that the program was successfully achieving its goals. These Master Naturalist contributed to accomplishments in the Forestry and Climate Changed Planned Programs.

Key Items of Evaluation

A longitudinal evaluation of the Master Naturalist program described how the program is effectively preparing citizen volunteers to educate others and work on community environmental projects. Their skills were tapped by Forestry initiatives and the Climate Change Planned program this year, with significant efforts to fight invasive species and monitor the effects of climate change.

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Water Resources

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
111	Conservation and Efficient Use of Water	10%		20%	
112	Watershed Protection and Management	40%		40%	
133	Pollution Prevention and Mitigation	40%		10%	
403	Waste Disposal, Recycling, and Reuse	10%		10%	
605	Natural Resource and Environmental Economics	0%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	27.2	0.0
Actual Paid Professional	18.1	0.0	33.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
518378	0	231541	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1855916	0	1574463	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
593359	0	2390608	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Minnesota's waters--its lakes, river, streams and groundwater, are an important part of the state's economic strength and even its identity. But these waters are under constant demands by competing interests, and face new threats from invasive species, climate change, and land and population change. MAES research helps support Minnesota's water resources from several perspectives. Highlights of research results and outcomes in 2013 include:

- A study of local stakeholders perspectives on water use examined constraints to community engagement in water resource protection and restoration. The study resulted in strategies to better engage the community in these issues, which were shared with natural resource agencies and community stakeholders across the state.
- Attempts to control invasive Eurasian watermilfoil has led to suppression of native water plants. Researchers studied methods of reestablishing native aquatic plant communities after invasive species control and found that they could transplant native plants into lakes with success. Poor water clarity, however, did inhibit native plant recovery and expansion in some lakes.
- To meet EPA standards for lower arsenic concentrations in well water, work is needed to find better methods to detect and analyze the biogeochemical cycling of arsenic through soil and groundwater. Researchers developed a method to quantify arsenic in water using hydride generation atomic absorption spectrometry. They also completed a large incubation experiment using freshly collected glacial sediments. The result is a better understanding of the chemical and microbial factors contributing to arsenic release to groundwater.
- Land management changes such as tile drainage, cultivation, and cropping practices have been blamed for recent increases in river flows and increased bank erosion. Researchers analyzed river flow data in the Upper Midwest to decipher climate and land management effects on river. They compared recent data to earlier data before tile drainage systems were installed in fields. They found any upward shift in erosion due to land management changes, such as tile drainage systems, was relatively small compared to the upward shift from recent wet climate.
- In studies of the interactions between surface waters and groundwater, especially in urban areas, researchers looked at whether captured storm water could be re-directed to augment water flow in urban creeks and rivers. Results indicated that it might be a better strategy to re-evaluate the groundwater pumping management in the area. The study showed that as water is flowing into deep aquifers, most of the surface aquifer recharge ends up in the deep aquifer rather than discharged into the area creeks. The information is useful to urban water managers.
- A study of the quality of sub-surface water under active compost sites was undertaken to develop a set of standards for evaluating compost media for use in dairy barn composting bedding systems. Researchers conducted one of the most comprehensive studies of leachates from a single compost site, including not only pH, nitrogen, phosphorus and potassium, but fecal coliform, total phenolics, pesticides, herbicides and others. The results will provide direction on what needs additional study on these compost facilities to maintain ground water quality.
- We have reported in previous years about a spreadsheet decision tool that MAES water quality researchers and economists developed to compare the effectiveness and cost of potential best management practices to reduce the nitrogen load entering surface waters from cropland. This year we can report the continued impact of this decision tool. It is serving as a key part of the Minnesota Pollution Control Agency's statewide nitrogen reduction plan, and was instrumental in the agency's decision to set a 20 percent reduction milestone for 2015.

Extension. In 2013, the Water Resource team at Extension continued to build partnerships with local

elected and appointed officials so that local policy and action would support water quality. Specific evaluated activities trained others to use the Watershed Game in their communities, developed online resources for shoreland property owners, and convened community leaders who can work together to protect the St. Croix Watershed. The team also worked across state lines to consider research and program management needs throughout Extension and other professional sectors.

2. Brief description of the target audience

Water Resource Programs are available to communities across the entire state, especially through key conduits who can create local policy and action that protects water quality. This includes local government and elected and appointed officials and their staff. Local government engineers and planners, consulting engineers, planners, and architects are also targeted as they help communities make decisions that impact Minnesota's waters. Natural resource and horticulture professionals are engaged as partners, learners, and agents of change. Homeowners are another key audience, including shoreland owners, lake association members, and volunteers.

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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5091	9159	1688	0

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

Patent Applications Submitted

Year: 2013
 Actual: 1

Patents listed

8,367,389--Methods, Compositions and Devices Utilizing Structurally Stable Cyanuric Acid Hydrolase

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	9	11	20

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.

Year	Actual
2013	18

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
2013	91

Output #3

Output Measure

- Number of shoreline demonstration projects that provide hands-on learning opportunities.

Year	Actual
2013	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Local decision-makers will know: 1) Where stormwater goes; 2) Major stormwater pollutants and their impact and 3) Components of plans, policies and practices their community could implement to maintain clean water and minimize impacts from stormwater.
2	Shoreland target audiences will practice one or more of five watershed friendly landscaping behaviors. (Outcome expressed as a percentage of workshop participants.)
3	Community leaders will change local ordinances and strategies to protect waterways in their community. (Target expressed as the number of previous workshop attendees who had taken specific actions in their community.)

Outcome #1

1. Outcome Measures

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

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	66

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

When individuals understand the connection between land use and water quality, they are likely to adopt land uses that keep water safe and clean.

What has been done

One effective way to disseminate information about connections between land use and water quality is the Watershed Game. The Watershed Game is an interactive tool that increases best management practices among shoreland owners and elected officials. For 2013, the Watershed Game was included in a number of workshops for elected officials, increasing their knowledge and providing them the opportunity to use the game with constituents in their communities.

Results

In 2013, the Watershed Game increased its use to more than 100 trained facilitators who use it in more than ten states. Among training participants, 71 percent indicated they were very ready to lead the activity following the training, and more than 50 percent indicated they had used the game within six months of being trained. The positive effects of the program intervention will now

be disseminated to more communities and states.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Community leaders will change local ordinances and strategies to protect waterways in their community. (Target expressed as the number of previous workshop attendees who had taken specific actions in their community.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Actions on the part of a single community or jurisdiction within a waterway do little to protect an entire watershed from harm. A multi-jurisdictional approach is needed to increase awareness and action across a region.

What has been done

Extension convened community leaders in jurisdictions along the St. Croix Watershed. Representatives came from 19 communities and counties, ten watershed organizations, four state agencies and other partners. The event was "a workshop on the river" to help leaders understand the need for phosphorous reduction, learn strategies to achieve the goal, identify priority actions and discuss challenges. Ultimately, the goal was to reduce phosphorous in the river, aiming for reduction Total Daily Maximum Load by 27 percent.

Results

The event successfully created shared knowledge and consensus about the need for action. All participants said they would review and revise current ordinances, would increase local

education, and would share what they'd learned with other local leaders, staff and communities. Forty-seven percent (47) of participants had attended previous sessions and had taken specific actions as a result. Five had reviewed and strengthened ordinances, policies and zoning, and an additional five had increased resident education.

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges

Brief Explanation

A small team is working to enhance water quality throughout Minnesota, the land of 10,000 lakes. To magnify their impact, the team seeks to leverage relationships with local partners who can, in turn, train and guide their community constituents. Targeted efforts to leaders who can impact an entire watershed makes positive results more possible.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of water resource programs examine the degree to which participants learned, and what particular actions they intend to take that will change policy, educate the public, or create structures that protect the water. In 2013, these evaluations found that programming had prepared local decision-makers to educate constituents on the issues of watershed management, and that past participants in programs targeted toward total maximum daily load reductions had strengthened ordinances, policies and zoning, and had educated shoreland owners to strengthen compliance.

Key Items of Evaluation

In 2013, these evaluations found that programming had prepared local decision-makers to educate constituents on the issues of watershed management, and that past participants in programs targeted toward total maximum daily load reductions had strengthened ordinances, policies and zoning, and had educated shoreland owners to strengthen compliance.

V(A). Planned Program (Summary)

Program # 12

1. Name of the Planned Program

Forestry

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources	50%		60%	
124	Urban Forestry	25%		10%	
125	Agroforestry	25%		20%	
133	Pollution Prevention and Mitigation	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	9.0	0.0	22.0	0.0
Actual Paid Professional	18.1	0.0	43.9	0.0
Actual Volunteer	10.2	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
549627	0	415777	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1797670	0	2214618	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
582207	0	4425263	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES. Minnesota has over 15 million acres of commercially productive forest land split up among private, state, federal, county and industrial ownership. This commercial forest land supports about 38,000 jobs in Minnesota with in an annual economic impact of \$6-7 billion. There are about 128 million urban trees in Minnesota, representing a value of over \$100 billion. That urban and state-wide research is under threat from new insects and diseases. Diseases are responsible for more than 65 percent of the wood volume lost in forests each year. MAES has supported basic and applied research into managing and maintaining our forests and developing new forest products. Some of this research is reported this year under the Climate Change and Sustainable Energy programs, when they are focused specifically on those areas. Other highlights of MAES forest and forest products research in 2013 include:

- Researchers have been using breeding techniques to improve northern temperate forest species for growth rates, disease resistance and wood quality. They measured a 23 year old progeny trial planted in a very high blister rust risk area near Lake Superior and have found six families with blister rust resistance. The parentage of these survivors was used to develop breeding plans.
- Tree breeding is not a short term process. This year marked 20 and 15 year milestones for forest researchers' oldest hybrid aspen progeny trials. The results have shown that hybrid aspen has higher growth potential than native aspen with better wood quality than hybrid poplar.
- Researchers have collected and stored ash seed as part of the Minnesota native ash seed germplasm collection in cooperation with two Native American tribes, Prairie Island Indian Community and Fon Du Lac. The project is preserving genetic variation of ash species in Minnesota in response to the threat of emerald ash borer.
- We have reported over the years on developing novel methods to determine wood fungi and screening methods to determine their potential for bioremediation of toxic pollutants, novel new compounds for pharmaceutical and other medicinal uses as well as new microbes for bioprocessing technologies to produce biofuels. Many of these are now being studied in scale up bioprocessing investigations.
- Research on the processes of decomposition of wood to understand the basic mechanism of lignocellulose degradation. The most important finding this year was learning that wood was depolymerized ahead of the regions where cellulose enzymes and lignin modifications occurred, calling long-standing through troublesome aspects of the brown rot mechanism into question. The work is valuable for those working with lumber or with forest processing involving wood.
- Since private landowners oversee much of the urban forest, it is important to consider the motivations of these landowners as they relate to invasive species detection and treatment. Researchers developed and maintain Minnesota Land Economics, a searchable database for users to obtain land price, conservation easement and property tax information. The website is updated quarterly.
- Cost-effective strategies are needed to find and remove diseased trees in forests damaged by pathogens. Researchers developed a model of cost-minimizing surveillance and control of forest pathogens across multiple sites. In our application to oak wilt in Anoka country, they developed a cost curve associated with saving healthy trees from infection. Assuming an annual infection growth rate of eight percent a \$1 million budget would save an expected 185 trees from infection for an average of \$5400 per tree. The model provides practical guidance about allocating surveillance and control resources when only modest information about their geographic distribution is available.
- Damage from early summer storms provided U of M researchers with a crash course in treefall. With thousands of suddenly downed trees, the storms provided opportunity the correlations between recent excavation and pavement work and downed trees. The study could lead urban communities to remove and replace older trees as part of street and sidewalk products to reduce the number of storm-vulnerable trees lining city streets. Other changes, such as moving sidewalks, eliminating boulevards but creating more space in the public right of way so trees would be at less risk from snowplowing and other work.

Extension. With concentrated efforts in counties and regions of the state where healthy forests provide quality of life, the forestry team is building sustainable solutions to ecological problems by coupling the good intentions of Minnesotans with the knowledge they need to act to maintain the health and well-being of forest lands. Through community-based efforts in 2013 the Forestry team mobilized dedicated volunteers to identify problems and implement solutions to the problems of invasive species. Extension provided these volunteers with the education they need to identify species. With new funds, online reporting systems and tablet computers were utilized to enhance tracking systems. Finally, training helped volunteers and community members use herbicides safely.

2. Brief description of the target audience

The Forestry team at the University of Minnesota Extension continue to deliver education to any and all Minnesotans who can help to keep Minnesota's forests safe from invasive species, and can utilize the resources of the forest for economic good. In 2013, education reached farmers, landowners, natural resource professionals, policy makers, community volunteers, woodland owners, city workers who care for trees, Minnesota loggers and cabin owners.

Targeted audience for research includes 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

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3609	4058	20	0

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

Patent Applications Submitted

Year: 2013

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	20	66	86

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
2013	125

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	State departments will use education to make key policy changes. (Quantitative outcome is the number of policy resolutions.)
4	Forest First Detectors will be trained and mobilized to identify emerald ash borer and other pest infestations. (Target expressed as number of responses to pest infestations.)
5	Research will help provide new tree species more resistant to invasive insects.
6	Research will provide new knowledge to support urban forestry.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	77

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Focused educational events provide community members concerned with what they need to maintain forests responsibly, and develop a stronger community that works together on forest preservation. One example of a focused educational initiative took place in Cook County and the Sugarloaf project -- a North Shore Stewardship Association. This region is a Minnesota tourist destination of particular significance.

What has been done

In conjunction with the Cook County Invasive Species Team and the North Shore Stewardship Association, eight invasive species control workshops were offered in Northeast Minnesota. These were attended by a total of 100 persons. Five were offered to the public, one was focused on buckthorn identification and control, and two were offered to maintenance workers responsible for weed control on public lands. Most participants attending the workshops attended to find answers to specific problems and to use the information for their own lands or jobs.

Results

The outcome reflects percentage of significant learning gains by all Forestry program participants. Application of knowledge in Cook County was reported for the following items: 1) control of invasive species; 2) reading labels for herbicide use; 3) knowing which herbicide to use and where to get it; and, 4) calibrating spray equipment. (Learning gains of at least 1.1 point on a five point scale were reported.) Participants attending the workshop on buckthorn control worked cooperatively to begin control of buckthorn on 90 acres of land. This work began the same day the workshop was held.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	11590

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

One example of a community-based approach to forest management exists in Itasca County. With two million acres of rural forested land, the county hosts 45,000 residents and cabin owners. Historically, the county averages 60 wildfires each year, and experts predict an increase in the frequency and intensity of fires. Access is an issue for rural fire trucks and emergency service vehicles.

What has been done

Through education to property owners and facilitation of nine sectors of public service in the county -- including 18 rural fire departments -- Extension has helped to mobilize the county to reduce risks from wildfire and improve the safety of Itasca County residents. According to the FedGazette, estimates of the total cost of wildfires to landowners, investors and taxpayers range from 10 to 50 times the cost of fire suppression.

Results

In 2013, 276 property owners volunteered 19,891 hours to improve defensible space and remove hazardous materials around structures, improving access for emergency service vehicles. The value for this in-kind contribution equals \$440,386.74. In addition, property owners contributed 1,089 tons of hazardous fuel. Deer River Hired Hands, a local non-profit, hauled materials to neighborhood consolidation sites where it was chipped and used for renewable energy at the Minnesota Power Rapids Energy Center in Grand Rapids, Minnesota.

4. Associated Knowledge Areas

KA Code **Knowledge Area**
123 Management and Sustainability of Forest Resources

Outcome #3

1. Outcome Measures

State departments will use education to make key policy changes. (Quantitative outcome is the number of policy resolutions.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Agroforestry, an ancient practice that's only been recognized as a science since 1977, is undergoing a mini-revival in Minnesota. With support from Extension, farmers look to trees to increase the productivity of their land and to and become better stewards of the land. Trees can increase farm productivity and reduce problems with air pollution, declining water quality and degraded agricultural landscapes. Beyond simply planting trees and shrubs, farmers can intentionally integrate trees into crop and livestock systems.

What has been done

As interest in sustainable agriculture grows, Extension educators are teaching Minnesotans about agroforestry and its benefits, including healthier soils, water conservation, and increased crop and forest yields. In 2013, three natural resource professionals were recruited and trained to grow agro-forestry initiatives throughout the state.

Results

One of the trained professionals initiated discussion with the Bureau of Soil and Water Resources (BWSR) to integrate agroforestry into their educational program. A resulting BWSR resolution included the adoption of agroforestry as an integral part of the agency's work. In addition, he established agroforestry demo trails through a local non-profit organization.

4. Associated Knowledge Areas

KA Code **Knowledge Area**
125 Agroforestry

Outcome #4

1. Outcome Measures

Forest First Detectors will be trained and mobilized to identify emerald ash borer and other pest infestations. (Target expressed as number of responses to pest infestations.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	99

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Early identification of pests can prevent infestation, but early identification happens most easily when citizens of the forest are educated and alert to finding pests easily.

What has been done

The Minnesota Forest Pest First Detectors training program is designed to help identify the occurrence of Emerald Ash Borer and other forest pests in Minnesota. First Detectors are the front line of defense against likely infestations. Meeting, working with and educating the public about exotic forest pests are key activities of Forest Pest First Detectors. First Detectors are a part of the Federal National Plant Diagnostic Network (NPDN) that promotes the early detection of invasive, exotic plant pathogens, arthropods, nematodes and weeds.

Results

A study of 103 Forest Pest First Detectors in 2013 found that the program had generated significant action and impact for Minnesota's Forests. Detectors responded to at least 99 reported pest infestations, made 179 site visits and addressed 1,450 general questions about pests. They volunteered 775.5 hours, valued at \$16,991.21 by IndependentSector.org. One significant impact was that one of these trained volunteers was the first to detect emerald ash borer in Superior, Wisconsin, triggering mitigation efforts among local and state agencies.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Research will help provide new tree species more resistant to invasive insects.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In the 1970's there were more than 300,000 elms lining the urban landscape of Minneapolis-St. Paul. Then Dutch Elm Disease swept through the region and over the course of the decade, most of the trees were lost.

What has been done

U of M researchers have been studying one large elm tree that appeared to be tolerant of the disease. The tree is 80 feet tall and 175 inches in diameter and is over 100 years old. After many studies and clippings, researchers are replicating it and going to try to bring it to market.

Results

If this tree could be brought to market and people started to plant it again it could change the urban landscape, and potentially bring back the beauty of city boulevards lined with American Elm.

4. Associated Knowledge Areas

KA Code	Knowledge Area
124	Urban Forestry

Outcome #6

1. Outcome Measures

Research will provide new knowledge to support urban forestry.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Cities nationwide are grappling with how to replace a dwindling supply of trees. The U.S. Forest Service found last year in a study of aerial photographs that urban areas are losing four million trees a year, while paved surfaces are expanding. The urban forest must constantly be renewed.

What has been done

In a pilot project in Minneapolis U of M urban forest researchers are testing new tree tube technology to help nurse seeds from seedlings. Currently, the 5,000 trees planted yearly by the Minneapolis park system are many feet tall and several years old by the time they're planted into the city's soil. That's because it is often difficult to grow seedlings in an urban setting. The tubes can foster the growth of more and longer-lasting trees by nurturing seedlings as they mature in place. The 4-foot tubes offer just right amount of light and support.

Results

Establishing trees when they are smaller and younger is not only less expensive, but gives them a better chance of becoming resilient to stresses in their environment and living longer. Minneapolis is grappling with the loss of thousands of trees from summer storms and the invasive emerald ash borer.

4. Associated Knowledge Areas

KA Code	Knowledge Area
124	Urban Forestry

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes
- Public Policy changes
- Government Regulations

Brief Explanation

Partnerships with local and state government have greatly enhanced the outcomes and impacts that forestry education can make. Local public services join with Extension to educate local volunteers and citizens, ultimately creating safer forests for the entire community. Education about agroforestry for state department officials has resulted in a change in public priorities for the Bureau of Water and Soil Resources in Minnesota, among others.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Forestry team tracks whether education of citizens and professionals results in local action to protect forests or to use them for local economic or natural resource gains. In 2013, this work leveraged over nine full-time equivalents of volunteer time, and integrated best practices in forest management into several local initiatives. Ultimately, Extension education resulted in better management of 11,590 acres of forest in Minnesota.

Key Items of Evaluation

In 2013, Extension mobilized the equivalent of 9.8 full-time volunteers and ultimately impacted the quality of land management in 11,590 acres of Minnesota's forest land.

V(A). Planned Program (Summary)**Program # 13****1. Name of the Planned Program**

Agricultural Business Management

 Reporting on this Program**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management	50%		20%	
602	Business Management, Finance, and Taxation	50%		20%	
603	Market Economics	0%		30%	
604	Marketing and Distribution Practices	0%		20%	
610	Domestic Policy Analysis	0%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	20.3	0.0	2.7	0.0
Actual Paid Professional	21.0	0.0	21.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
586269	0	617097	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2024235	0	1134757	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
986803	0	5672874	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES research to improve Minnesota's agricultural profitability included studies in risk management and in analysis of regulatory policies to support agricultural business stability. Research focused on profitability issues in specific niche markets such as organic farming, as well as broader market trends. New technologies are offering agricultural producers new opportunities to increase their profitability, but research is needed in the risk/benefits in adopting these technologies. Results in research in agricultural business management in 2013 include:

- Using survey data on the U.S. pork industry, researchers explored how technology adoption affected farm size and employee wages in the industry. The results showed that new production technologies were encouraging increased farm size and that employees working for these larger farms benefited by receiving higher wages than employees working on smaller farms.
- Research showed that the global value of sustained research to maintain stem rust resistance in wheat was about \$50 million annually, which exceeds the current levels of investment.
- There are about 150,000 acres in Minnesota being farmed organically by over 2,000 producers in Minnesota and the numbers are growing. Researchers have produced a risk management guide for organic farmers. The interactive materials cover the basics and fundamental of organic agriculture as well as how to transition to organic farming. Decision case studies focus on critical issues affecting profitability such as weed control, soil fertility and marketing of crops.
- A study of 2012 Minnesota cropland prices was done in 2013 and provided a more nuanced view of the sales of agricultural land in Minnesota. The results showed that while in prime farming areas, including the corn and soybean territory of southwest Minnesota, land prices were still climbing, up nine percent. But little or no increase was evident in the central third of the state.
- Researchers studied why a high profit group of farmers were increasing in profit compared to the low profit group, with the goal of identifying characteristics, practices and tendencies of the top income group that are different from the rest of the producers. The analysis showed that farms in the lower income group received more inheritance than the top income group. The results of the research identified controllable positive and negative factors farmers can use to evaluate their own business decisions.
- Researchers completed an analysis of the long-run productivity growth of key crops grown in the U.S. and worldwide. They also completed an a Minnesota Agricultural Projections Model to assess the future supply and demand prospects for global agriculture to 2050.
- A spreadsheet was developed to assist dairy farmers in analyzing the economics of installing robotic milking systems in small dairy farms.

Extension. Based upon an extensive survey completed by U of M Ag Business Management Educators, 84.8 percent of all farm families do not have a business transition plan, and 69.9 percent do not have a personal estate plan. In 2013, programming for farm transition and estate planning continued, and a nine-year study of the program measured its financial impact. Fourteen formal farm transition estate planning workshops were held, serving 495 participants. Six updates and informational workshops were held. Educators also disseminated information at national conferences and through local and statewide news releases.

A program that was initiated in 2012, focused on business and management concerns for hiring labor on farms. This program achieved resulted in impacts in 2013. Three of the eight educational topics address concerns and skills for hiring employees from other cultures. Workshops were sponsored through a mixture of private, public and non-profit organizations.

The Agricultural Business Management team also manages three Southern Minnesota marketing

groups. With 48 farm operations involved in these groups, the cooperative is helping each farm operation reduce costs and increase income.

The Agricultural Business Management program is measuring its impact in protecting and growing the financial health of farm managers and enhancing business practices, as seen in descriptions of program outcomes. Cumulatively, offerings of the Agricultural Business Management team influenced business practices for 1,900,005 acres of Minnesota farmland.

2. Brief description of the target audience

Agricultural Business Management programming is reaching farm families and farm managers, but enhances that effort by targeting organizational sponsors who can bring educational offerings to constituents. These partnerships leverage the networks available across Minnesota to provide broad educational outreach efficiently.

Other target audiences for research include farmers and researchers interested in crop, livestock an organic cropping systems, food processors, food retailers, food system professionals, policy makers, national and international food and trade analysts, and scholars interested in food systems, rural financial institutions and microfinance institutions and policymakers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4564	57738	0	0

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

Patent Applications Submitted

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	9	12	21

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2013	91

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants of the Agricultural Business Management (ABM) program workshops/classes and conferences will achieve significant learning gains regarding research-based agriculture business management knowledge and skills. (Target expressed as the percentage of participants who achieved significant learning gains as a result of attending ABM program workshops/classes and conferences.)
2	Participants of Agricultural Business Management (ABM) workshops/classes and conference sessions intended to improve participant agriculture business management practices will significantly improve their management practices as a result of attending the program. (Target expressed as a percentage of participants that significantly changed one or more of their agriculture business management practices as a result of attending workshops/classes and conference sessions intended to improve participant management practices.)
3	Business transition plans completed by farm businesses will the protection of financial assets for farm business owners and local economies. (Outcome expressed as the dollar value of assets protected in 2013.)

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	98

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

As farms grow, farm managers sometimes take on laborers to support farm work. This puts businesses at risk if owners are not informed about effective management practices or the rules and responsibilities of employment.

What has been done

The Agricultural Business Management team presented four personnel management workshops called "Employment Skills for Today: Planning for Success." The workshops provided educational content about: 1) determining if hired labor is required, 2) developing effective hiring process, 3) cultural issues related to employee and employer, 4) cross-cultural communication techniques, 5) conflict management techniques, 6) employee compensation plans, 7) legal issues of being an employer, and 8) federal and state tax requirements of employer.

Results

Participants reported substantial increases in knowledge around all eight program educational points. A follow-up report about impacts was prepared by surveying 2012 attendees of the workshop. At follow-up, 20 percent of respondents had revised their recruiting and hiring process; 35 percent had updated or revised their tax and labor law procedures to more closely comply with federal and state regulations; 45 percent said the cultural portion of the program was helpful to their employee relations.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	45

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Based upon an extensive survey completed by U of M Ag Business Management Educators, 84.8 percent of all farm families surveyed do not have a business transition plan, and 69.9 percent do not have a personal estate plan. Without planning for business transition and personal estate distribution, farm and small businesses are at financial and legal risk. Protecting these asseets benefit local economies, because an average southern Minnesota farm operator spends \$1,034,266 for business expenses, personal expenses and taxes.

What has been done

In 2013, a total of 14 farm transition estate planning workshops were held, as well as six update and informational workshops. Materials were also disseminated through conferences, media, and online resources.

Results

In post-workshop follow up six months after the program was completed, 45.5 percent of those responding reported that they had completed a business transition and personal estate plan within six months of attending the workshop. The dollar value of this impact was calculated for 2013, as well as over the past decade. (See program outcome 3.)

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Business transition plans completed by farm businesses will the protection of financial assets for farm business owners and local economies. (Outcome expressed as the dollar value of assets protected in 2013.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	81400000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

When farm families do not have a business transition plan, small business are at financial and legal risk. When locally-owned farm businesses are not protected, local economies suffer as local purchases for business and personal expenses are lost, as well as tax revenues.

What has been done

In 2013, and over the past nine years, Farm Transition and Estate Planning have been delivered to farm families that have not taken steps to legall transition businesses and personal estates.

Results

Using data for those completing the process and farm management association for asset values, the financial impact of orderly plans for transfer to the next generation was \$81.4 miillion in 2013. The nine year cumulative evaluation completed in 2013 notes that 208 businesses developed and implemented business plans after the program, and 228 developed an associated personal estate plan. The financial impact of these transfers to the next generation is \$438.2 million dollars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Program content for business management programming has addressed new economic and demographic conditions. In the past several years, program changes accommodated, for example, concerns that long-term disability could put a business at risk and the need to help farm managers to effectively hire and retain employees from other cultures.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Agricultural Business Management team at the University of Minnesota Extension rigorously evaluate whether management changes are made as a result of education, and has designed ways to calculate the economic impact of those changes. In 2013, such evaluation strategies revealed that programming for marketing, risk management and farm transition (collectively) had a financial impact of \$84,931,072. An ongoing nine-year examination of this financial impact has documented a financial impact of \$469,979,648.

Key Items of Evaluation

In 2013, evaluation of agricultural business management programming that addressed commodity marketing, risk management, along with farm transition and estate planning, revealed that programming collectively had a financial impact of \$84,931,072. An ongoing nine-year examination of this financial impact has documented a financial impact of \$469,979,648.

V(A). Planned Program (Summary)

Program # 14

1. Name of the Planned Program

Housing

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	4.2	0.0	4.8	0.0
Actual Paid Professional	13.1	0.0	1.6	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
396730	0	69241	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1619683	0	194924	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
499579	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES research in housing spans several departments and research groups, including the work of researchers in social science, community economics, design and public policy. One new project is looking at housing insecurity with the goal of providing information to designers and policy makers concerned with affordable housing. The researchers are beginning by focusing on low-income and seniors often at risk for housing issues and concentrated in rural communities. Other housing research results in 2013 included:

- Researchers examined the impact of high incidence of seasonal/recreational homes on the economic and demographic characteristics of small town and rural areas. They identified eight counties in Minnesota with the most recreational housing and compared home property data with assessed value of the property in the past ten years. They are also studying to what extent recreational home development impacts the planning and provision of community services such as medical facilities, police and fire protection and schools. The results have been disseminated to community development practitioners and Extension Educators.

- Design researchers have developed, tested and validated a tool to measure occupant well-being to use in planning for new construction. It includes questions around building attributes that contribute to overall occupant well-being, including thermal, acoustic, lighting, indoor air quality, privacy and personal control conditions. The instrument has been shown to have potential for use by architects, interior designers, contractors and others to measure the results of their design decisions.

- Between 2005 and 2010, one in every twenty housing units in Minnesota went into foreclosure. MAES supported social science research of the impact of that disruption to Minnesota families and communities as has been reported in previous years' Accomplishment Reports, led to changes in Minnesota foreclosure laws. Researchers are now building on that housing data and analysis to develop an understanding of the impact of foreclosure on the built environment of Minnesota, looking at three types of neighborhoods: urban, suburban and rural.

- A cross-cultural study of differences in housing needs and culturally insensitive housing is helping to develop a holistic response to cultural differences through design. The research will result in a set of principles for culturally sensitive design for architects, contractors, policy makers and planners.

Extension. Courses, consultation and research from Extension's housing technology team engage inspectors, builders, remodelers and policy makers to make homes safe and environmentally friendly. In 2013, additional consultation with national and international agencies supported policy making strategies. For example, Minnesota's Extension Housing team was invited by the EPA as the U.S. representative to the International Atomic Energy Agency to develop a Basic Safety Standard on Radon. This standard serves as the United Nation's radon risk management guidance to about 190 national radiation control programs.

The team is also engaged with the Department of Energy and the Builders' Association of the Twin Cities to create leading-edge energy performance homes and feature them during the popular Parade of Homes in the Twin Cities and Michigan. Participation in this event can bring the science of building energy-efficient homes to the general public and, thus, to consumers who can create a market for this technology.

Finally, the team was pleased to win three awards at the Department of Energy's Housing Innovations Awards in Irvine, California in 2013. Two awards were received for housing innovations that were developed through research and technology deployment. The third, which was co-presented by the National Consortium of Housing Research Centers, was presented to an Extension specialist for Excellence in Building Science Education.

2. Brief description of the target audience

The target audience for this information is builders, remodelers, contractors, mitigaters and others involved with avoiding and resolving problems in homes.

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

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1478	53340	0	0

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

Patent Applications Submitted

Year: 2013

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	3	1	4

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Educational courses will be delivered to the target audiences.

Year	Actual
2013	53

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
2013	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1563

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Based upon research reviewed by the National Academies, the U.S. Environmental Protection Agency estimates that radon exposure in the nation's housing causes 21,000 lung cancer deaths per year.

What has been done

The Extension Housing Program and research team trains home inspectors, contractors and builders to test occupied housing for elevated indoor radon concentrations, and to mitigate harm. The scope of training reaches from the Gulf Coast to the Canadian border and beyond.

Results

Course graduates have reduced radon in more than 60,000 homes per year and, according to an EPA matrix, prevented about 400 lung cancer deaths each year. Given the primary economic life of U.S. housing is about 75 years, the cumulative impact of the training is about 30,000 lung cancer deaths prevented.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	60000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Home inspectors, contractors and builders use testing and quality standards to prevent and mitigate radon's effects in building and rehabilitation of housing. A new concern in the industry is chemical vapor intrusion (CVI). CVI occurs when chemicals seep into soil and groundwater as vapors, ultimately moving into buildings to contaminate indoor air through foundations.

What has been done

In 2013, the Extension program team continued its work to measure and mitigate radon, and also collaborated with other states and the Environmental Protection Agency's CVI Science Team to develop and deliver the first CVI mitigation course.

Results

The impact of all radon measurement and mitigation courses has reached 60,000 homes. In addition, the EPA views the newly developed CVI mitigation course as the national model for CVI mitigation training. With the EPA endorsement, the course will reach inspectors, contractors and builders and will be evaluated in 2014.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Government Regulations

Brief Explanation

The work of the housing technology team is influenced by new science that identifies risks for housing safety, and by government priorities to create regulations and public information that prevents those risks. In 2013, responses to these demands furthered the mission of housing technology programs at Extension.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of housing programs uses models of the Environmental Protection Agency, along with known learning gains and behavior changes among home inspectors, contractors and builders who participated in measurement and mitigation courses. In 2013, learning gains of 75 percent or more and behavior changes of 75 percent or more will result in the reduction of radon in more than 60,000 homes per year. According to the EPA matrix, this will prevent about 400 lung cancer deaths each year.

Key Items of Evaluation

In 2013, learning gains of 75 percent or more and behavior changes of 75 percent or more will result in the reduction of radon in more than 60,000 homes per year. According to the EPA matrix, this will prevent about 400 lung cancer deaths each year.

V(A). Planned Program (Summary)

Program # 15

1. Name of the Planned Program

Horticulture

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	5%		5%	
132	Weather and Climate	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		50%	
204	Plant Product Quality and Utility (Preharvest)	20%		20%	
205	Plant Management Systems	50%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		5%	
213	Weeds Affecting Plants	5%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	15.7	0.0	51.2	0.0
Actual Paid Professional	18.5	0.0	60.3	0.0
Actual Volunteer	66.0	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
537488	0	699887	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1835707	0	4760552	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
890283	0	5883017	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES horticulture research supports a growing and diversified sector of Minnesota agriculture, including fruit and ornamental crops, vegetables, potatoes, forages and grasses, U of M horticultural research is perhaps best known by its "stars"--the Honeycrisp apple, and the Frontenac, Marquette and La Crescent wine grapes that made a new Minnesota wine industry possible. But U of M horticultural research in 2013 has had impact on a wide range of horticultural crops. Some highlights:

- Work was completed on flowering initiation in native sedges. The knowledge is helping researchers propagate native plants that can be used to restore native ecosystems and difficult sites in urban landscapes.
- U of M scientists confirmed a new invasive fruit fly in Minnesota, which threatens Minnesota's berry crops. Researchers recommended strategies to deal with the pest including monitoring traps and disposing of overripe fruit, which is most attractive to the pests.
- Laboratory research into the behavior of viruses in Echinacea and its family of plants yielded unexpected insights into the formation of abnormal plant proteins. These abnormal forms have parallels with abnormal forms of protein that have been demonstrated in animals (for example, Alzheimer, scrapie and mad cow disease). As a result of this connection, researchers have focused on the biochemical and biophysical characterization of the disease-associated protein filaments in this plant family to establish the extent of their similarity to the amyloid proteins found in animals, with possible benefits to those researchers.
- A study to determine if it was possible to predict the effect of the rate of Nitrogen fertilizer on potato tuber aclamide concentration, which negatively affects the quality of potato chips, was completed. The study showed that the concentration depended more on the cultivar than manipulating nitrogen rates.
- A new plant virus infecting cultivated roses was transmitted, characterized and sequenced.
- Researchers studying prairie diversity with the goal of prairie restoration found that increasing plant richness in natural prairie communities decreased bacterial species, while fungal species richness increased with increasing plant richness. Understanding the interaction of micro-organisms in prairie soils is important for understanding prairie plant health.
- Some popular plant species are themselves invasive. To allow gardeners who enjoy those plants to continue to grow them, researchers have been researching the possibility of developing seedless cultivars of those plants. They are using irradiation treatments of seeds and unrooted cuttings to create a mutation that results in seedlessness. Researchers have determined the relative sensitivities of a species to

achieve maximum efficiency for mutagenesis, targeting long-lived woody perennial species. Mutagenized material from 2013 is being grown in the greenhouse and will be transplanted for further assessment and selection.

- Turf grass researchers are defining management systems using fine fescues that will reduce the inputs of pesticides and fertilizers. They are using the U of M golf course as a living laboratory for testing and teaching.
- The highest quality turf grass quality can be found in European germplasm; however, this germplasm lacks economically viable levels of seed production. Researchers have begun a program to cross the native and developing perennial ryegrass cultivars that are more winter hardy and have higher levels of resistance to rust disease. They have identified a number of lines of perennial ryegrass that show high levels of rust resistance.
- A study of various light sources for plant growth for use by home gardeners compared new LED lights with six other light sources on the germination and growth of nine different herbaceous species. The results of the research are helpful to home growers, and were publicized in the popular media, including an article in Fine Gardening.
- In a collaborative research project with Cornell and Washington State, Minnesota researchers have been developing genetic markers to allow more efficient apple selection. Genetic markers allow them to tell, even when a seedling is very young, if it's more likely to have crisp fruit several years from now or mushy fruit, if it's red or yellow, or if it's sour or not. In 2013, the power of marker-assisted parent selection was shown: crosses planned using only marker-assisted parent selection for skin color saved the U of M apple breeding program about \$20,000 in costs of caring for seedlings in the breeding orchard that would have no commercial potential due to undesirable skin color.
- Two new azalea varieties adapted for northern climates were released in 2013 along with a Kentucky coffeetree selection.

Extension: In 2013, commercial horticulture education in Minnesota reached commercial fruit and vegetable growers, influencing producers on 296,000 acres of land. Focused educational efforts addressed protecting crops from the threat of pests, effective application of pesticides, nitrate leaching from fertilized lawns, and education about hops production for Minnesota's burgeoning craft beer industry.

The Master Gardener program mobilized 2,722 volunteers throughout Minnesota. For these volunteers, Extension provided 27,126 hours of continuing education. In turn, the volunteers delivered 137,295 hours of service through contributions to community events, plant diagnostic workshops, publications, adult education venues, fairs and consultations.

2. Brief description of the target audience

The audiences are:

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

3. How was eXtension used?

Among U of M Extension's horticultural contributions to eXtension in 2013 was educational content about bed bugs. U of M Extension's most popular factsheets were translated into Arabic, Hmong, Somali

and Spanish and are available on eXtension.

Minnesota also contributes education and parters for the Bee Health topic area on eXtension.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	258033	306389	55486	0

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

Patent Applications Submitted

Year: 2013

Actual: 3

Patents listed

2 new deciduous azalea selections: UMNAZ 493 and UMNAZ 502

New Kentucky coffeetree selection: UMN720283

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	13	66	79

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
2013	475

Output #2

Output Measure

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

Year	Actual
2013	137295

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	Through research, educational and media outreach, the public is becoming aware of the importance of protecting bees.
4	Research will provide knowledge to support better understanding of the biological mechanisms for plant improvement
5	Research will develop new fruit varieties to increase consumer choices.

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.)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Consistent messaging about yard and garden care through a league of volunteers statewide mobilizes the entire state to protect plants, conserve water, protect watersheds, stimulate active living,

What has been done

Over 5,000 educational workshops were delivered in community settings. Evaluations measured learning after the program.

Results

An example of learning outcomes come from Vegetable Growing Basics. In this case, participants reported the most learning and projected behavior change in: mulching vegetables to control weeds and retain moisture (64 percent gain); watering vegetables from below (60 percent gain); reading the instructions on a packet of seed (54 percent gain); and using integrated pest management practices (53 percent gain).

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	32

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Those who care for yards and green space are in a unique position to prevent plant diseases, nurture healthy plants, conserve water, protect watersheds, and prevent the spread of invasive species.

What has been done

Master Gardeners are trained to convey eight key messages as they help Minnesotans. They are: 1) Grow fruits, herbs and vegetables to assure active living; 2) Reduce overhead watering; 3) Protect bees by reducing pesticide use; 4) Plant more native plants and install rain gardens; 5) Reduce use of fertilizers to curb toxic runoff; 6) Manage yard waste through composting; 7) Proactively plan for Emerald Ash Borer; and 8) Reduce premature decline of trees through proper watering, planing and pruning.

Results

A survey of yard and garden keepers taught by Master Gardeners in one major metropolitan county showed that consistent messages impacted behavior and, thus protected resources and plants: 44 percent of respondents had reduced overhead watering; 40 percent used two or fewer fertilizer applications; 37 percent used chemical-free options to deal with pests; 35 percent removed invasive weeds from their property; 30 percent improved their tree care; 30 percent planted disease resistant or native plants; 28 percent planted more fruits, herbs or vegetables; 28 percent started watering in the morning; 23 percent composted; 21 percent reduced the quantity and frequency of watering. While this evaluation was not conducted statewide, it suggests probable impact from Master Garderners' volunteers statewide.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Through research, educational and media outreach, the public is becoming aware of the importance of protecting bees.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Given that bees pollinate fruits, vegetables and nuts, and pollination is required for about one-third of all food production, recent concern and focus on declining bee populations have highlighted the importance of saving this essential agricultural resource. Beekeepers, food scientists and entomologists are worried throughout North America, Europe and other continents as bees keep dying. About one-third of bee colonies each year have been dying for the past six years.

What has been done

Few people have contributed as much to understanding the life and health of the honeybee in recent decades as Marla Spivak, the U of M entomologist who is a world leader in bee research. She developed the "Minnesota Hygienic" bee which has resistance to disease. Her research has helped identify several culprits to bee decline, called "colony collapse," but the use and timing of insecticide applications have been identified as chief suspects. Neonicotinoid

insecticides are used by both crop growers and urban gardeners and are lethal to bees. In addition to long-standing short courses and on-line courses, national and international conversations like the recent TED Talk on the subject, and downloadable fact sheets, two new important programs have been added to Extension Programming.

Results

The focus on bee health has led the Minnesota Legislature to pass a pollinator habitat bill. It appropriates \$150,000 a year to improve bee habitat and increase public awareness of pollinators. The legislation also requires state agencies to create a report on pollinator habitat and to establish a process for reviewing the safety of neonicotinoid insecticides. Working in collaboration with this research, U of M Extension has developed a Bee Squad for urban residents, and Bee Tech Transfer Teams for commercial beekeepers, to teach strategies to support the health of bees and bee colonies, and to raise awareness of the threat to bees. Nurseries and garden centers are beginning to offer substitutes to neonicotinoid insecticides based on public concern and demand.

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

Outcome #4

1. Outcome Measures

Research will provide knowledge to support better understanding of the biological mechanisms for plant improvement

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

For many years, Minnesota plant breeders have been breeding for cold tolerance. This has allowed, for example, new hardy blueberries to be grown in northern Minnesota, for hardy azaleas to grace an urban garden in Minnesota, and has made it possible for other new fruits and flowers to enrich the urban landscape and local farmers' markets. But researchers have had to do this piecemeal, step-by step. The evolutionary pathways of plants have not been understood.

What has been done

An interdisciplinary team of researchers has assembled the largest dated evolutionary tree, using it to show how flowering plants evolved specific survival strategies, such as the seasonal shedding of leaves, to move into areas with cold winters. They created a database of over 49,000 species, studying their adaptive strategies and compared it with a global climate database, allowing them to model the evolution of species' traits and climate surroundings. They developed a 'timetree' that is the most comprehensive view yet into the evolutionary history of flowering plants. The findings were published in a December 2013 edition of Nature.

Results

The research shows the whens, hows and whys behind plant species trait evolution and movements around the globe. Researchers will use the timetree to explore other aspects of the evolutionary history of plants, especially to examine how plants respond to additional environmental pressures besides just freezing. It may be possible in the future to breed cold tolerance in a different way than we do today.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate
201	Plant Genome, Genetics, and Genetic Mechanisms

Outcome #5

1. Outcome Measures

Research will develop new fruit varieties to increase consumer choices.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2013

0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Back in 1996, 60 percent of the apples sold in the U.S. were either Golden Delicious or Red Delicious. Neither is overly sweet or tart, neither is especially crisp and neither inspires nearly as much enthusiasm today. Today, consumers reap the benefits of advances in apple breeding, and their options are much broader.

What has been done

Honeycrisp apple, released by U of M fruit breeders in 1991, has become a nationwide success story. The apple, which is now grown around the country and in other countries, was the result of a 15-to-20 year development process. Between 10,000 and 15,000 new varieties are grown each year by U of M apples breeders, of which roughly 15 percent make the cut and are cloned into orchards that are observed for five more years. There is no guarantee any of them will become a sellable variety. The Honeycrisp is now used as parentage in a lot of the breeding selections in the Minnesota breeding program, and well as in breeding programs in other states. The offspring of Honeycrisp are now bearing fruit.

Results

Sweetango apple is the first apple with Honeycrisp parentage released by U of M. New York has one that's soon to be released to be marketed under the name Snapdragon that has Honeycrisp as a parent. Washington has an apple under development with Honeycrisp parentage that will be released in the next five years. Another that's coming out of the Midwest Apple Improvement Program will be called Evercrisp, which is a Honeycrisp-by-Fuji cross. There is a whole group of Honeycrisp children coming that, in the next 10 years will really change what kind of apples are available, and continue to increase consumer's appetite for this healthy fruit.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

The growing popularity of locally-grown foods, facilitated by Extension's outreach to growers, has grown interest in gardening at home and in fields. As a result, participation in horticulture education grew by 49 percent in 2013.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluations of horticulture programs examine the degree to which participants in program have adopted processes to enhance the health of their plants, increased their gardening activity, protected or conserved water, or made appropriate use of pesticides. In at least two program evaluations, participants reported that they were adopting important practices. Most significant impacts were had in the reduction of overhead watering, decreased use of fertilizer and other chemicals, management of invasive or noxious weeds, and growing and maintaining more native plants or trees.

Key Items of Evaluation

A study of the Master Gardener program in a major metropolitan county of Minnesota demonstrated that the program was effectively changing behaviors in gardens, especially with regard to reducing overhead watering, decreasing use of fertilizer and other chemicals, managing of invasive or noxious weeds, and growing and maintaining more native plants or trees.